Dataset Development and Modeling for Resilient Decision-Making for extreme events, harmful environmental trends, and land cover impacts to Nez Perce Tribe salmon, wetlands, Forests, and prairies.

Executive Summary

The objective of this project is to develop a dataset and tools which can inform management scale decision making in light of vulnerabilities to tribal enterprises, natural resources, and food sovereignty resulting from increasingly extreme cycles of drought, heat waves, wildfire, extreme precipitation, and erosion. These tools will assist the Nez Perce Tribe (NPT) in obtaining and interpreting the information needed for resilient land use planning. The NPT Water Resources Division has been developing a Vulnerability Assessment and Adaptation Plan to plan for extreme events and harmful weather patterns with funding from the BIA Rights Protection Implementation Program. Through the vulnerability assessment process, we have identified data gaps and decision support needs related to ongoing tribal projects including the Lewiston Orchards Project Water Exchange and Title Transfer Project (LOP), the Integrated Resources Management Plan (IRMP), the Water Quality Program, and several projects focused on forestry, food sovereignty, and agricultural enterprises. We have also identified potential actions that could improve soil health, reduce erosion, increase biodiversity, lower land and water temperatures, and increase snow retention, water retention, filtration, and base flows. However, we need more information about each option in order to identify which solutions are appropriate and propose pilot implementation projects. We propose to utilize the CGIAR Institute Programming and Indicator Tool to collect baseline data and to develop a model that will evaluate the outcome of land management scenarios on hydrologic dynamics, wildlife habitat/biodiversity, and fisheries. This grant will support data acquisition, preliminary forest and agricultural modeling, and identification of locations and management practices for pilot studies. Ultimately, this project will support the work of Nez Perce Tribe Fisheries, Wildlife, Water Resources, Forestry, Cultural Resources, Land Services, Economic Development, as well as Nez Perce Tribal Enterprises and Nimíipuu Health.

Background

Geographical Service Area & People Served:

This project will take place in the Nez Perce Indian Claims Commission Territory (ICC) of the Nez Perce Tribe, which covers approximately 13 million acres in Idaho, Oregon, Washington, and Montana. The project is focused on the Clearwater River Subbasin, which includes the LOP project area. The Subbasin is 9,350 square miles in size and extends 100 miles from north to south and 120 miles from west to east (Idaho/Washington border to Idaho/Montana border). The Nez Perce Reservation covers approximately 770,000 acres. The NPT owns 16.14 percent of reservation land, of which 38,030 acres are devoted to agriculture.

According to American Community Survey Demographic and Housing Estimates from 2012-2016, there were 4,039 self-identified American Indian or Alaska Natives living within the counties overlapping the ICC. There are 3,575 enrolled Nez Perce tribal members globally, 2,420 who live on the Nez Perce Reservation.

Description of Need

The Nez Perce Tribe has experienced increasing severity and frequency of wildfires, drought, heatwaves, extreme precipitation, floods, and erosion. This cycle of extremes has impacted the health, well-being, and lifeways of the Nez Perce

People (Nimíipuu) in tangible and intangible ways, and has had a wide range of social and economic impacts including public health impacts, losses to key subsistence resources (fish, game, wetlands, and native plants), and economic impacts on tribal enterprises and the regional and local economy.

For example, from 2015 to 2017, a combination of record-breaking drought, wildfire, extreme summer heat waves, and low base flows resulted in a massive fish kill in the Columbia River Basin. Salmon redds were exposed in dry creek beds, elders saw rocks in the rivers that they had never seen before, and adult fish washed up on hot river banks in record numbers far from their spawning grounds. The gravity of this to the traditional life ways and values of the Nimíipuu is hard to overstate. The following winter in 2016 and 2017, this region experienced record low temperatures and record precipitation in the form of snow and rain. Opposing extremes of drought and fire followed by record precipitation caused severe flooding and erosion that washed sediment into salmon streams, burying spawning grounds and choking important fish passages with sediment and debris. The drought, fires, smoke, and floods impacted transportation, agriculture, forestry, tourism, fisheries, water quality, traditional gatherers, hunters, fishermen, and habitat quality for wildlife and plants. Experts at the University of Washington, University of Idaho, National Oceanic and Atmospheric Administration (NOAA) Fisheries, and within the NPT warn that these types of environmental extremes may become the new normal.

For the draft vulnerability assessment of the ICC, NPT staff gathered and evaluated information on projected stream and air temperatures, changes in snowpack and rainfall, thermal limits for salmonids, fire risk, and agricultural vulnerability. Data from the University of Washington and the U.S. Forest Service NorWeST Stream Temperature Regional Database indicate that if the system shifts from a snow dominant to a rain dominant system and a progressively earlier loss of snowpack by 2100, the result will be increasing stream temperatures and decreasing summer base-flows across the ICC watersheds. This will likely result in future water temperatures that cause stress-related fatalities among salmonids in the managed waters of the ICC. Historically, the Clearwater basin, the focus of this study, has the second highest stream temperatures of all similar sized subbasins within the ICC. This will only worsen by 2040 as this basin is projected to be the least conducive watershed within the ICC for salmonid survival due to projected increases in stream temperatures (Figure 1).

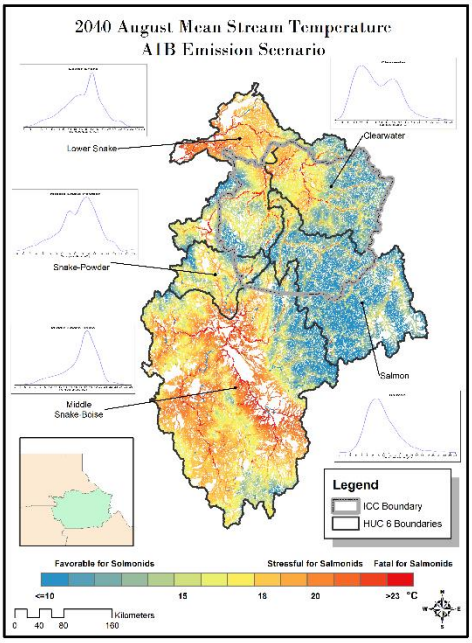

Figure 1. 2040 August Mean Stream Temperatures and salmon habitat suitability.

In addition to salmon habitat, we have identified vulnerabilities related to soil health, agricultural productivity, and food sovereignty. Most of the food produced in Idaho is for commodity markets instead of for local consumption. One in seven Idahoans is food insecure, and 50% of the residents of the Nez Perce Reservation live in households earning less than a livable wage. In addition, historic land and water degradation has led to fewer opportunities to traditionally gather wild foods, fish, hunt, and collect water from springs. Lastly, future projections indicate impacts to the cropping systems that are currently in place in northern Idaho, shifting crop suitability zones, and future range shifts of plants and animals. The Tribe is responding to this by building a food coalition and working on food sovereignty and security projects to provide adequate fresh, affordable food to the reservation community and to generate income and jobs.

Agricultural systems in the ICC encompass row crop, livestock, and fisheries sectors, which when approached holistically and balanced with the environment and tribal community interests will result in food security and sovereignty. There are vulnerabilities that emerge because of a focus to maximize one agricultural sector without maintaining a balanced and holistic approach for the whole system. For example, cereal production systems in semi-arid regions like the Columbia Plateau are

vulnerable to extreme climate events and harmful environmental trends. In addition, these cropping systems already pose some problems for salmonids and fisheries due to agricultural runoff, channelization of creeks, and hydrological changes associated with the transformation of deep-rooted prairie, shrub steppe ecosystems, and riparian forests into fallow cropped systems with short-rooted monocrops like annual wheat. This existing environmental stress is compounded further by a current and spreading interest among local farmers to grow more water intensive crops as we have more frost-free days and the Columbia Plateau becomes more suitable for a greater variety of crops. This creates a conflict between irrigated agriculture and fisheries resulting in an unbalanced system and overall lower system productivity. There are opportunities to implement cropping practices that do not run counter to fisheries production but rather improve them, while increasing crop productivity, increasing moisture retention in croplands and groundwater inputs, and mitigating against environmental degradation.

The Nez Perce Tribe's Watershed Division has been working on the LOP project for several years. The LOP project is a remediation project for restoring flows to the tribe instead of being diverted to the Lewiston Orchards Irrigation District off-reservation. This is being accomplished by replacing irrigation withdrawals from Webb Creek and the spring-fed Sweetwater Creek with an off-reservation deep aquifer well field. The LOP project will assist in restoring a cool-water thermal refugia in the lower Clearwater River Subbasin for coho salmon, Snake River steelhead (listed as a threatened species under the Endangered Species Act) and their designated critical habitat, and other fish species. Spawning, incubating, rearing, and migratory habitat for listed steelhead and coho salmon in the lower Clearwater is already compromised and is expected to become more so because of increasing temperatures and diminishing summer flows associated with changing weather patterns. The reintroduction of cool water and summer base flows into the Lapwai and greater Clearwater basin is an important step for salmon recovery and adaptation. However, there are questions about how land use changes can improve snow retention, water quality, water storage, and soil health in other parts of the basin.

PROJECT DESCRIPTION

We are proposing to improve our ongoing resilience planning by collecting baseline data on the land use systems (forestry, fisheries, crops, and grazing) of the NPT. We will evaluate how these systems interact to affect water quality, water quantity, soil health, and agricultural yield. This will aid our resilience planning because it will inform NPT agricultural and environmental managers on the emergent properties (e.g., water flows) of these interacting systems that are enhanced or inhibited by management efforts and quantify several identified vulnerabilities (e.g., cropping practices) within the land use system. In addition, it can also be used for future evaluations of proposed management actions (e.g., no-till agriculture), which aim to build resilience capacity to extreme events and harmful environmental trends by balancing the land use systems of the NPT.

We are limiting our scope to the Clearwater basin, and we will leverage established methodologies that have been developed for similar data acquisition projects and land use systems. These project characteristics will ensure a comprehensive data acquisition and evaluation process while making the identified goals attainable within the project's timeframe. Secondary to the goals identified above, we aim to develop and verify a process to acquire, organize, and evaluate these data, specifically for these types of land use systems, such that this process can be applied to other watersheds within the Nez Perce and other tribal territories.

We will leverage two existing resources to guide and streamline implementation of this project, which correspond to the stages of the project. The first is the CGIAR institute's Programing and Indicator Tool (PIT) for sustainable agriculture. The second resource is the existing land use ecosystem models that have been developed for the ecological regions adjacent to the NPT ICC. In stage 1, the PIT will guide our efforts to evaluate the human and natural systems within the study area, which interact to produce complex results (e.g., soil water storage and total plant-based materials). In this stage, we will collect and organize data on the stakeholders (e.g., land owners, farm lessees), ecosystem services (e.g., soil water storage and fertility,

or plant-based material), and agricultural practices (crop/range systems, forestry, fisheries) within the study area per the PIT process. Next, several metrics (e.g., soil water storage, agricultural yield, or total plant-based material) will be identified and quantified to baseline current conditions, provide a means to evaluate the second stage's models, and provide a seamless evaluation and comparison process for future research. Finally, this information will be used to identify sustainable agriculture practices (e.g., no-till agriculture, crop diversity, crop waste recycling) that are not being used but would be applicable to the study area and could improve resilience. Identification of these alternative agricultural practices will be directly evaluated in stage 2 of the project.

The second stage will use the first stage's information to build a landscape model that will provide information on the state of the land use systems. We will evaluate different land use types (e.g., current and alternative agricultural practices or reversion of lands from crop agriculture to forest), extreme events, and harmful environmental trends and look for interactions between these and their effects on ecosystem services (e.g., water quality, water quantity, soil fertility, and agricultural yield). The information from stage 2 and these models will inform the following outcomes: 1) an understanding of how the *interactions* between current land use and ecological conditions affect ecosystem services (e.g., as more land is allocated to a type of agriculture and given the location on the landscape, how does water flow change); 2) how current land management *practices* are increasing or decreasing the resilience of the system to extreme events and harmful environmental trends (e.g., ability to maintain agricultural yields under the current/alternative crop systems and changing precipitation); 3) how and which management practices identified in stage 1 should be evaluated in a future modeling project. Upon completion of the project, outcomes 1 and 2 can be used to assist NPT land and resource managers on decision making with regards to resiliency planning.

These outcomes will provide integrated information that can further support the implementation of the IRMP, which has been slow to be adopted due to a conflict between ranching/agriculture leasing revenue and other desired outcomes, e.g., sustainable land management. Alternative and more sustainable land use systems, specifically crop systems (e.g., integrated multispecies or deeper rooted) or grazing systems, could help mitigate for impacts of lost soil fertility, shifts in environmental trends, and changes in water storage and flows, for example. However, adoption of such plans requires stakeholders to have confidence that the benefits of changing agricultural and land use practices outweigh the costs. By supporting such changes through data development, we can build resilience by facilitating the transition to changes that are adaptive, mitigate environmental impacts, and maximize agricultural security and food sovereignty. This project will be a step towards improving stakeholder adoption of sustainable practices and thus ultimately tribal resilience.

The second stage modeling process is possible because of the proposed working cooperative with Dr. Tara Hudiburg of the University of Idaho. Her lab has the expertise and experience to model the land use systems of the study area. In addition, the lab has developed a landscape model of the Northern Rockies Ecoregion that is transferable to the project's study region. Eric Walsh has been working for the Nez Perce Tribe Resilience Program while concurrently obtaining his doctorate at the University of Idaho under Dr. Hudiburg. Eric has contributed to the background information, fisheries, wildlife, and forestry sections, is intimately familiar with the needs of this project, and already has a positive working relationship with the NPT. As such, we would like him to conduct this investigation as a post-doctoral associate in Dr. Hudiburg's Lab.

In addition to subcontracting with the University of Idaho, we are including salary for the Watershed Division's Fisheries Database Administrator, Keith Mortensen, who has expertise in gathering and processing data through the NPT GIS program and in creating story maps. We are also including salary to hire one new part-time temporary applied economist, to assist with the economic impacts analysis.

MILESTONES, PROJECT TASKS, DELIVERABLES

The milestones are identified below in a table with corresponding project tasks and associated deliverables. The primary deliverables will be a GIS database, final report, peer-reviewed journal article, conference presentation, and story map. These will cover several types of communication types (general, scientific, and visual) to ensure stakeholders, interest groups, and the tribal community as a whole will have the proper and usable information. Finally, the final report and journal article will be formulated as the project progresses.

STAGE 1

January – March 2019 **Deliverables:** GIS database; Landscape Statistics summary (Final Report)	1. Build comprehensive database of current land use practices and cover types of the NPT ICC in preparation for stage 2. To do so we will: a. Apply the CGIAR Institute Programing and Indicator Tool to the Clearwater Subbasin i. Identify stakeholders (e.g., land owners, farm lessees) ii. Quantify natural resources (e.g., forest composition) and ecosystem services (e.g., soil water storage and plant-based material) iii. Quantify current land use practices and agriculture intensity; this includes crop and range systems, forestry practices, and fisheries
February – March 2019 **Deliverables:** Landscape Statistics Summary (Final Report)	2. Identify and quantify the scale dependent metrics that will inform current and future condition evaluations. a. Use the Programing and Indicator Tool to identify indicators in the following: i. Natural resources (e.g., wildlife biodiversity) ii. Ecosystem services (e.g., soil fertility) iii. Crop systems (e.g., quantity of winter wheat landscape coverage) iv. Grazing systems (e.g., spatial distribution of rotational grazing systems) v. Fisheries (e.g., water temperature) vi. Forestry (e.g., total plant-based material)
March – April 2019 **Deliverables:** Best Agricultural Practices summary (Final Report)	3. Identify additional or underutilized sustainable agriculture practices that are conducive or complementary with the current land use/cover identified in step A (e.g., no-till agriculture and reduced impact logging) a. Conduct a literature review and seek expert opinions to discuss best practices

STAGE 2

April - September 2019 **Deliverables:** Model methods and outcomes (Final Report)	1. Develop forest and agriculture landscape models a. Expand on existing models and data of region and integrate information from Stages 1.1 and 1.3 i. Build LANDIS/Daycent models and scenario evaluation 1. Scenarios include: irregular weather patterns and extreme events; different crop, grazing, timber harvest practices; changing disturbance events and extremes 2. Link model outcomes to other aspects of the landscape to evaluate cascading effects and inform metrics from Stage 1.2. Revisit Stage 2.1 as necessary to improve the quantification

October - December 2019 **Deliverables:** Final Report, journal article, presentation, story map	3. Finalize final report and journal article. Final report will also include implementation methodology that is transferable to other watersheds 4. Deliver presentation of findings at regional/national conference 5. Develop story map for Division website

TRANSFER OF RESULTS

The project results will be summarized in a final report, story map, regional/national conference presentation, and published peer-reviewed article. The story map will be made available to the public after approval of the Nez Perce Tribe Executive Committee (NPTEC). We will follow the proper tribal procedures to ensure that private information is not published. Databases, maps, and models will be housed within the NPT and instructions will be provided to tribal staff to help them utilize this information. M.S. PowerPoint presentations will be delivered to relevant tribal entities including Watershed and Water Resources, Wildlife, Land Services, the Food Coalition, and the Columbia River Inter-Tribal Fish Commission (CRITFC). The methodology will be submitted to a scientific journal for publication. We will also attempt to highlight this project at our annual retreat, and prepare brochures that summarize the results for tabling at local and regional events and meetings. We plan to submit for oral or poster presentations to tribally relevant meetings such as the Northwest Climate Conference or Rising Voices.

REPORTING

QUARTERLY: Quarterly reports will include financial accounting, updates on tasks completed, leverage of partnerships, and an update on data collected and analyzed.

FINAL: The final report for this project will include a financial report, model outputs, GIS database, datasets as appropriate, written report with conclusions, link to the final story map, and other deliverables listed above.

PARTNERSHIPS

This project will be completed through a partnership between the Nez Perce Tribe and the University of Idaho. Staff from the NPT Water Resources and Watershed Divisions will work on this project which will enhance the NPT adaptation planning process. It will expand work that is ongoing with the NPT Wildlife Division, Forestry Division, Land Services, Economic Development, Air Quality, Nimíipuu Health, and the Food Coalition. Because this project dovetails with other projects that are supported in part by the BIA, and other federal funders including the Bureau of Reclamation and the EPA, we are not listing the work that staff will be contributing to this as in-kind.