Catching catch-and-release- evidence from an Atlantic salmon recreational fishery

Jon Olaf Olaussen

Trondheim Business School

Abstract

Catch-and-release (C&R) is often regarded a win-win management tool in recreational fisheries. As long as release mortality is low, C&R may both secure sustainable fish stock and a large recreational fishing sector at the same time. Hence, apparently both the targeted fish populations and the recreational anglers are better off. However, this depends on both fish welfare assumptions as well as angler preferences. While fish welfare is widely studied, angler preferences have been ignored. The present paper presents the results from a study of angler preferences in a Norwegian recreational Atlantic salmon (*Salmo salar*) fishery. The results suggest that introducing mandatory C&R regimes may reduce the angler utility by a magnitude of up to 80% in this fishery, and hence advocates caution and surveys to be undertaken before C&R introductions.

JEL: Q26, Q22, Q21

Keywords Angler preferences, angling, catch-and-release, recreational fisheries, Salmo salar, willingness-to-pay, management.

Introduction

Recreational fishing has become increasingly important the last decades, both with respect to catch shares and economic values provided. Recreational fishing is a popular activity, and based on estimates across countries with reliable statistics, it is undertaken by 10.6 percent of the global population (Cooke and Arlinghaus 2009). Angling participation rates varies from 1 percent in some southern European Countries to 40 percent in Finland (Cooke and Cowx 2004). In many fisheries, both the catch as well as the economic importance of recreational fisheries can be greater than commercial fisheries (Fenichel et al 2012, Abbot and Wilen 2009). Using data from Canada, Cooke and Cowx (2004) estimated that the recreational fish harvest around the world may represent 12 percent of the global fish harvest. There are several case based studies on the value of recreational fishing in specific regions. For example, applying an input-output analysis, McKean et al (2011) estimated the personal income associated with the salmonid fish run in central Idaho to be $9.7 million.

In recreational fisheries, catch-and-release (C&R) refers to sport fishing where the fish is set free after being caught. From an economic point of view, C&R fishing may seem to represent a classical win-win situation. If the utility of the angling experience is mainly related to non-landing attributes of fishing, then releasing the fish, given that release mortality is low, clearly counteracts overfishing. Hence, from a biological standpoint, C&R looks preferable at first sight. However, this is given that the fish survives, and that fish welfare does not suffer. Animal welfare science is among the most comprehensive in biological sciences (Dawkins 2006). Huntingford et al (2006) presented an overview of a number of issues relating to fish welfare, for example the topic of fish welfare in C&R fisheries. Arlinghaus et al (2007a) critics Huntingford et al (2006) for taking on a feelings based approach to fish welfare. They go true the literature and argue that the scientific evidence for fish suffering is poor, and that the uncertainty regarding pain perception and suffering in fish must be acknowledged. Rose et al. (2014) add to the critics by Arlinghaus et al. (2007a) and argue that fish cannot feel pain. Pain or no pain, from an ethical point of view, it may still be argued that C&R fishing is ethically problematic because it involves playing with the animal's life. Interestingly, the various attitudes and opinions differ strikingly among different countries and fisheries. For example, due to animal welfare and ethical considerations, C&R is strictly prohibited by law in some countries (Switzerland and Germany), while in other places; there are C&R only fisheries.

In the resource economics literature, McConnell and Sutinen (1979) developed the first bioeconomic recreational fishing model. In their quite simple model, the angler demand was determined by number of trips and harvest rate. Anderson (1993) took the recreational fishing theory a great step further by developing a bioeconomic model that took some of the most important special features of recreational fishing demand into account. The main contribution was to separate between harvest rate and landings to allow for catch-and-release (C&R) fishing. While a commercial fisherman may release fish due to size regulations or catching the wrong species, a recreational angler does not necessarily value the landing part of the fishing experience at all. Abbott and Wilen (2009) developed a bioeconomic model of open access and optimal management for a for-hire recreational fishery. While building on McConnell and Sutinen (1979) and Anderson (1993), they added a realistic and flexible theory of choice inputs of the for-hire fishing firm.

C&R classification

Since Anderson (1993) introduced the topic of C&R in bioeconomic models, the issue has been more or less neglected (a noteworthy exception is Abbott and Wilen (2009)). Moreover, C&R is not a plain one-dimensional regulatory instrument, and since there are many different types of C&R, many of the most important features are still unexplored. For example, fish may be released even if the fishery is a catch only fishery. The non-selective nature of recreational angling in general, and bait fishing in specific, often calls for release of non-targeted species and fish that does not meet the size requirement, e.g. due to minimum or maximum size restrictions. Generally, we can define C&R fishing in 4 different types:

i) C&R due to angler preferences (voluntarily C&R)

ii) Strict No C&R

iii) Strict C&R only

iv) C&R due to size/type restrictions only/ C&R due to bag limit restrictions

In order to analyze these various aspects of C&R from an economic perspective, we developed a survey to capture the angler preferences with respect to C&R. This was described as one of the key research needs in Arlinghaus et al (2007b): “Information is needed on how much anglers value C&R angling, how they respond to C&R angling opportunities, and how much of their time and money they spend on C&R, opposed to other forms of recreational fishing. (p. 143).

Thus, while there is an extensive literature on fish welfare under C&R fishing, the issue of angler welfare seems to have been forgotten. There are some few exceptions that have launched ad hoc arguments of the type that C&R is important because it increases fishing opportunities overall, hence increasing the potential harvest quantity. However, no study has examined to what extent angler welfare increases due to C&R management. This question is part of a larger and highly unexploited area concerning the quality of the fishing experience. The novelty of the present study is that the angler preferences for catch-and-release are addressed and estimated directly.

Theoretical framework

The underlying main question is what drives angler utility? Since fishing permits are paid for in many recreational fisheries, this allows us to look at this utility measured in terms of money. Hence, we ask what drives the angler's willingness to pay (wtp) for fishing permits? Moreover, by asking the anglers to report their maximum willingness to pay under different scenarios, we are able to reveal how different management tools affect angler utility.

The quality aspect of the fishing experience may involve several attributes, both catch- and non-catch related. Non-catch related are typically nice surroundings, the sociability aspect, non-congested sites, while the catch related attributes include size, type, and number of fish caught (Moeller and Engelken 1972, Anderson 1983, Anderson 1993). In this study, we focus on the demand attributes most relevant for the C&R aspect of recreational fishing.

The size of the fish population is perhaps the most basic driver of demand as it directly influences the catch rate (see Anderson 1993). The first null hypotheses we want to test is therefore:

H0.1: *The wtp is not affected by the size of the fish population*

Against the alternative

H1.1: *The wtp increases in the size of the fish population*

Anglers may or may not have preferences for keeping their landings as thoroughly discussed by Anderson (1993). If they only want to keep e.g. one fish or less per angling day, a one-fish per day bag limit should not affect their utility. However, if they prefer to keep more of the catch, a one-fish bag limit would impose a restriction; hence their wtp should be lower. The second null hypothesis is therefore:

H0.2: *The wtp is not affected by a bag limit*

Against the alternative

H1.2: *The wtp decreases under a bag limit*

The same argument as for H0.2 goes for the next hypothesis. Anglers that voluntarily release all their catch are not affected by a no-keep policy, while those preferring to keep some of their catch would experience decreased angling related utility, hence the third null hypothesis is:

H0.3: *The wtp is not affected by a strict C&R management regime (Release only)*

Against the alternative

H1.3 *The wtp decreases under a strict C&R management regime (Release only)*

Several studies have found that the more frequent an angler participate in recreational fishing during a season, the more likely is he or she to practice catch-and-release (Grambsch and Fisher 1991, Graefe and Ditton 1997). A related factor was suggested by Sutton (2001), namely that more committed anglers would be more in favor of C&R. He operationalizes committed anglers to be the more experienced anglers and those where angling is more central to their lifestyle. Both these aspects should also be positively correlated with frequency of trips, and thus, the forth null hypothesis is that

H0.4: *The wtp under a C&R is not affected by the frequency of angling*

Against the alternative

H1.4 *The wtp under C&R are higher for frequent anglers*

The ultimate purpose of releasing fish is to secure future fish populations. In fact, in a study of Australian anglers in 2002, 95% believed that releasing fish benefitted the fish stock. The preservation of healthy fish stocks was suggested to be more important for specialized or more experienced anglers by Bryan (1977). We formulate the fifth null hypothesis to test for the concern about the fish stock:

H0.5: *The wtp under C&R regimes is not affected by to what extent anglers are concerned about the fish population*

Against the alternative

H1.5: *The wtp under C&R regimes is higher for anglers that are concerned about the fish population.*

The survey

The survey was undertaken in Norway during fall 2013, just after the fishing season ended. Anglers were recruited randomly from catch registers from 16 salmon rivers in Norway during the 2013 fishing season. 244 respondents >18 years out of 392 responded after two reminders (62% response rate). Documentation, together with the full questionnaire, is given in Olaussen (2013).

The questions asked in the survey and the response categories are presented in Table 1 together with variable names. Each respondent was asked 11 questions altogether. The first five questions regard maximum willingness to pay (wtp) under different scenarios. Responses are given by marking which payment interval their wtp lies in. Then follows two questions about how frequent they normally do salmon angling, and what type of gear they typically use. Next, the anglers were asked about whether or not they were concerned about the future of the wild Atlantic salmon stock. Finally, we asked about some background statistics like gender, age, and household income.

Table 1 about here

Statistical treatment and analysis

The questionnaire form requested estimates for wtp data in bands, e.g., NOK 1–199, 200–399, …, NOK 1000-1199, 1200 or more (NOK 1=0.17 USD, March 2014). Respondents were then asked to choose the band that best represented their maximum wtp value. Since the true amount lies between the amount lower and upper band, these wtp responses define intervals. There are several ways to proceed when estimating average numbers from such data. One option is to use the midpoint of each interval, meaning that all respondents choosing the NOK 400–599 interval are registered as choosing NOK 500 and so one. This method provides a correct estimate if, and only if, the true amounts are uniformly distributed over the interval. It is well known that this is a somewhat ad hoc method since the real underlying values are unknown and since it is far from obvious that they are uniformly distributed over the whole range of the interval (Stewart 1983).

A more robust option is therefore to run a grouped data regression model. The dependent variable is a latent variable as the actual wtp amounts are not directly observable. This means that the observed information about the dependent variable that we utilize is that it falls within a certain interval of the underlying real line. The real line is divided into M (m=1…M) mutually exclusive and exhaustive intervals, the m-th being given by (A_{m-1}, A_m). In addition, the data is right-censored due to open-ended upper interval, that is $A_M=\infty$ (e.g., the more than NOK 1200 interval). By utilizing the information on which of these intervals the dependent variable falls into, such latent dependent variable models can be estimated by grouped data regression (Stewart 1983). Stewart (1983) developed a least squares algorithm to attain the maximum likelihood estimator and combined this with a moment estimator of the OLS regressors in what he referred to as a two-step estimator. It was demonstrated that the procedure allowed consistent and efficient parameter estimates in the case of grouped dependent variables. This procedure later came to be known as the grouped data regression model. In the STATA/IC 10 program package, it is known as interval regression and found under the censored regression routine. Hence, instead of assuming that the true amounts are uniformly distributed over the whole range of each interval and apply the midpoint of each interval when estimating mean wtp values, the values are simply estimated by running the grouped regression with a constant term only. As it turned out, the results came out very close to the results when using midpoints only (less than 1% difference for all values), indicating that the uniform distribution of responses at each interval seems to hold. Note that the frequency of fishing trips is also answered within intervals, and hence the same method was applied for the *freq* variable.

For the multivariate regressions, we ran both grouped data regressions and regressions based on midpoint values. As for the mean value estimates, the differences seem to be quite small (less than 1%), and hence the results presented are the regressions based on midpoint values. The advantage with these regressions is that we are able to test for heteroscedasticity and multicollinearity directly, as well to get the adjusted R-squared calculated.

Results

Descriptive statistics

The descriptive statistics are reported in Table 1. The mean maximum willingness to pay for salmon fishing permits in the current situation and with no catch restrictions is about NOK 763. When asked about the wtp if the salmon stock was twice the current level, the average maximum wtp increased to NOK 955, hence an increase of about 25 percent. On the other hand, if a bag limit of one salmon per day is imposed, the mean wtp decreases to NOK 507, a decrease of about 33 percent. Further, imposing a no-keep regime (release all) reduces the mean wtp to NOK 160, a decrease by 79 percent from the unrestricted case. Finally, the mean wtp when only the largest salmon (the three-sea-winter salmon) must be released is NOK 317, about 59 percent below the unrestricted wtp amount.

The mean frequency of salmon angling per season among the anglers is 6.9. The average level of concern for the salmon population on the 1-5 scale is 3.8 (4= agree that the salmon stock is threatened). 36 percent of the anglers report that they mainly use fly rod when they fish salmon, and only 11 percent of the anglers are females. Further, the average age is about 44 and the average total household income is almost NOK 700 000. Based on comparison of this background statistics with earlier surveys on salmon anglers in Norway, it seems like the respondents are quite representative for the angling community. For example, in a survey from 2005, the mean angling frequency was 7.4, average age 44, and the net yearly income was NOK 624 000 (Olaussen 2010).

Multivariate statistics

Before trying to explain the wtp under different scenarios, the hypotheses proposed in the theoretical section above may be tested by simple t-tests. First, running a two-group mean-comparison test on *Wtp1* (baseline wtp) versus *WtpD* (wtp if stock is doubled), we find the mean difference of NOK -192 to be statistically significant at the 1 percent level (t-value=-5.42, df 242). This means that we are able to reject the first null hypothesis that the wtp is not increasing in the population level. Next, the difference between the mean *Wtp1* and the mean *WtpB* (wtp under a 1 salmon per day bag limit) is also statistically significant with t-value of 7.21(df =242, and p=0.000). Hence, we also reject the second null hypothesis that the bag limit does not reduce the wtp. Since the mean value differences are even larger for the release all (WtpRa) (strict C&R) and the release all large (*WtpRl*) salmon, we also reject the null hypotheses that releasing all or releasing large salmon does not affect the wtp. Next, the fourth null hypothesis is that more frequent anglers have the same wtp for C&R fishing as the less frequent anglers. This null hypothesis is not rejected. In fact, even if the t-test finds more frequent anglers to be willing to pay significantly more in the unrestricted case (p=0.002), the increased population scenario (p=0.023), and under the bag limit(p=0.000), we find no significant difference under the release all (p=0.385) and the release all large salmon situations (p=0.467). Finally, the fifth null hypothesis is that the more concerned anglers (about the salmon population) have the same wtp for C&R as less concerned anglers. This null hypothesis is rejected as the wtp for the concerned anglers are on average much higher (p=0.000).

What drives willingness to pay?

To get an understanding of the overall effect of different scenarios on the wtp for salmon angling, and to what extent the results from the t-tests hold when controlling for additional factors, several multiple regression models were ran. Tables 2-6 present the results where the wtp under different scenarios are dependent variables. First, Table 2 presents a model where the unrestricted wtp (*Wtp1*) is estimated. The significant independent variables are *Freq*, *Worried* and *Inc*, all with $p<0.05$. The coefficient on *Freq* is 18, meaning that anglers spending on average one more angling day per season on average are willing to pay NOK 18 more per permit. Moreover, an angler that "strongly agree" with the concern about salmon statement will on average be willing to pay NOK 97 more than an angler reporting to "agree". Finally, increasing the income with NOK 1000 increases the average wtp by NOK 0.3. Altogether, the explanatory variables explain about 45 percent of the variation in the unrestricted wtp (adjusted R-squared=0.45).

Table 2 about here

Moving to model 2 in Table 3 where the wtp under the release all regime (*WtpRa*) is estimated, *Worried* and *Inc* are still significant and of about the same magnitude, while *Freq* is not significant. However, *Gender* and *Age* are now significant at the 10 percent level. Males are on average willing to pay NOK 121 less than females while each year older the respondents are decreases the wtp by NOK 3.83. The adjusted R-squared is 0.42, meaning that the explanatory variables explains about 42% of the variation in *WtpRa*.

Table 3 about here

In model 3 (Table 4) the wtp under the release all of the largest year class (*WtpRl*) is estimated, and here *Worried*, *Age* and *Inc* are all significant, with the same size and of about the same magnitude as in the previous models. In this case, the model explains as much as fifty percent of the variation in the *WtpRl* variable. Again, neither gear type nor frequency of angling seem to play a role.

Table 4 about here

Table 5 and 6 presents wtp models for a bag limit of one salmon per day and a twice as high salmon stock, respectively. In the bag limit case (*WtpB*), the adjusted R-squared is 0.73, and with *Gender* as the only insignificant explanatory variable. The main difference here is that *Gear* type seems to play a major role and where fly rod anglers on average report a NOK 120 higher wtp than others. In the twice as high stock scenario (*WtpD*), only *Worried* and *Inc* are significant independent variables. As a consequence, the adjusted R-squared is reduced to 0.21.

Table 5 and 6 about here

Robustness

The data shows no sign of multicollinearity, with a mean VIF of 1.66, ranging from 2.31 (*Freq*) to 1.10 (*Worried*). As for heteroscedasticity, the Breusch-Pagan test rejected heteroscedasticity in all models. However, the White test indicated heteroscedasticity for all of the models except *WtpBl*, and hence robust standard errors (heteroscedastisticy consistent standard errors) were estimated in the other models. As mentioned, the models were also run with grouped data regression, but since the results more or less coincided with the results presented, and since the robustness tests are applicable under ordinary least squares, these results are left out. Finally, since the *Worried* variable is measured at an ordinal scale, all models were run with ordered logistic regression as well. The results became identical with the ordinary least squares regressions presented in the sense that the same hypothesis holds and at the same significance levels.

Discussion and concluding remarks

The results presented above shows that C&R clearly may impact the utility of anglers in a negative way in the Norwegian Atlantic salmon recreational fishery. Moving from an unrestricted catch case to a strict C&R regime reduces the maximum willingness to pay with almost eighty percent. Even if an introduction of C&R increases the fish population significantly and thereby increases the catch rate in the rivers, it seems unlikely that it will mitigate the direct negative effect on angler utility. The policy implications of the results are, however, not straightforward. Do our results mean that the policy advice should be not to implement C&R in this fishery? Not necessarily. First, we only have cross section data. It may very well be that angler preferences changes over time. For example, if C&R is implemented, anglers may find this to be a good regulatory tool as soon as they get used to it. Another related topic is that of selectivity. What if these anglers are those who do not like C&R fishing and therefore are fishing in Norwegian salmon rivers where they do not have to release fish? We have partly controlled for this problem by excluding foreign anglers from the respondent group. Although some Norwegian anglers also goes abroad and fish, and if this is those that are most in favor of C&R, this could potentially affect the results. However, based on the quite low rate of anglers going abroad to fish in the summer, we do not think this is likely to bias the respondent group.

If the manager in a given fishery wants to implement C&R, the present survey provides a clear cut advice as to how to improve the reception in the angler community. If the implementation is communicated closely in association with information about concerns about the fish stock, and explaining why C&R may help the stock, the anglers may be more supportive. Somehow surprising, we did not find support for earlier findings that the more frequent anglers were more in favor of C&R. We found however, to some extent that age affected wtp for C&R in a negative way, and this indicate that reaching out with information to the older group of anglers may help too.

Even if C&R does not seem particularly promising in the Norwegian Atlantic Salmon fishery, this does not mean that it may not be a good idea in other fisheries that currently has not yet implemented C&R. However, the results justify that surveys on angler preferences are undertaken before C&R is introduced as it is far from clear from an economic perspective that the win-win necessarily occurs. Neither does the "wordwide" success of C&R management necessarily secure that angler welfare is maximized, as it may be that selection has taken place, so that only those in favor of C&R have remained fishing. To what extent such selection is present should be addressed in future research, as the welfare and management implications may be substantial. Irrespective of the results of such selection studies, the main message from this survey is simpler: One should consider angler welfare, not only fish welfare when C&R management is considered.

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Table 1. Variable names, descriptions and descriptive statistics

Variable	Question[1]	Response categories	Mean[2]	St.E	N
Wtp1	What is your maximum wtp for a one day fishing permit if there are no bag limit in the river?	0, 1-199, 200-399, 400-599, 600-799, 800-999, 1000-1199, more than 1200	762.98	24.63	244
WtpD	What is your maximum wtp for a one day fishing permit if there are no bag limit in the river and the fish stock is twice as large as the present?	0, 1-199, 200-399, 400-599, 600-799, 800-999, 1000-1199, more than 1200	954.95	25.37	244
WtpB	What is your maximum wtp for a one day fishing permit if there are a bag limit of 1 per day?	0, 1-199, 200-399, 400-599, 600-799, 800-999, 1000-1199, more than 1200	506.53	25.28	244
WtpRa	What is your maximum wtp for a one day fishing permit if all fish must be released?	0, 1-199, 200-399, 400-599, 600-799, 800-999, 1000-1199, more than 1200	160.41	24.90	244
WtpRl	What is your maximum wtp for a one day fishing permit if all big salmon (>7kg) must be released?	0, 1-199, 200-399, 400-599, 600-799, 800-999, 1000-1199, more than 1200	316.89	27.71	244
Freq	How many times do you usually fish salmon per season?	0, 1-3,4-6,7-9,10-12, more than 12	6.90	0.32	244
Worried	To which degree to you agree with the following statement: The Norwegian salmon population is threatened	1=strongly disagree, 2=disagree, 3=neither/nor, 4=agree, 5=strongly agree, 6:not sure/don't know	3.80	0.11	244
Gear	What type of fishing gear do you most often use?	1=fly rod, 2=other	1.64	0.04	244
Gender	Are you male or female?	0=Female, 1=Male	0.89	0.03	242
Age	What is your age?		43.93	1.11	244
Inc	What is your household's yearly total gross income?	(in nearest 50,000)	694.07	29.58	236

[1] Translated from Norwegian
[2] Calculated with grouped data regression

Table 2. Model 1. Willingness to pay (*Wtp1*) for salmon angling.

The dependent variable in the regression is the maximum willingness to pay for a one day salmon fishing permit when catch is not restricted. The *Freq* variable is the frequency of salmon angling, *Gear* is a dummy for fly rod versus other fishing gear, *Worried* is the concern for salmon stock variable, *Gender* is a dummy for male anglers, *Age* is the respondent age measured in years, and *Inc* is yearly household income measured in NOK 1000.[3]

Wtp1	Coef.	Robust HC3 Std. Err.	t	P>|t|	[95% Conf.	Interval]
Freq	18.45893	6.744611	2.74	0.007	5.092692	31.82516
Gear	-50.55398	64.07314	-0.79	0.432	-177.5319	76.42394
Worried	96.64946	16.69592	5.79	0.000	63.56206	129.7369
Gender	32.67329	84.36118	0.39	0.699	-134.5108	199.8573
Age	-1.165006	2.070598	-0.56	0.575	-5.268445	2.938433
Inc	.2988613	.0818726	3.65	0.000	.1366091	.4611135
_cons	167.334	202.1887	0.83	0.410	-233.3565	568.0245

[3] Adjusted R-squared=0.45.

Table 3. Model 2. Willingness to pay in a release all (*WtpRa*) salmon fishery*

The dependent variable in the regression is the maximum willingness to pay for a one day salmon fishing permit under a strict C&R regime. The *Freq* variable is the frequency of salmon angling, *Gear* is a dummy for fly rod versus other fishing gear, *Worried* is the concern for salmon stock variable, *Gender* is a dummy for male anglers, *Age* is the respondent age measured in years, and *Inc* is yearly household income measured in NOK 1000.[4]

WtpRa	Coef.	Robust HC3 Std. Err.	t	P>|t|	[95% Conf.	Interval]
Freq	-.5087299	6.324667	-0.08	0.936	-13.04274	12.02528
Gear	-86.00069	63.68247	-1.35	0.180	-212.2044	40.20302
Worried	115.5137	18.80262	6.14	0.000	78.25127	152.776
Gender	-121.123	65.9773	-1.84	0.069	-251.8746	9.628497
Age	-3.829609	2.295315	-1.67	0.098	-8.378385	.7191667
Inc	.2510247	.0986644	2.54	0.012	.0554949	.4465544
_cons	-32.9945	155.0446	-0.21	0.832	-340.2566	274.2676

[4] Adjusted R-squared = 0.42.

Table 4. Model 3. Willingness to pay when all of the largest salmon group (>7kg) must be released (*WtpRl*)

The dependent variable in the regression is the maximum willingness to pay for a one day salmon fishing permit when all of the largest salmon group must be released. The *Freq* variable is the frequency of salmon angling, *Gear* is a dummy for fly rod versus other fishing gear, *Worried* is the concern for salmon stock variable, *Gender* is a dummy for male anglers, *Age* is the respondent age measured in years, and *Inc* is yearly household income measured in NOK 1000.[5]

WtpRl	Coef.	Robust HC3 Std. Err.	t	P>|t|	[95% Conf.	Interval]
Freq	1.158888	6.920161	0.17	0.867	-12.55525	14.87302
Gear	-51.73786	54.92628	-0.94	0.348	-160.5888	57.11313
Worried	145.5662	15.18508	9.59	0.000	115.4729	175.6595
Gender	-46.32254	41.86766	-1.11	0.271	-129.2944	36.64934
Age	-4.621348	2.132252	-2.17	0.032	-8.84697	-.3957258
Inc	.4169277	.0811376	5.14	0.000	.2561321	.5777233
_cons	-202.282	170.6487	-1.19	0.238	-540.4677	135.9037

[5] Adjusted R-squared = 0.58.

Table 5. Model 4. Willingness to pay under a one salmon per day bag limit (*WtpB*)

The dependent variable in the regression is the maximum willingness to pay for a one day salmon fishing permit under a one fish per day bag limit. The *Freq* variable is the frequency of salmon angling, *Gear* is a dummy for fly rod versus other fishing gear, *Worried* is the concern for salmon stock variable, *Gender* is a dummy for male anglers, *Age* is the respondent age measured in years, and *Inc* is yearly household income measured in NOK 1000.[6]

WtpB	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Freq	24.85512	5.687588	4.37	0.000	13.58366	36.12659
Gear	-120.2694	43.60882	-2.76	0.007	-206.6918	-33.84693
Worried	120.5563	12.14982	9.92	0.000	96.47823	144.6344
Gender	-42.67845	49.45911	-0.86	0.390	-140.6948	55.33791
Age	-3.623608	1.494714	-2.42	0.017	-6.585779	-.6614362
Inc	.3749351	.0537862	6.97	0.000	.2683435	.4815267
_cons	15.32781	123.8082	0.12	0.902	-230.031	260.6867

[6] Adjusted R-squared =0.72

Table 6. Model 5. Willingness to pay when the salmon population is doubled (*WtpD*)

The dependent variable in the regression is the maximum willingness to pay for a one day salmon fishing permit if the salmon population is twice as high. The *Freq* variable is the frequency of salmon angling, *Gear* is a dummy for fly rod versus other fishing gear, *Worried* is the concern for salmon stock variable, *Gender* is a dummy for male anglers, *Age* is the respondent age measured in years, and *Inc* is yearly household income measured in NOK 1000.[7]

WtpD	Coef.	Robust HC3 Std. Err.	t	P>|t|	[95% Conf.	Interval]
Freq	8.934009	8.376375	1.07	0.289	-7.666	25.53402
Gear	-86.81538	71.66449	-1.21	0.228	-228.8376	55.20682
Worried	60.92008	23.7411	2.57	0.012	13.87079	107.9694
Gender	10.43884	89.01377	0.12	0.907	-165.9656	186.8432
Age	-1.315734	2.580921	-0.51	0.611	-6.430514	3.799047
Inc	.1946853	.0970217	2.01	0.047	.002411	.3869596
_cons	707.3839	211.9951	3.34	0.001	287.2593	1127.508

[7] Adjusted R-squared = 0.21