RESEARCH STATEMENT AND LITERATURE REVIEW

We are proposing a data collection from Washington State steelhead anglers. This document (1) summarizes the Pacific Northwest steelhead angling context, (2) reviews prior literature related to the data collection, (3) describes data products generated by the data collection, and (4) discusses how the proposed data collection can inform management decisions.

Background

Steelhead are an important and valuable recreational fishery in Washington State despite significant declines in wild steelhead populations compared to historical abundances (Gustafson et al. 2007, Ruckelshaus et al. 2002). Underscoring wild steelhead population declines were the listings of five evolutionarily significant units (ESUs) of steelhead in Washington as Threatened under the Endangered Species Act (ESA)[1]. Owing to their reduced populations, recreational retention of wild steelhead is prohibited in Washington State. In order to provide harvest opportunities, fish hatcheries release marked juvenile steelhead. Upon their return from the ocean these marked fish can be harvested by anglers or tribal fishers. However, hatcheries operated for fishery enhancement can also have negative consequences for wild steelhead through direct competition and genetic interactions with hatchery (Buhle et al. 2009, Naish et al. 2007); so there may be trade-offs between conservation of ESA-listed fish and the recreational opportunities provided to anglers.

Washington steelhead anglers target both hatchery and wild fish. On the hatchery side, anglers harvested an estimated 78 thousand steelhead in 2016 (Kraig and Scalici 2018). There is also demand for targeting wild steelhead in areas and times when regulations permit. For example, NOAA Fisheries recently approved a catch-and-release fishery for an ESA-listed steelhead stock after wild stocks rebounded (Bernton 2018).

Literature review

Before turning to the availability of economic values in the existing literature, we find it important to make a clear distinction between two economic metrics: economic value and economic impact.

Measures of economic value are derived by integrating under demand curves for market or nonmarket goods. In this case, the good is recreational steelhead fishing trips in Washington State. The economic value of a steelhead fishing trip is the maximum amount of money or other goods an individual is willing to give up (willingness-to-pay) in order to take the trip. The methods we use also allow the calculation of willingness-to-pay for trip attributes, such as catch rates for hatchery and wild steelhead, and for season long measures, such as closures in a particular river. Economic value is useful for capturing the net benefits associated with a particular management change, in contrast to economic impact. Economic impacts are a measure of the gross economic activity within a particular study region and are estimated by applying input-output models of the regional economy to determine how angler expenditures on trips and

[1] These ESUs, with listing year in parentheses, include: Snake River Steelhead (1997), Lower Columbia River steelhead (1998), Middle Columbia River Steelhead (1999), Puget Sound Steelhead in (2007), and Upper Columbia River Steelhead (2009).

durable goods support jobs and incomes. Without a behavioral model, input-output models provide only gross measures of economic activity and are not capable of quantifying the net benefits of the change to be valued. The primary goal of our proposed study is to estimate economic values, so we do not consider distinct studies that measure only economic impact for steelhead fishing in our review of the literature.

Economic values for goods have been shown to be relatively stable in short time frames, but relying on values from past studies that are decades old in current applications is questionable, and would likely result in large transfer errors (Boman et al. 2011, Johnston and Rosenberger 2010, Rosenberger and Johnston 2009, Zandersen, Termansen, and Jensen 2007). Based on our review of the literature, there are no economic values of steelhead fishing in Washington State that are calculated using survey data from within the last 20 years. The most recent Washington State study that we were able to locate was administered 20 years ago, in 1998 (Layton, Brown, and Plummer 1999). To illustrate the age of potentially relevant steelhead studies among all the studies we examined – including those in other states – we classify each by the number of decades between the current period and the year in which the surveys were fielded. There is one study (in California) that uses data from within the last 10 years (The Program for Applied Research and Evaluation 2013), one study (in Ohio) between 10 and 20 years ago (Kelch et al. 2006), five studies that use data 20 to 30 years old (Layton, Brown, and Plummer 1999, Loomis 1992, 1996, Loomis and White 1996, Olsen, Richards, and Scott 1991), four studies that use surveys between 30 and 40 years old (Donnelly 1985, Johnson and Adams 1988, 1989, Sorg and Loomis 1986), and three studies that rely on data more than 40 years old (Brown, Singh, and Castle 1965, Chou-Yang 1980, Loomis 1988).

There are no studies in the literature that separate out values for hatchery and wild steelhead catch rates. In addition to grouping hatchery and wild steelhead together, a number of studies also group salmon together with steelhead in a way where their values are not separable (Brown, Singh, and Castle 1965, Layton, Brown, and Plummer 1999, Loomis 1996, Loomis and White 1996, Olsen, Richards, and Scott 1991). This lack of distinct values for hatchery and wild steelhead represents a major shortcoming of the current literature – as both fishery managers and anglers consider hatchery and wild fish to have different costs and benefits, our research must be capable of treating them distinctly.

Another issue with the existing studies is related to the framing of value. To evaluate the effects of changes in season length, including closures and changes in hatchery production, we need a behavioral model capable of estimating changes in fishing effort. Instead, some existing studies provide the total economic value to the general population, rather than the change in value to the angling population from changes to the fishery (Layton, Brown, and Plummer 1999, Loomis 1996, Loomis and White 1996, Olsen, Richards, and Scott 1991). These studies seek to quantify the net value to all members of the population, for increases in the viability of steelhead populations. A number of studies come closer our needs, by capturing the value of fishing to the steelhead angling population directly (Brown, Singh, and Castle 1965, Chou-Yang 1980, Donnelly 1985, Johnson and Adams 1988, 1989, Kelch et al. 2006, Loomis 1988, 1992, Sorg and Loomis 1986, The Program for Applied Research and Evaluation 2013). However, all of these provide the value framed in terms of a steelhead fishing day. Using these values for evaluating the effects of changes in management would still require knowing how the number of days fished would change under the relevant management scenarios we seek to evaluate. Such a model does not exist in the literature.

Regional specificity is also an important consideration in determining which values would be the most defensible to transfer from existing studies. Fewer than half of the studies included in this review are specific to Washington State (Brown, Singh, and Castle 1965, Chou-Yang 1980, Layton, Brown, and Plummer 1999, Loomis 1996, Olsen, Richards, and Scott 1991). Although we have considered studies from other states, some of these are very different fisheries where steelhead are actually an introduced species (Kelch et al. 2006) and earlier attempts to transfer benefits across state lines in a seemingly ideal setting (neighboring states) have shown to be problematic (Loomis 1992). Specifically, the equality of values was rejected between steelhead days in Oregon and steelhead days in Idaho. This suggests that attempts to transfer benefits across state lines should be conducted with caution.

Based on these criteria, it is our determination that using a benefit transfer approach using any of the available studies in the literature would not serve as a viable alternative to a primary data collection, on the multiple levels discussed above.

Products of the planned data collection

The proposed data collection will employ a choice experiment format to estimate angler preferences for steelhead trips to Washington rivers. In particular, the data collection and subsequent modeling will facilitate estimation of several policy-relevant values that characterize angler preferences for steelhead trip attributes and behavioral responses to changes in management. These values include:

- The economic value of steelhead fishing in individual rivers under (a) current and potential future catch rates for hatchery and wild salmon and (b) current and potential future season lengths / closures

- A model quantifying the number of trips anglers would take, conditional on catch rates and season lengths, and quantifying these changes re-allocate effort to other rivers

In addition to the choice model outputs listed above, the proposed collection will gather individual angler characteristics and trip expenditures by river and angler type. Angler demographics, including income and area of residence, will facilitate characterization of river-specific steelhead fisheries in terms of the anglers who frequent them. As a secondary motivation, the expenditure data can serve as inputs to an economic impact model created by colleagues at our Science Center that estimate the impacts of angler trip expenditures on incomes and employment in the regional economy.

Finally, the proposed data collection will generate estimates of current levels of angling pressure at specific Washington state rivers. At present, estimating angling pressure is typically estimated using Catch Record Card Data that only includes data on retained fish (e.g. NMFS 2017b).

Moreover, the proposed data collection will facilitate research within a body of literature that is examining management of multi-use species, or species whose marginal values can be positive or negative depending on population size (e.g. Rondeau 2001, Zivin, Hueth, and Zilberman 2000). Hatchery steelhead likely fit into this category given their value as a recreational resource coupled with their

potentially negative influence on wild stocks. This collection will also provide a freshwater context to existing literature evaluating heterogeneous angler preferences and substitutability between hatchery and wild fish caught in marine sport fisheries (Anderson and Lee 2013).

How the proposed data collection can inform policy and management

Because steelhead fishery and hatchery operations can have negative consequences for wild steelhead stocks, steelhead fisheries plans and steelhead hatchery programs operating in regions with ESA-listed populations are subject to NMFS review. These reviews are conducted to ensure the planned activities are consistent with ESA conservation and recovery goals. In particular, the National Environmental Policy Act requires that NMFS conduct an environmental impact statement (EIS) for resource management plans that have significant negative environmental impacts, including take of ESA-listed species. The EIS process includes consideration of economic effects, and prior EIS evaluations of steelhead management utilize estimates of recreational catch and trip expenditures to estimate economic impacts under alternative management scenarios (e.g. NMFS 2017b, a).

The first section of this document described a steelhead policy landscape in the Pacific Northwest that requires resource managers to balance NMFS conservation objectives and other valuable uses for steelhead. The need to strike this balance is due to the multi-objective nature of current steelhead management. For example, instead of focusing solely on conservation, existing fishery and hatchery management plans seek to provide recreational and tribal harvest opportunities for steelhead while achieving conservation goals (NMFS 2017b, 2018, 2017a). Components of past hatchery management plans in Washington include hatcheries to supplement fisheries, conservation hatcheries, catch-and-release fisheries, and establishment of a network of "Wild Gene Banks" or rivers where wild fish are largely protected from the effects of hatchery programs (WDFW 2018, NMFS 2017b, 2018, 2017a). The proposed data collection will provide information for estimating the economic value of recreational fisheries under multi-objective management alternatives designed to meet conservation objectives while providing valuable angling opportunities.

The data products associated with the proposed data collection will provide estimates of economic value, expenditures, and behavioral responses that can serve as inputs to EIS analyses and other policy evaluation processes. As discussed in the literature review, these estimates represent more recent, rigorous, and fishery-specific estimates compared to the economic data that are currently available.

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