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Willingness to Pay for Local Coho Salmon Enhancement in Coastal Communities

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Abstract *Salmon restoration and enhancement are dominant environmental policy issues in Oregon and Washington. In response to salmon species listings under the Endangered Species Act, salmon protection and recovery actions are being implemented throughout the Pacific Northwest at substantial opportunity costs. In this paper, we examine the willingness to pay (WTP) of coastal residents for local coho salmon enhancement programs. A contingent valuation study is completed using survey responses from five rural, coastal communities of Oregon and Washington, where coho salmon are prevalent. Our empirical results indicate that coastal residents are willing to pay for local coho salmon enhancement and that WTP varies considerably with individual opinions of the merit of the enhancement program.*

Key words Willingness to pay, coho salmon, contingent valuation.

JEL Classification Codes Q28, H00, D60.

Introduction

Salmon restoration and enhancement are dominant environmental policy issues in Oregon and Washington State (Lichatowich 1999; Taylor 1999). Within these two states, 18 salmon and steelhead stocks were listed as threatened or endangered under the Endangered Species Act (ESA) in 2001. An additional three stocks were candidates for listing in 2001. Policy actions implemented and proposed to address the marked decline in salmon populations include government actions at local, state, and national levels. Habitat rehabilitation, restrictions on sport and commercial

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catch, changes in operation of hydroelectric power facilities, and hatchery programs are examples of actions undertaken to restore and enhance salmon stocks.

Salmon restoration and enhancement involves fundamental tradeoffs in the use and appreciation of natural resources, and because the lifecycle of anadromous salmon involves migration between rivers and the ocean, these tradeoffs occur over wide expanses of the landscape. As more salmon species are listed under ESA, policymakers are increasingly faced with the consequences of these tradeoffs; namely the conflicts between salmon preservation uses and other economic uses of water and land (Huppert 1999). While the costs of federal and state salmon enhancement programs are distributed widely across taxpayers, other costs are incurred locally at the community level. Concerns over the concentration of such costs at the community level are commonly voiced in petitions regarding the listing of salmonid species as threatened under ESA.

In this paper, we examine the willingness to pay (WTP) of coastal residents for local coho salmon enhancement programs using contingent valuation methods. A range of salmon restoration and enhancement options with diverse opportunity costs is available to decision-makers. Given this abundance of options, we believe that an improved understanding of local willingness to pay for specific protections may inform future salmon restoration and protection decisions. The National Marine Fisheries Service (NMFS) groups West Coast salmon and steelhead species into 51 distinct population segments entitled "evolutionarily significant units" or ESUs, that are eligible for listing under the Endangered Species Act.[1] Coho salmon are grouped into six West Coast ESUs: Central California, Southern Oregon/Northern California Coasts, Oregon Coast, Puget Sound/Strait of Georgia, Lower Columbia River/Southwest Washington, and Olympic Peninsula. The Central California, Southern Oregon/Northern California, and Oregon Coast ESUs were listed as threatened in 1996, 1997, and 1998, respectively. The Puget Sound/Strait of Georgia and Lower Columbia River/Southwest Washington ESUs are candidates for listing (US Department of Commerce 1999).

Substantial government-sponsored efforts to protect and enhance the listed salmon and steelhead stocks have heightened public awareness of salmon conservation and management in the Pacific Northwest. During the course of our survey of coastal residents, the listing of Oregon Coast coho ESU as threatened was being contested in Oregon District Court by the Pacific Legal Foundation (*Alsea River Alliance vs. Evans*) because of the exclusion of hatchery fish in the listing. This case, and other petitions, have caused NMFS to reconsider the listing of salmon ESUs under ESA.[2] We anticipate that the legal contests over the salmon listings will continue and believe that such contests underscore the value of understanding public opinion and support for salmon enhancement programs, such as the one featured in this paper. Furthermore, as government agencies increasingly involve stakeholder groups

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[1] NOAA's National Marine Fisheries Service (NMFS) establishes two criteria for a stock to be considered a "distinct population segment" or ESU under the federal Endangered Species Act (ESA): "(1) It must be substantially reproductively isolated from other conspecific population units; and (2) It must represent an important component in the evolutionary legacy of the species" (*Federal Register*, Nov. 20, 1991).

[2] The Pacific Legal Foundation's lawsuit (Alsea River Alliance vs. Evans Case) was filed in US District Court in 1999, questioning the inconsistent treatment of wild and hatchery fish under the ESA listing. In September 2001, the US District Court vacated NMFS' listing for the Oregon coastal coho because the threatened species listing did not include hatchery fish. The Alsea Valley Alliance v. Evans decision was stayed by the 9th Circuit Court in December 2001 pending an appeal by conservation groups. In February of 2002, NMFS announced that it would formally revisit the salmon listings and begin a new status review of the listed salmon ESUs.

in the design and implementation of restoration and enhancement programs, public opinion and attitudes take on a growing importance in implementing and designing effective policies.

Our study focuses on coho enhancement programs in five estuaries, which are located within the geographic boundaries of the Oregon Coast and Lower Columbia River/Southwest Washington coho ESUs. Coho salmon originating from rivers that empty into the three Oregon estuaries belong to the Oregon coastal ESU, which is listed as threatened, and coho salmon in the two Washington estuaries belong to an ESU that is a "candidate" for listing. We explore public opinion and support for local coho enhancement using responses from a survey of local residents.

Recent studies have examined the WTP for restoration of depleted or threatened salmon stocks in the Pacific Northwest and California. Hanemann, Loomis, and Kanninen (1991) examined the WTP for a program designed to restore flows in the upper San Joaquin River and enhance salmon, other fish and wildlife, and vegetation along the river banks. As defined, the salmon improvement program would increase Chinook salmon returning to spawn annually to 15,000 and raise the total number of chinook caught by sport (increase of 7,500 fish) and commercial (increase of 23,000 fish) anglers. Their contingent valuation study employs a double-bounded dichotomous choice referendum format with a payment vehicle of additional taxes. Data were collected in May 1989 using a combined mail and telephone survey approach. The final sample included responses of approximately 1,004 residents of California, Oregon, Washington, and Nevada. Five different environmental programs were addressed in the study. For the salmon improvement/restored river flows program, Hanemann, Loomis, and Kanninen (1991) report a truncated mean WTP of $181 per year for California households.

Olsen, Richards, and Scott (1991) estimate non-use and sport fishing values for a doubling of salmon and steelhead runs in the Columbia River Basin from 2.5 million to 5 million fish. Their contingent valuation study uses a modified open-ended response format with a payment vehicle of additional electric power bill charges. The data for this study were collected using a telephone survey of both user and nonuser (interpreted here as not involved in the sport or commercial salmon fisheries) households of the Pacific Northwest. The final sample consists of approximately 700 user and 700 nonuser households. Olsen, Richards, and Scott (1991) report mean annual WTP estimates for the doubling of these runs for three categories of households: (*i*) $26.51 per year for households stating that they would never fish for these anadromous species; (*ii*) $58.56 per year for households that currently don't fish but may go fishing at some time in the future; and (*iii*) $74.16 per year for households that currently fish for anadromous species.

Loomis (1996) estimates the WTP for removing two dams on the Elwha River in Washington State. The removal of these two dams is assumed to result in increased populations of four salmon and steelhead species (increase of 300,000 fish). Of these four species, pink salmon were expected to benefit the most from the removal of the dams (an increase of 200,000 fish). Contingent valuation methods are used to analyze the responses to a mail survey of Clallam County, Washington State, and other US residents conducted in fall of 1994. Approximately 1,624 responses were analyzed in this study. A single-bounded dichotomous choice referendum question format is used with a payment vehicle of additional annual federal taxes for 10 years. Loomis (1996) reports truncated mean WTP estimates of $59 per year per household in Clallam county (the location of the two dams), $73 per year per household in the rest of Washington State, and $68 per year per household in the rest of the United States.

Layton, Brown, and Plummer (1999) assess the WTP of Washington State resi-

dents for changes in population levels of five broad categories of fish. They consider two migratory fish categories, which are predominantly composed of salmon species. A contingent ranking format that asks individuals to rank four alternative outcomes relative to a baseline outcome of no new programs is employed to characterize the WTP for multiple enhancement programs. The programs are described using household cost information and the assumed population levels for the five categories of fish in 20 years. Data were collected using a mail survey; their final sample includes the responses of approximately 1,611 Washington State residents. Layton, Brown, and Plummer (1999) report a mean WTP estimate of $9.92 per month ($119.04 per year) per household for a 50% increase in eastern Washington migratory fish (from 2 to 3 million). For western Washington migratory fish, the corresponding WTP estimate for a 50% increase (from 5 to 7.5 million) is $20.83 per month ($249.96 per year).

In this study, we examine the WTP of residents living within 30 miles of five Pacific Northwest estuaries: Grays Harbor and Willapa Bay in Washington and Tillamook Bay, Yaquina Bay, and Coos Bay in Oregon.[3] We estimate the WTP of these coastal residents for the enhancement of local coho salmon stocks from a baseline defined as the 1996–98 average annual coho salmon run size. Programs resulting in the doubling and quadrupling of baseline runs are examined for the Washington estuaries (*e.g.,* increases of 40,000 and 165,000 fish). Whereas programs resulting in the delisting of coho as threatened and increases in the allowable catch of 100,000 fish are evaluated in the Oregon estuaries. Variation in WTP is explained using data on individual opinions of the merit of the enhancement program and causes of salmon decline, involvement in sport fishing, and membership in an environmental organization.

Survey Questionnaire Design and Response

Data for this analysis were drawn from responses to a coastal resident survey undertaken in the spring of 2000. The survey questionnaire was a multi-purpose research instrument, seeking the opinions of coastal residents on a variety of matters including residential location preferences, recreation interests, threats to the local natural environment, and management of these threats. A pre-test mailing of the coastal resident survey was conducted to identify problematic questions and other design flaws. In addition, the entire resident survey was written with the input of local scientists and natural resource managers.

Coho Enhancement

One section of the survey was dedicated to coastal salmon stocks and included a referendum question outlining a hypothetical ballot measure to fund a local coho enhancement program. This section of the survey aimed to incorporate the protocol designated by the NOAA Panel on contingent valuation in 1993 (*Federal Register* 1993; Portney 1994) and the guidelines outlined by Mitchell and Carson (1989) regarding the use of surveys to value public goods. A broad description of native salmon runs along the Pacific Northwest Coast was stated prior to the referendum

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[3] The counties surrounding these estuaries are: Grays Harbor County, WA; Pacific County, WA; Coos County, OR; Tillamook County, OR; and Lincoln County, OR, respectively.

question, and each respondent was asked their opinion of the importance of various potential causes of salmon decline. These questions were included to evaluate the sensitivity of voting behavior to individual perceptions of threats to coastal salmon. The enhancement program described in the survey questionnaire targets overfishing and habitat degradation as important causes of salmon decline.

After summarizing the history of coastal coho and chinook salmon stocks, the questionnaire presented figures displaying recent trends in local, coastal chinook and coho salmon catches. The proposed local coho salmon enhancement program was described by contrasting the expected outcome of the enhancement program as of the year 2004 with a baseline characterized as the level of the catch and salmon populations during 1996–98. Expected coho salmon run size and allowable catch under the coho salmon enhancement program and baseline were presented in tabular form and described in the text. The specific wording of the referendum question for one area (Willapa Bay, WA) is shown below:

> Although the state has committed to spending additional money to help salmon in general, local partnerships and watershed councils may need additional funding. Residents of the Willapa Bay area will be asked to provide additional support to improve salmon populations in your local area. The collection of additional taxes to fund these programs can be authorized by a majority vote on a ballot measure in the next election. If no local programs are funded, then coho salmon runs would remain near their current levels, as shown in the table above.
>
> If this Coho Enhancement Program is proposed for the Willapa Bay area in the next election, coho runs will increase to a level that will raise allowable coho catch to an average of 80,000 fish per year by 2004. If this ballot measure will cost your household $25.00 per year for the next 5 years, will you vote in favor of the ballot measure? (circle one response)
>
> 1 YES
> 2 NO
>
> If you answered NO, please briefly explain your response.

The specified annual household cost (annual tax amount or COST) of the program varied randomly from $5.00 to $500.00. Assigned tax amounts were uniformly distributed over this range.

Each respondent voted on one local coho enhancement program. Two levels of enhancement (high and low) were considered. Both levels of enhancement were contrasted with the baseline (current) condition of salmon catch and run size (described using 1996 to 1998 data). For Willapa Bay and Grays Harbor, the low level of enhancement represented a doubling of current runs and catch, while the high level of enhancement involved a quadrupling of current runs and catch. Because the Oregon Coast coho ESU were listed as “threatened” with extinction under the Endangered Species Act at the time of the survey, a different set of programs was evaluated in the three Oregon estuaries. For these bays (Coos, Tillamook, and Yaquina), the low-enhancement program increased stocks to the point that they would no longer be threatened with extinction, and the high-enhancement program protected stocks from extinction and increased allowable coho catch to 100,000 fish per year.

Response Rates and Voting Responses

The coastal resident survey was distributed in spring of 2000. In total, 5,000 mail surveys were distributed, with 1,000 going to each of the five study areas. Surveys were mailed to a random sample of property owners residing within 30 miles of five estuaries. These residents live in communities surrounding estuaries located in Southwest Washington (Grays Harbor and Willapa Bay) and on the outer coast of Oregon (Tillamook Bay, Yaquina Bay, and Coos Bay). As is characteristic in the rural Pacific Northwest, the local economies of these communities have historically depended on natural resource-based industries — fishing, forest products, and farming. As a result, many of these communities have been affected by recent changes in fishing and forest product industries. Compared to the urban areas of the Pacific Northwest, these coastal communities have relatively lower incomes per household, higher unemployment rates, lower population growth rates, and larger proportions of retired people living on pensions and other transfer incomes.

The survey distribution process generally followed the total design method (TDM) guidelines (Dillman 2000, 1975). Table 1 displays the final response rates based upon the number of deliverable addresses. These rates vary from 49.1% in the Grays Harbor area to 61.7% in the Willapa Bay area. Of the 2,209 surveys returned, 2,006 (91%) contained responses to the referendum question. After eliminating "don't know" and "protest" responses, our final samples for the contingent valuation study included 1,771 responses from the five coastal areas.

Responses were categorized as protest or non-protest responses based upon the reasons given for rejecting the hypothetical coho enhancement program (Mitchell and Carson 1989). Responses were categorized as protests if the respondent objected to the payment vehicle. In addition, responses were dropped if individuals expressed a need for further information, entered don't know, and/or stated that they do not vote in local elections.[4] Using this definition of protests, our protest rates were relatively low, ranging from 4% in Yaquina Bay to 10% in Coos Bay. Protest behavior may be consistent with two phenomena observed in these coastal communities and indicated in written comments. First, there is considerable distrust of certain government agencies and dislike of taxes. Second, numerous and varied salmon protection efforts have been tried in these areas, many of which have had limited success. Therefore, there is skepticism among the public regarding government-initiated salmon protection programs. As noted in the introduction, legal conflicts may be an additional source of skepticism regarding salmon enhancement programs.

Table 1
Coastal Resident Survey Response Rates

	Number Delivered	Number Returned	Response Rate
Grays Harbor, WA	849	417	49.1%
Willapa Bay, WA	718	443	61.7%
Coos Bay, OR	883	516	58.4%
Tillamook Bay, OR	770	410	53.2%
Yaquina Bay, OR	708	423	59.7%
Total	3,928	2,209	56.2%

[4] Protest behavior was deduced by review of the open-ended, follow-up responses.

Theoretical Model

Following Hanemann (1984), Cameron (1988), and Hanemann and Kanninen (1999), we employ a random utility modeling framework to examine the dichotomous responses to the local coho salmon enhancement ballot measure. Under this framework, a respondent's voting decision is represented as the comparison of his or her utility at two states: status quo (u_0) and with the local coho salmon enhancement at cost c_1 (u_1). Utility is assumed to be a function of income (y), respondent characteristics (z), choice characteristics (g), and factors that are known by the respondent but are unobservable to us as researchers (ε). If the utility of the respondent is higher with the salmon enhancement, we expect that respondent to vote for the program. Formally, this comparison for respondent j looks as follows. Respondent j votes YES for the program if:

$$u_{1j}(y_j - c_{1j}, z_j, g_1, \varepsilon_{1j}) > u_{0j}(y_j, z_j, g_0, \varepsilon_{0j}). \tag{1}$$

Given the dichotomous responses available to us as researchers, we make probabilistic statements about YES and NO responses and rewrite this expression in probabilistic terms, where the probability that respondent j votes YES is as follows:

$$\Pr_j(YES) = \Pr\left[u_{1j}(y_j - c_{1j}, z_j, g_1, \varepsilon_{1j}) > u_{0j}(y_j, z_j, g_0, \varepsilon_{0j})\right]. \tag{2}$$

Modeling Specifications

A variety of modeling assumptions can be made to estimate the expression shown in equation (2). As part of our contingent valuation study, we experimented with a variety of specifications and assumptions.[5] Our final specification is an adaptation of the linear random utility model (Haab and McConnell 2002). We begin by assuming the utility function is additively separable in form, the sum of deterministic (v) and stochastic (ε) components:

$$u_{ij}(y_j - c_{ij}, z_j, g_i, \varepsilon_{ij}) = v_i(y_j - c_{ij}, z_j, g_i) + \varepsilon_{ij}, \tag{3}$$

where i references the state and j references the individual. Next, we specify the deterministic part of the utility function (v) as linear in income (y) and respondent (z) and choice attributes (g).

Finally, we assume that the coho enhancement program will have no income effect. Specifically, although we assume that the marginal utility of income is constant across states, we permit this value to vary across high- and low-income individuals.

Allowing for the marginal utility of income to be different for individuals falling into high (H) and low (L) income categories but constant across states, the probability individual j votes YES on the ballot measure can be written:

$$\Pr_j(YES) = \Pr(\alpha z_j - \eta_L I_{Lj} c_j - \eta_H I_{Hj} c_j + \varphi g_i - \varepsilon_j > 0), \tag{4}$$

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[5] A comparison of log likelihood values determined that the modeling specification featured in this paper fit the data best.

where α, η_L, η_H, and φ are parameters to be estimated; z_j are characteristics of individual j; c_j is the cost of the enhancement program to individual j; I_{Hj} and I_{Lj} are dummy variables that indicate whether or not individual j is in the high- or low-income category; and g_i are characteristics of the local coho enhancement program. Expression (4), a simple varying parameter model, forms the basis of our empirical modeling specification.

Willingness to Pay

One interpretation of willingness to pay (WTP) for the ballot measure is the amount of money that makes a respondent indifferent between the two states, status quo, and with the coho salmon enhancement program. Algebraic manipulation allows for individual j's WTP for program i to be written as:

$$WTP_{Hj} = \alpha z_j / \eta_H I_{Hj} + \varphi g_i / \eta_H I_{Hj} + \varepsilon_j / \eta_H I_{Hj} \quad (5)$$

$$\text{or } WTP_{Lj} = \alpha z_j / \eta_L I_{Lj} + \varphi g_i / \eta_L I_{Lj} + \varepsilon_j / \eta_L I_{Lj} .$$

The two different measures of WTP correspond to the high- and low-income categories.

Empirical Approach

Willingness to pay (WTP) for salmon enhancement is expected to vary across individuals according to their perceptions of the costs of and returns from the program. In this case, we expect WTP to vary directly and positively with the size of the good offered (*e.g.*, the extent of enhancement), fishing participation, income, and membership in an environmental organization. In addition to these priors, we also expect to find a direct and positive relationship between WTP and public confidence in the enhancement program. The familiarity of coastal residents in Washington and Oregon with salmon enhancement programs affords a unique significance to some of our policy variables designed to approximate public confidence. In turn, it also complicates the assessment of WTP because residents may be more likely to reject specific elements of the enhancement program. Lastly, having two different versions (high and low) of enhancement allows us to examine whether WTP is positively related to the extent and type of coho salmon enhancement. As defined, the Willapa Bay and Grays Harbor programs enable us to test whether or not the size of the salmon enhancement (*e.g.*, doubling versus quadrupling run and catch) significantly affects WTP. In addition, the Oregon estuary programs allow us to examine WTP for two fundamentally different types of enhancement programs. The low-enhancement program removes the threatened with extinction label from the local coho salmon stocks but precludes local catch of coho salmon. In contrast, the high-enhancement program removes the label and allows a moderate catch level of 100,000 fish per year. We were interested to see if the two versions used in the Oregon estuaries would speak to the relative influence of use and non-use values in motivating protection and enhancement of local coho stocks.

Variable Definition

Table 2 provides the names and definitions of the variables used to examine the WTP for local coho salmon enhancement. Table 3 presents descriptive statistics for these same variables for each of the five estuary-based samples. Particularly noteworthy demographic characteristics are the relatively advanced age of our samples (AGE) and the predominance of male respondents (MALE). Using 1997 county median income levels as a reference, high (HIGHINC) and low (LOWINC) income categories were defined as household incomes above or below $30,000.[6] We anticipate that these dummy variables will capture additional demographic variation across these groups that is not measured by our existing set of explanatory variables. On average, approximately 65% of residents had household incomes above the median county level, and 35% had household incomes falling below. Comparing the demographics of the survey respondents with those of the general population living

Table 2
Variable Names and Definitions

Name	Description	Units
VOTE	Equals 1 if YES response; 0 if NO response.	0/1 dummy
COST	Stated annual household cost.	Dollars ($)
HIGHEN	Equals 1 if high coho salmon enhancement program; 0 otherwise.	0/1 dummy
LOCSALM	Equals 1 if respondent fished for salmon or steelhead locally in 1999; 0 otherwise.	0/1 dummy
FISH	Equals 1 if respondent fished in the area in 1999; 0 otherwise.	0/1 dummy
ENVIRO	Equals 1 if respondent is a member of any conservation or environmental organization; 0 otherwise.	0/1 dummy
SPORT	Equals 1 if respondent is a member of a sporting club; 0 otherwise.	0/1 dummy
HIGHINC	Equals 1 if the respondent's household income is not below $30,000; 0 otherwise.	0/1 dummy
LOWINC	Equals 1 if the respondent's household income is below $30,000; 0 otherwise.	0/1 dummy
IMPTHR	Equals 1 if respondent ranked "too much commercial fishing" or "degraded river habitats on forest or agricultural lands" as important causes of native salmon decline; 0 otherwise.	0/1 dummy
PARTNER	Equals 1 if respondent believes that existing partnerships between government agencies and citizens (*e.g.*, watershed councils) should be the most or second most influential group in making natural resource management decisions at the county level; 0 otherwise.	0/1 dummy
STATE	Equals 1 if respondent believes the state should be the most or second most influential group in making natural resource management decisions at the county level; 0 otherwise.	0/1 dummy

[6] The 1997-model based US Census median household incomes for the counties surrounding these five bays are as follows: Grays Harbor ($31,091), Pacific ($28,131), Coos ($29,933), Tillamook ($30,713), and Lincoln (30,294). Income data were collected using categories. We used a threshold value of $30,000, since this income category was closest to the median.

Table 3
Means of Explanatory Variables

Name	Grays Harbor	Willapa Bay	Coos Bay	Tillamook Bay	Yaquina Bay
VOTE	0.51	0.52	0.40	0.44	0.52
COST	97.96	93.39	90.13	97.22	88.26
HIGHEN	0.52	0.48	0.42	0.51	0.47
LOCSALM	0.23	0.31	0.15	0.22	0.14
FISH	0.46	0.51	0.45	0.48	0.36
ENVIRO	0.11	0.10	0.09	0.14	0.07
SPORT	0.07	0.09	0.11	0.15	0.14
HIGHINC	0.68	0.64	0.56	0.68	0.70
LOWINC	0.33	0.36	0.34	0.32	0.30
IMPTHR	0.68	0.71	0.55	0.73	0.70
PARTNER	0.50	0.54	0.51	0.49	0.50
STATE	0.34	0.14	0.32	0.34	0.36
MALE	0.75	0.67	0.76	0.76	0.66
AGE	57	58	61	60	60

in these areas, there are meaningful differences.[7] Our respondents tend to be older, wealthier, better educated, and "more" retired.

Local fishing participation rates (FISH) average near 45%, and local salmon fishing participation rates (LOCSALM) are higher in the WA bays than in the OR bays, as might be expected due to the ESA listing of coho in coastal Oregon. The average membership rates in environmental (ENVIRO) and sporting (SPORT) organizations are 10% and 11%, respectively. Tillamook Bay, with approximately 15% membership rates in both types of organizations, had the highest participation rate of all five areas. Interestingly, membership rates in environmental organizations in the WA samples exceed those in sporting organizations; while the converse holds for the OR samples. The fishing participation and environmental organization membership variables are used to measure interest in and attachment to local fish and wildlife. While FISH and LOCSALM may capture motivations for use values of the local coho salmon stocks, we anticipate that ENVIRO may represent motivations for both use and nonuse values of these same stocks.

Turning to the explanatory variables that describe opinions of the merits of the enhancement programs, we observe some interesting trends across the five samples. Fairly high levels of support are expressed for local citizen and government partnerships (PARTNER) to control local natural resource management decisions.[8] Conversely, lower levels of support for state control (STATE) of local natural resource management decisions are expressed. Support for PARTNER and STATE are measures of expected public confidence in the enhancement program, as the featured programs were to be implemented by state and local governments and government-citizen partnerships.

Another measure of public confidence was created using a dummy variable describing attitudes about the causes of salmon decline. IMPTHR is equal to 1 if sport

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[7] We compared the demographics of our sample with data from the 1990 US Census. This comparison was made using zip code level data. Our sample over-represents males (actual gender distribution shows 50% male; 50% female) and older persons (above 46); under-represents younger persons (35 and under); and over-represents persons with higher educational attainment and income levels.

[8] This result may reflect approval for existing and past partnership organizations, such as the watershed councils of Oregon, the Willapa Bay Alliance, and the Tillamook Bay National Estuary Program.

fishing, commercial salmon fishing, or habitat degradation (IMPTHR) were ranked by the individual as extremely important (4 or 5 responses on a scale of 1 to 5) causes of native salmon decline in the Pacific Northwest. Overall, residents believe commercial salmon fishing and/or habitat degradation are extremely important causes of native salmon decline in the Pacific Northwest.[9] Approximately 67% of respondents in all five samples ranked at least one of these three threats as extremely important. The lack of importance awarded to excessive sport fishing may have lessened the extent to which this dummy variable proxied for public confidence, as our hypothetical program did not distinguish commercial and sport fishing when discussing the threats imposed by overfishing.

Finally, the level of enhancement program (HIGHEN) voted on is distinguished across respondents. HIGHEN is a dummy variable that equals 1 if the high-enhancement program was voted on and equals 0 otherwise. This is the variable that permits a cursory test of scope. In selecting the final set of explanatory variables, we dropped some that are commonly used in other studies of WTP because of multicollinearity, as well as the homogenous demographic nature of our samples.

Empirical Model

The linear random utility modeling specifications [refer to expression (4)] are estimated empirically using logit models, where we assume ε_j is distributed logistically (ε_{ij} are distributed extreme value) and estimate the parameters α, φ, η_H, and η_L using conventional maximum likelihood methods.[10] In the results section that follows, we begin our discussion focusing on the logit model results and conclude by examining the associated mean WTP estimates.[11] These mean WTP estimates are calculated using the deterministic portions of the functions shown in expression (5) and by applying the estimated coefficients from the empirical models to the mean values of the respondent and choice attributes.

Results

Ballot Referenda Logit Models

Tables 4 and 5 display logit model results by estuary-based sample. Responses to the high- and low-enhancement referenda are pooled.[12] The dependent variable is the voting response (YES or NO), and the set of explanatory variables is identical in all

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[9] Respondents were asked to rank the importance of several potential causes of native salmon decline using a likert scale of importance ranging from 1 to 5, where 1 represents not important and 5 indicates extremely important. The potential causes of salmon decline included: too much sport fishing for salmon; too much commercial fishing for salmon; poor ocean conditions for salmon; degraded river habitats in forest lands; degraded river habitats in farm lands; degraded marshes in the bay; water pollution in rivers and the bay; and dams on rivers. Generally, responses to the set of threat-ranking questions were similar across the five samples, with water pollution in rivers and bays, too much commercial salmon fishing, and degraded habitat ranked consistently as more important causes of salmon decline. Too much sport fishing and dams on rivers ranked consistently as less important causes of salmon decline.

[10] Probit models, which rest on the assumption that ε_j are distributed normally, were also run. There were no significant differences between the results of the logit and probit models.

[11] The mean and median willingness to pay are identical for these modeling specifications because ε is symmetric and mean zero. The WTP estimates shown in table 6 are those for the first year of payment and have not been annualized.

[12] Separate models were run using the responses to the high- and low-enhancement programs by bay. Likelihood ratio tests comparing the estimated parameters failed to reject the null hypothesis of equivalent parameter estimates across the high and low runs in all five bays.

Table 4
Local Coho Enhancement: Logit Model Results (Coastal Washington)

	Grays Harbor		Willapa Bay	
Parameter	Estimate (Ψ)	Ψ/St. Er.	Estimate (Ψ)	Ψ/St. Er.
HIGHEN	–0.0109	–0.054	–0.0176	–0.086
ENVIRO	–0.4538	–1.264	0.7262*	1.804
IMPTHR	0.3317	1.566	0.7952**	3.828
STATE	0.4511*	1.826	0.1411	0.429
PARTNER	0.2170	0.988	0.0834	0.408
LOCSALM	0.0314	0.115	–0.2051	–0.863
HIGHINC*COST	–0.0037**	–3.550	–0.0052**	–4.175
LOWINC*COST	–0.0056**	–3.228	–0.0081**	–3.947
N	357		386	
$\ln(L_U)$	–233.2081		–241.2788	
$-2[\ln(L_R) - \ln(L_U)]$	28.42		51.71	
Pseudo R^2	0.08		0.13	

Notes: The dependent variable is the binary voting response (VOTE). Ψ includes α, η, and φ. Significance at the 0.10 level (*) and 0.05 level (**).

five areas, with one exception. Local fishing participation is characterized differently across the Oregon and Washington samples. In the Washington models, LOCSALM is included as an explanatory variable and FISH is not included because the two variables were highly collinear. Because of the recent decrease in salmon fishing opportunities in coastal Oregon, we did not include LOCSALM as an explanatory variable for the three Oregon samples and used the dummy variable, FISH, in its place.

Across all areas, the parameter estimate associated with the COST variable has the expected negative sign and is highly statistically significant, indicating that the likelihood of a YES response declines with the annual household cost. In this modeling specification, the "price" response is allowed to vary across high- and low-income categories (HIGHINC*COST and LOWINC*COST). The relative size of these parameter estimates varies across communities. As might be expected, the marginal utility of income of the lower income category is consistently greater than that of the higher income category.

Membership in an environmental organization (ENVIRO) has mixed influences on voting behavior and WTP. ENVIRO has a positive and significant influence in the Willapa Bay-based sample and a negative and significant influence in the Coos Bay-based sample. In Willapa Bay, the significance of ENVIRO may be partially due to past efforts of the now defunct environmental research and educational group, the Willapa Bay Alliance. In the Coos Bay model, the negative sign of the parameter associated with ENVIRO is unexpected. However, one possible explanation of this sign is that members of environmental organizations in Coos Bay may not see the delisting of coho as threatened as desirable, especially if they regard the actions undertaken when a species is listed as beneficial to the local coastal environment.

The proxies of public confidence in the local coho enhancement programs have mixed influences on WTP. The dummy variable, IMPTHR, has a positive and statistically significant influence on acceptance of the program in the specification for Willapa Bay only. Individual attitudes towards state and local management institu-

Table 5
Local Coho Enhancement: Logit Model Results (Coastal Oregon)

	Coos Bay		Tillamook Bay		Yaquina Bay	
	Estimate (Ψ)	Ψ/St. Er.	Estimate (Ψ)	Ψ/St. Er.	Estimate (Ψ)	Ψ/St. Er.
HIGHEN	–0.1809	–0.918	0.1014	0.504	–0.0566	–0.253
ENVIRO	–0.7868**	–3.730	–0.0158	–0.073	0.2589	1.092
IMPTHR	0.1871	0.498	0.0003	0.001	–0.4474	–1.005
STATE	1.0159**	4.708	0.0904	0.381	0.4985**	2.282
PARTNER	0.1126	0.512	0.5809**	2.371	0.3002	1.272
FISH	0.1991	1.013	–0.1265	–0.574	0.4037*	1.855
HIGHINC*COST	–0.0074**	–4.522	–0.0025**	–2.328	–0.0063**	–4.616
LOWINC*COST	–0.0089**	–4.127	–0.0079**	–3.312	–0.0096**	–3.352
N	424		347		357	
$\ln(L_U)$	–252.4180		–226.4367		–222.5196	
$-2[\ln(L_R)-\ln(L_U)]$	64.55		23.32		49.53	
Pseudo R^2	0.14		0.06		0.13	

Notes: The dependent variable is the binary voting response (VOTE). Ψ includes α, η, and ϕ. Significance at the 0.10 level (*) and 0.05 level (**).

tions have stronger effects on voter support of the hypothetical coho enhancement program than opinions of threats. One of the two variables concerning the degree to which the state government (STATE) and citizen county-level partnerships (PARTNER) should be influential in making resource management decisions is significant in all cases except for Willapa Bay. In the Grays Harbor, Coos Bay, and Yaquina Bay-based models, the parameter associated with STATE is positive and significant. In the Tillamook Bay model, the parameter associated with PARTNER is positive and significant.[13] Generally, these estimates suggest that public confidence in a salmon enhancement program is inextricably linked to the WTP for such a program. This finding is intriguing and may underscore the importance of dialogue between local scientists, natural resource managers, and residents.

Surprisingly, participation in local sport fishing does not significantly affect WTP for the enhancement program in the five areas. Only in the Yaquina Bay-based model is the parameter on FISH positive and significant.

Our comparison of the low- and high-enhancement programs provides limited fodder for understanding individual perceptions of the scope or types of enhancement programs. The influence of HIGHEN is not significant in any of the specifications. Because each respondent voted on a single enhancement program, we can only test for scope by examining the influence of HIGHEN. We fail to reject the null hypothesis that the influence of HIGHEN is statistically equal to zero (at the 0.05 level). Furthermore, the influence of HIGHEN is often not the expected positive sign, and the negative parameter estimate associated with this variable results in higher mean WTP estimates for the low-enhancement program.

In retrospect, we believe that greater differences in the magnitude and types of our salmon enhancement programs would have improved our ability to explore individual perceptions of the scopes and types of programs. In the Washington samples, the differences between our high- and low-enhancement programs may simply not be large enough to distinguish the services provided by the enhancement program. In addition, it may be the case that many people will support local recovery efforts related to ESA. However, when the issue is increased harvest opportunities for the minority of people who fish salmon, many of those same people may decline to pay. If this is the case, the result is a muddied scope test because for some households, the high-enhancement program does not represent a larger public good. Similar issues arise in contrasting the levels of enhancement faced by the Oregon samples. Respondents who doubt the legal integrity of the ESA listing of the coho stock are likely to perceive little reward from enhancement efforts aimed at removing the title of threatened. Conversely, individuals who highly regard the ESA listing (and its associated actions) may perceive little reward from the removal of this title. Lastly, if WTP is largely motivated on the basis of non-use values, one might expect less sensitivity to changes in run size and harvest opportunities.

WTP Estimates

Mean annual WTP estimates are derived by evaluating the expressions shown in equation (5), employing the mean respondent attributes (refer to table 3), and distinguishing the level of enhancement program. Table 6 displays annual mean willingness to pay estimates (and their standard errors) by area. These estimates cor-

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[13] Tillamook Bay is home to a unique partnership group entitled the Tillamook Bay National Estuary Program.

respond to the payment in the first of five years. Standard errors were calculated using the delta method. When examining the estimates shown in table 6, it is important to note the differences in the local enhancement programs across the five estuaries. In addition to the distinctions between the Oregon and Washington programs, there are further differences because of unique coho baseline and demographic conditions by bay. While it may be sensible to compare the qualitative results in all five areas and perhaps the WTP estimates within state, it is not appropriate to directly compare the WTP estimates for the Oregon and Washington programs.

The Washington estuary-based samples and the Yaquina Bay-based sample provide greater insights, where the WTP estimates are positive and significantly different from zero. Mean WTP estimates in some of the Oregon estuary samples (Tillamook and Coos) are not significantly different from zero. Observing the results, higher income individuals are generally willing to pay more than lower income individuals for local coho enhancement in these areas. Furthermore, and commensurately, the expected mean willingness-to-pay estimates are not statistically different for the high- and low-enhancement programs. As noted previously, the negative parameter estimates on HIGHEN result in a mean WTP estimate for the high-enhancement program that is smaller than that for the low-enhancement program. We acknowledge the necessity of future research devoted to understanding preferences and sensitivity to run sizes to improve the assessment of WTP for salmon enhancement programs.

Table 6
Mean WTP Estimates by Estuary: Local Coho Enhancement

	Mean WTP Estimate (Std. Error)	
Estuary	High Income	Low Income
Grays Harbor, WA		
HIGH ENHANCE	116.59** (45.70)	77.00** (32.30)
LOW ENHANCE	119.54** (39.64)	78.94** (30.68)
Willapa Bay, WA		
HIGH ENHANCE	118.44 ** (35.01)	75.99** (23.14)
LOW ENHANCE	121.81** (30.33)	78.15** (23.00)
Coos Bay, OR		
HIGH ENHANCE	25.39 (24.05)	20.88 (20.11)
LOW ENHANCE	50.00** (15.52)	41.13** (14.77)
Tillamook Bay, OR		
HIGH ENHANCE	120.50* (66.62)	37.18* (22.11)
LOW ENHANCE	79.32 (55.42)	24.48 (17.65)
Yaquina Bay, OR		
HIGH ENHANCE	106.50** (28.90)	69.81** (23.98)
LOW ENHANCE	115.54 ** (27.55)	75.74** (23.05)

Notes: Standard errors were calculated using the delta method. Significance at the 0.10 level (*) and 0.05 level (**).

The mean WTP estimates are very similar in the two Washington samples. In contrast, there is much more variation when comparing the results in the three Oregon samples. Mean WTP is highest in Yaquina Bay, followed thereafter by Tillamook Bay, where the difference between mean WTP across high- and low-income groups is most pronounced. Finally, the mean WTP is consistently lowest in the Coos Bay area.

Comparing these estimates with those derived in previous studies of salmon enhancement programs, the WTP estimates derived are within range of the previous studies. Converting the Hanemann, Loomis, and Kanninen (1991) estimate to 2000 dollars yields an estimate of approximately $254 per year for California households for the enhancement of the San Joaquin River salmon populations. A similar conversion of the Olsen estimates measured in 1989 dollars to 2000 dollars yields estimates of $37.19, $82.15, and $104.04, respectively (doubling of salmon and steelhead runs in the Columbia River; 2.5 million fish). Mean estimates based on Loomis (1996) are $68.94, $85.30, and $79.45, respectively, in 2000 dollars (300,000 fish). Lastly, converting the Layton, Brown, and Plummer (1999) estimates from 1998 to 2000 dollars yields estimates of $126.57 and $265.77, respectively (1 million and 2.5 million fish). Specific comparisons of estimates are difficult because of differences in baseline conditions, as well as the nature of the enhancement program and targeted salmon species. Higher WTP estimates may be expected in the Olsen, Richards, and Scott (1991) and Layton, Brown, and Plummer (1999) studies because the enhancements involve greater increases in fish. However, as our study notes, there is considerable uncertainty regarding individual perceptions of the outcomes of salmon enhancement programs.

Conclusions

We have summarized the results of a contingent valuation survey of residents of five rural, coastal communities in the Pacific Northwest and described the willingness to pay of coastal communities for local coho salmon enhancement programs. Willingness to pay for salmon enhancement initiatives is higher when the public demonstrates confidence in the objectives of the programs and the managing institutions. The linkage between public confidence in the objectives of the program (*e.g.*, causes of salmon decline addressed) and the managing institutions is an extremely interesting result, for it underscores the importance of community outreach and education when devising salmon enhancement and protection strategies. We also find evidence that WTP for local coho enhancement is positively related to income.

We experienced several empirical problems commonly associated with survey research that necessitate further study of individual preferences concerning local salmon stocks. We recognize the limitations imposed by our survey design. Despite these problems, the statistical results presented confirm that residents of coastal communities of the Pacific Northwest are generally willing to pay for local coho salmon enhancement. In addition, the modeling results provide insights about the preferences of residents concerning salmon protection programs. We believe that the explanatory power of the enhancement program related variables (IMPTHR, STATE, PARTNER) underscores the importance of public outreach and education in devising salmon restoration and enhancement strategies. Finally, we hope that these and other findings assist local decisionmakers when making future and inevitably difficult salmon protection choices in the Pacific Northwest. Future research that directly compares the WTP for local enhancement by local residents and non-local residents may provide additional insights on how the magnitude of WTP for enhancing a particular stock varies across regions.

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