PROJECT SUMMARY

Goals

1. To contribute our expertise and knowledge in economics, optimization, and conservation biology to maximizing the returns on investment from barrier culvert restoration in Washington State.
2. To learn about the diverse priorities, objectives, and concerns of tribes and various other stakeholders as relates to barrier culvert restoration in Washington State.
3. To train graduate students in producing high-quality, relevant, and reproducible applied research related to natural resources management.

Objectives

1. Catalog methods and datasets used in generating fish passage prioritization indices for all counties, and any other entities using prioritization indices, within the Washington State Case Area.
2. Generate consistent predicted cost estimates for all barriers to fish passage within the Washington State Case Area.
3. Generate consistent habitat quality metrics associated with all barriers to fish passage within the Washington State Case Area for all five species of Pacific salmon and steelhead.
4. Develop a data-driven optimization framework for project prioritization, within the Washington State Case Area, that synthesizes multiple geospatial datasets with statistical economic and ecological models, and incorporates feedback based on multiple workshops, to identify restoration plans that maximize ecological, social, and economic objectives at a given funding level.
5. Develop a customizable open-source online decision support tool (DST), along with a video tutorial, to make our optimization framework accessible to tribes, stakeholders, managers, and academics.

1. Methodology

1. We will catalog all methods and datasets used for fish passage prioritization within the Case Area. This catalog will allow for comparison across jurisdictions and serve as a starting point for considering data inputs into the optimization framework and DST.
2. We will refine and apply predictive cost models currently being finalized by our team. We will generate consistent cost estimates for all inventoried barriers in the Case Area using statistical learning methods designed to maximize out-of-sample predictive power.
3. We will use statistical models to relate measures of salmon habitat quality to features of the environment, building upon earlier efforts to develop a consistent metric of salmon habitat quality based on instream temperature and flow data, as well as upland features related to riparian forest density and composition, road density, elevation, and watershed area.
4. We will develop an optimization framework for identifying cost-effective restoration plans that meet multiple planning goals defined in our workshop series, e.g. salmon habitat gains, equity considerations, and risk mitigation, under a fixed budget.

5. We will build and deploy a web-based DST that will allow resource managers and other users to explore and compare fish passage restoration plans generated by our optimization framework. Users will be able to compare optimal and user-selected plans in terms of objectives (e.g. habitat miles, equity, risk) and how relative performance is affected by different funding levels or levels of coordination between barrier owners.

6. Throughout our project we will conduct a series of three workshops with representation from tribes, resource managers, and other stakeholders. Through these workshops we will refine our methods and DST to ensure that the resulting tool reflects the various objectives and practical constraints to fish passage restoration in Washington State.

2. Rationale

Across Western Washington, thousands of poorly-designed culverts at road crossings prevent migratory salmon from accessing potential habitat, hampering recovery efforts for declining populations. In 2013, a federal court found that barrier culverts in Washington violate tribal treaty rights and issued an injunction requiring their replacement. While the injunction only applies to state-owned culverts, thousands of additional barrier culverts are owned by local governments and private landowners, often within the same watersheds leading to inter-dependencies between barrier correction activities.

Counties and other actors are independently ramping up efforts to correct barriers to fish passage in their jurisdiction resulting in prioritization frameworks that only allow for comparison within a given entity's jurisdiction, complicating the coordination of investments in fish passage across Western Washington. Our project will develop a consistent, data-driven framework for prioritizing fish passage barriers over multiple objectives, drawing from a rich literature on fish passage restoration plans that maximize return on investment, experiences from similar frameworks and tools developed to aid fish passage investments in California and the Great Lakes region, and our workshop series.

The decision support tool we develop will serve a coordinating function between barrier owners and managers by allowing the consistent comparison of alternative barrier correction plans. Users will be able to identify cost-effective plans that meet their specific user-defined objectives and budgets while considering opportunities to coordinate with other barrier owners. Our decision support tool will add to and complement ongoing efforts to restore fish passage in the state of Washington.