Gone fishing:

The value of recreational fishing in Sweden

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Abstract

Data from a unique nationwide recreational fishing survey in Sweden is used to estimate benefits of recreational fishing in Sweden, differences between regions and age groups, and how they relate to expected catch. The data targets the whole Swedish population, and as a consequence a large fraction of zero fishing days exists in the sample. To consider this, a zero-inflated Poisson model was used. Swedes fished around 16 million days in 2013, of which two-thirds was spent on inland fishing, and one third was spent on marine and costal fishing. Expected consumer surplus per fishing day vary over the season, from about SEK 23 for winter fishing, to SEK 148 for summer fishing. The highest consumer surplus values are found among the youngest and the oldest age groups that were surveyed. Expected catch is an important determinant for number of fishing days, but catch increases mainly influence summer fishing.

Keywords: Consumer surplus, Recreational fishing, TCM, ZIP-model

JEL classifications: Q22, Q26, Q51

1. Introduction

There is a substantial interest in recreational fishing in Sweden. More than a million Swedes engage in recreational fishing at some time during the year (Board of Fisheries, 2008). One of the reasons is of course the natural conditions in the country, with nearly 100 000 lakes, tens of thousands of kilometers of rivers and a long coastline from the Norwegian border in the west to the Finnish border in the east. As this study will show based on survey data, the interest in recreational fishing in Sweden is high; the estimated total number of fishing days is approximately 15.9 million.

Nature-based recreational activities like recreational fishing have proven health effects (e.g. Jensen, 2008). Being a nature-based recreational activity recreational fishing has great potential to contribute to improved health and bestows course great quality of life and joy for the practitioners. In general, it seems Swedish anglers take advantage of the catch to a large extent, upwards of 90 percent (Cooke & Cowx, 2004). Recreational fishing is conducted mainly by men, and most of the fishing is done with hand tools. Only one-fifth of the fish is caught using quantity-catching gear, i.e. nets, cages, fish traps, or pots, and most people who use these tools also use hand tools. In terms of the catch it accounts for about 60 percent, while the remainder consists of quantity-catching gear. Furthermore, about half of the fish is caught in the sea, while the rest is caught in lakes or rivers.

The main purpose of this study is to estimate the value of recreational fishing in Sweden, how this value differs between regions, and how it is related to fishing quality in terms of expected catch. To do this, data from a unique nationwide recreational fishing survey is used. The survey, which since 2013 is done by Statistics Sweden, is primarily used by the Swedish Agency for Marine and Water Management (SwAM) to gather information about the scope and value of recreational fishing in Sweden. As such it will serve as important information for long-term and sustainable management of fish resources.

Given the objectives with the study, there are two main challenges related to the data that is used. The first follows from the nature of the survey. The survey targets the whole Swedish population, which means that a very large share of the respondents has not been fishing at all during the period under consideration. As a result, there is a large fraction of zero fishing days in the sample, which may lead biased estimates if a standard econometric model is used. The second challenge stems from the fact that the survey does not contain any information about the quality of the fishing sites. To overcome the latter a model for estimating the expected catch per unit of effort is developed, which then is used in the demand function for recreational fishing. It should be noted that given the unique nature of the data set, no similar national estimates have been presented for Sweden to this date.

Recreational fishing is here meant to imply all fishing activities which are not conducted for the commercial market. The main purpose is recreation and/or consumption of the catch in the household. Recreational fishing can be conducted as fishing tourism, which means that fishers travel to a place outside their usual environment or uses the services of fishing tourism companies.

The paper is structured as follows. Section 2 provides a short description of the Recreation Fishing Survey that is the basis for this study. Section 3 briefly presents the economic framework for the valuation model used, as well as the econometric modeling considerations that has to be considered given the specific data. The following section describes the econometric modeling considerations, and also present the specification of the econometric model use in this paper. The results are presented in Section 6. Finally, the paper ends with conclusions and ideas on how to further develop the use of this survey.

2. The Recreational Fishing Survey

The data used in this study is taken from a unique Swedish Recreational Fishing Survey that started 2013 under the auspices of the SwAM. The basic motivation behind the survey was, and is, to gather information about fishing habits in Sweden, and how these may change over time.

The survey collects information about the magnitude of recreational fishing in Sweden and targets the whole Swedish population, not just fishers. This sampling procedure thus makes the sample representative of the Swedish population between the ages of 15-79 years. The collection of data is done through questionnaires distributed by mail three times a year. In the first round, which concerns recreational fishing during the period from January to April, 2500 questionnaires are sent out. The second round consists of 5000 questionnaires concerning recreational fishing during the period from May to August. Finally, there is a third mailing of the 2500 questionnaires which will collect information about recreational fishing during the period from September to December. Sampling, distribution of the survey, collection, verification, follow-ups and compilation of the source data set is done by Statistics Sweden.

The survey provides the data necessary for a valuation of recreational fishing using individual data based travel cost methods and/or random utility models. The analysis in this study is the first attempt to use these data for estimating the value of recreational fishing in Sweden.

The data for the empirical model used the compilation of the source data that Statistics Sweden collected for the survey in 2013. The data contains a total of 5414 observations with all three rounds of questionnaires included. This corresponds to a response rate of 54 percent. This survey includes questions about where, when, how the respondents have fished, how many fish that have been caught and what species. Hence, the data contain individual information on the number of recreational fishing days, individual costs incurred when fishing, including costs for fees, equipment, petrol, capital investments such as boats etc. The respondent also reports catch data divided into different geographic areas, species and equipment respectively. In addition, socio-economic information, such as age, gender, income, place of residence, are matched by Statistics Sweden and included in the data.

3. Economic framework and econometric model

3.1 Modelling

The point of departure in measuring the values attached to recreational fishing is a utilitarian perspective. In the utilitarian context, individuals (including fishers) are assumed to maximize utility derived from the consumption of a variety of goods, services, etc. Recreational fishing is partly handled as an ecosystem service, or good, meaning that there are typically both market and non-market values attached to the activity. Ideally, the demand function for recreational fishing activities would give information on all the attached values. Some of the goods attached to recreational fishing are however not bought on regular markets and there is therefore no observable market price that can be used to assess its value. Instead, other methods are required. One of the most common methods is the travel cost method (TCM) which is based on real choices of, in this case, potential anglers and the costs associated with the fishing activity. The intuition is that preferences for angling are reflected in their choice of whether to go fishing or not. Their choice will in turn depend on their preferences for fishing, the quality of the fishing sites in their choice set, and the cost associated with each choice. Given this knowledge a demand function for recreational fishing can, in principle, be derived.

More formally this can be expressed as a utility maximization problem, where an individual maximizes utility, u, originating from fishing, ω, and consuming a composite market good, z, subject to a budget constraint, i.e.:

$$\max u(\omega, z|a, s) \quad \text{subject to} \quad p\omega + bz = y \tag{1}$$

where a is a vector of fishing site characteristics and s is a vector of individual characteristics. In the budget constraint, p is the price/cost of the fishing activity, b is the market price of the composite good and y is the individual income.

Solving this maximization problem gives us the indirect utility function as:

$$v = v(p, b, y; a, s) \tag{2}$$

From this utility maximization, the demand (Marshallian) for days of recreational fishing is, by the use of Roy's identity, derived as

$$\omega = f(p, b, y; a, s) = -v_p(p, b, y; a, s)/v_y(p, b, y; a, s) \tag{3}$$

This implies that demand for fishing, in this case the number of fishing days, is a function of the cost of a fishing activity, the price of the composite good, and income, but also on other factors such as site- and individual angler characteristics. In principle, the value of recreational fishing, in terms of consumer surplus (CS), is found by integrating the demand function above the price. Data on fishing activity, costs, prices, income, as well as site characteristics, and a functional form for the demand function in (3) will then be sufficient for estimating the demand function, and hence CS.

As mentioned, the dependent variable is number of fishing days, which is a non-negative integer number. This implies use of statistical models that consider the integer qualities of the data, so called count data models (Phaneuf & Smith, 2005). The Poisson distribution is the basis of count data model in this study (cf. Phaneuf & Smith, 2005). Furthermore, since the sample can be seen as an off-site sampling, each respondent's choice can be thought of as a two-step process. The first step reflects the decision to take a recreational fishing trip or not, i.e. a binary choice, while the second step concerns the decision of how many trips to take during the time period in question. In principle then, the first step can be modelled as a bivariate choice model, and the second as a Poisson model. An additional issue, related to the off-site nature of how the data are collected, which has to be considered concerns the interpretation of zero-trip observations in the data. The reason is that not only active recreational fishers are surveyed, but also non-fishers. Because of this it is not known if a zero trip observation is because the respondent is a non-fisher, or if he/she is a fisher but did not fish that particular period. Related to this is also the fact that the most common observation of fishing days is zero, i.e. the individual has not been fishing at all. For the 2013 survey approximately 90% of the respondents in the survey reported zero fishing days during the period under consideration. In other words, the distribution of fishing day count data was severely skewed. To take both these issues into account, a so-called zero-inflated Poisson model (ZIP model) is used, which is particularly suitable when facing a random event that includes a surplus of "zero" observations (Zuur *et al*., 2009).

The two-step choice process described above requires an econometric model that can characterize this type of decision. ZIP models consist of two components corresponding to two zero-generating processes (Lambert 1992). The first process is controlled by a binary distribution that generates "structural" zeros, in this case non-fishers. The second process is controlled by a Poisson distribution, which generates integers, some of which may be zero (Zuur *et al*., 2009). Intuitively, one can understand this as follows: the structural zeros are observations of people who are not recreational fishers, while the zeros that are governed by the Poisson distribution are observations of people who are fishers, but who did not fish during the period examined.

To summarize, the first process in the ZIP model is estimated using a logit model, while the second is estimated with a Poisson model adjusted by the result from the logit model, as shown by equations (4) and (5) below:

$$Pr(\omega_j = 0) = \pi + (1 - \pi)e^{-\lambda_j} \tag{4}$$

$$Pr(\omega_j = h_j) = (1 - \pi)\frac{\lambda_j^{h_j} e^{-\lambda_j}}{h_j!}, h_j \geq 1 \tag{5}$$

where ω_j is an integer number (number of fishing days for individual j) larger than or equal to zero, i.e. 0, 1, 2, etc. λ_j is the expected number of fishing days for individual j, and π is the probability that the observed zero is the result of not being a fisherman. Then, to explain the variation in the number of fishing days, ω_j, given the Poisson distribution, the following model was used; $\lambda_j = exp(\boldsymbol{\gamma}'\mathbf{x}_j)$ where $\boldsymbol{\gamma}$ is a vector of parameters to be estimated, and $\mathbf{x}$ is a vector of explanatory variables for individual j.

Given equation (4) and (5) and the specific functional form for λ, the per-fishing day consumer surplus can be expressed as[1]:

$$CS = -\frac{1}{\gamma_k}(1 - \pi) \tag{6}$$

where γ_k is the estimated cost coefficient in the model for explaining number of fishing days.

The explanatory variables, vector **x**, in the model above are socio-economic descriptions of each of recreational fishers, as well as costs of fishing per fishing day for the recreational fishers. Data for fishing site quality is however missing, which is a drawback considering that the quality of fishing probably is an important factor when making the decision to go fishing or not. A natural choice of variable describing fishing quality would be the expected catch per fishing trip, which do not exist in the data set. However, data on actual catch per fishing trip exists, which means that it is possible to estimate the expected catch per trip as a function of individual characteristics, as well as where they go fishing.

Denoting the total catch of all species per fishing day for each respondent and fishing season by F_i, respectively, the equation for the expected catch per fishing day for individual i can be written as:

$$F_i = c + \sum_{j=1}^{j-1} d_j \times AREA_j + e_i \tag{7}$$

[1] See e.g. Bilgic & Flowkowski (2007) who calculate consumer surplus estimates based on a hurdle negative binomial count data model applied to bass fishing.

where i = 1,…, n = number of individuals, j = 1,…, J = areas, and $AREA_j$ is a dummy variable that takes the value 1 if individual i has fished in area j, and zero otherwise. e_i is a random term with the expected value zero. Equation (7) is estimated using the familiar Tobit-specification, because the zero-observations can be interpreted as either an outcome of not fishing or the outcome of fishing but no catch at all. Equation (7) can then be used to calculate the expected catch per unit of effort, FF_i, for individuals included in the data (see equation (8)).

$$FF_i = \hat{c} + \sum_{j=1}^{j-1} \hat{d}_j \times AREA_j \tag{8}$$

where $\hat{c}$ and $\hat{d}$ are the estimated parameters in the model. Worth noting is that FF, the expected catch per unit of effort, is not assumed to be due to individual specific factors, but only depend on where the fishing takes place. This means that if all the individuals fished in the same area they would all have the same expected catch. But since they fish in different areas, and in many instances in several areas, there will be a variation over the individuals in terms of expected catch. Of course, this method is a simplified way to obtain a measure of the expected catch per unit of effort. One could argue that expected catch per unit of effort should also depend on the fishing skills on the individual fishers. However, from a modelling point of view it was decided to include the individual specific factors in the demand function rather than in the expected catch function, as using these factors as explanatory variables in both equations will result in biased estimates of the coefficients.

3.2 Empirical models

Based on the data the econometric model was specified using the number of fishing days during the period, respectively, and using the explanatory variables presented in Table 1 below. Note that the model was estimated for each fishing season respectively. There are no "rules" on how to specify the variables included in the two "estimation-steps" described above. However, to avoid collinearity the variables "Earned income" and "Expected total catch" were excluded from the logit model. The model was estimated using Limdep 9.0.

To the variable "Expenditure per fishing day" a time cost amounting to 30% of the individual's income (before tax) per day (calculated on the assumption of 225 working days per year) was added. An increased cost is expected to reduce demand for fishing days. A negative sign of the coefficient for this variable was therefore expected. The variable “Expected total catch per fishing day”, which is estimated using the catch equation (7) above, is expected to have a positive effect, as an increase in the expected catch should increase interest in recreational fishing in general.[2] Assuming that recreational fishing is a normal good, the sign of the variable “Household income” can be expected to be positive. For other socioeconomic explanatory variables the anticipated signs are a little more difficult to predict. Finally, the variable "Total distance traveled for fishing during the period", is worth an additional comment. The experience gained from using the data material suggests that the survey question to measure the travel costs may contain systematic biases. We suspect for instance that travel with one’s own car may be undervalued. We have therefore chosen to include this variable in the model. Note also that the catch-equations as well as the ZIP-model is estimated for each fishing season respectively, because the circumstances surrounding fishing are so very different between the seasons.

Finally, the results from the ZIP-model are used to calculate the consumer surplus per fishing day. Here consumer surplus is defined in the traditional way as the difference between the recreational fishers’ maximum willingness to pay (WTP) for a day of fishing, and what they actually pay or spend on their fishing. It means that the consumer surplus can be interpreted as the value added to experience of using time and resources to go fishing. The consumer surplus is important to study because the consumer surplus plus the total expenditure gives us the total value of fishing in a specific area for the consumers (citizens).

Using the results from estimating equation (8) for each season, respectively, the expected consumer surplus per season and fishing day using equation (4) can be calculated as described above.

4. Results

4.1 Demand equations, overall mean estimates and effects of changes in expected catch

Table 1, below, presents the results from the estimation of the ZIP models. The equation for “fishers” is determined based on the Poisson model explained previously, while the equation for “participants” is estimated using a logit model. We have chosen to show all results, but will

[2] See Appendix for a presentation of the specification and estimation results from the catch equations (7).

only comment on the equations for “fishers”. This is because we are particularly interested in the estimates from these equations as they form the basis for the consumer surplus calculations.

Table 1. Estimates of the expected number of recreational fishing days for all three periods respectively. The table also reports the mean of the variables included in the model.

Zero-inflated-Poisson model	Jan-Apr		May-Aug		*Sep-Dec*	
Dependent variable	*Mean*	*Coeff. (t-value)*	*Mean*	*Coeff. (t-value)*	*Mean*	*Coeff. (t-value)*
Number of fishing days during the period	0.594		2.883		1.378	
Independent variables						
Fishers						
Constant		–0.774		1.472		1.029
		(–2.30)		(60.56)		(21.10)
Variable expenditure per day, 1000s of SEK	0.468	–1.072	0.778	–0.747	0.767	–0.435
		(–13.25)		(–31.97)		(–7.74)
Expected total catch, kg per fishing day	0.296	0.066	0.398	0.124	0.297	–0.007
		(26.29)		(80.30)		(–2.20)
Age, 100s of years	0.535	0.587	0.535	0.700	0.528	1.530
		(2.97)		(30.70)		(24.16)
Fished last year (dummy variable)	0.355	1.170	0.320	0.312	0.436	0.259
		(3.74)		(18.84)		(9.31)
Earned income, households, million SEK	0.582	1.012	0.558	0.696	0.557	0.732
		(11.41)		(21.14)		(9.52)
Male	0.699	0.976	0.670	0.398	0.712	–0.16
		(10.98)		(33.28)		(–0.88)
Lives in coastal area (dummy variable)	0.638	0.154	0.594	–0.094	0.595	0.112
		(4.48)		(–12.33)		(7.32)
Lives in a metropolitan area (dummy variable)	0.408	–0.332	0.378	–0.267	0.381	–0.104
		(–6.44)		(–30.54)		(–7.16)
Total distance traveled for fishing during the period, km	15.070	0.003	32.243	0.001	16.746	0.0006
		(18.97)		(125.09)		(32.54)

Continued						
(Logit-model)						
Participant						
Constant		4.760		3.569		6.225
		(5.89)		(11.11)		(11.88)
Variable expenditure per day, 1000s of SEK	0.468	–1.756	0.778	–0.675	0.767	–0.682
		(–4.85)		(–5.24)		(–4.05)
Age, 100s of years	0.535	1.895	0.535	1.734	0.528	–1.706
		(1.87)		(3.94)		(–2.91)
Fished last year (dummy variable)	0.355	–2.767	0.319	–4.071	0.436	–3.292
		(–6.26)		(–25.55)		(11.04)
Earned income, households, million SEK	0.582					
Male	0.699	–0.864	0.670	–0.863	0.712	–0.692
		(–1.78)		(–5.04)		(–2.84)
Lives in coastal area (dummy variable)	0.638	0.080	0.594	–0.080	0.595	–0.401
		(0.29)		(–0.52)		(–2.24)
Lives in a big city (dummy variable)	0.408	0.284	0.378	0.070	0.381	0.584
		(0.98)		(0.45)		(3.05)
Probability of being a participant	0.975		0,890		0.946	
Voung statistic*		4.63		8.73		6.77
No. of observations	1 256		2 566		1 592	
Expected consumer surplus (CS) per fishing day, SEK	23		148		125	
95 percent confidence interval of CS**	20-27		138-156		93-157	

* Voung statistic is used to test whether a ZIP model preforms better that an standard Poisson model. The Voung statistic is distributed as standard normal and a value greater than +1.96 favors the ZIP-model on the 95 % confidence level.
** Calculated using a Taylor expansion around the mean (Wald command in Limdep).

Table 1 shows that during the winter fishing season the average number of fishing days is 0.59. Note that this is taken over all Swedes, regardless if they are active fishers or not. Moreover, all the coefficients in the equation for "fishers" are statistically significant, and the signs of cost-, catch- and income-coefficients are as expected. We also see that if the respondent fished any time during the last year, is male, and lives in a coastal area, the number of expected fishing days increases. On the other hand, if one lives in a metropolitan area one is less inclined to practice recreational fishing. The likelihood of practicing fishing during the winter period is low, 0.025 percent. The expected consumer surplus, calculated using equation (6), is about SEK 23 per day of fishing.

Regarding the results for the summer period, the average number of fishing days increases to 2.9 days. The results from the model estimation show that the signs of the coefficients are basically the same except for the variable residents of a coastal area. The probability of practicing fishing increases to 11 percent and the expected consumer surplus per fishing day is SEK 148.

Finally, looking at the results from the third period, we see that they differ slightly from previous periods. Among these differences is that the coefficient of the expected total catch is negative, which also applies to the coefficient for “male”, even though this coefficient is not statistically significant. The likelihood that you are going to practice fishing during the period will be 0.054 percent and the expected consumer surplus will be SEK 125 per fishing day. This consumer surplus is not statistically significantly different from the expected consumer surplus for the summer period. The summer and autumn consumer surpluses are however both statistically higher than the winter consumer surplus.

In Table 2 we present a numerical illustration of how sensitive the change in number of fishing days and consumer surplus, respectively, is with respect to a significant increase in expect catch per fishing day, in this case a 50 percent increase in catch, using average values of fishing days demanded and consumer surplus respectively.

Table 2. Effects of increasing expected catch per day on number of fishing days demanded and consumer surplus.

	Initial values			Effects		
	Number of fishing days	Expected catch per day (kg)	Expected catch per day (kg) after a 50% increase (kg)	Change in number of fishing days (percent in parenthesis)	Change in consumer surplus SEK/fishing day (percent in parenthesis)	Shadow price SEK per kg catch
Jan-Apr	0.59	0.296	0.444	0.03 (5%)	0.69 (3%)	SEK 5
May-Aug	2.88	0.398	0.597	0.07 (2%)	10.86 (7%)	SEK 55
Sept-Dec	1.38	0.297	0.446	-0.003 (–0.002%)	-0.39 (–0.003%	SEK –3

Table 2 shows that the summer period is strongly effected by an increase in expected catch. Although the number of fishing days increase by only two percent, the change in consumer surplus will be 7 percent or almost SEK 11 per fishing day. This increase is equivalent to a shadow price per kg catch approximately equal to SEK 55. For the winter and autumn periods, the effects are less clear, showing a small positive effect for the winter period and a marginal negative effect in the autumn period. The latter is an effect of the negative coefficient obtained for the expected catch variable in the estimation.

Summing up the results, the cost- and income-coefficients do have the expected sign for all three seasons, while the expected catch coefficients in the Sep-Dec-season become statistically insignificant and with an unexpected sign. This result implies that demand for recreational fishing is likely to be a normal good from a theoretical point of view. All other variables included in the model, receive statistically significant coefficients are in almost all cases, and with a few exceptions the signs of the coefficients are alike in all three seasons.

The estimates of CS are furthermore within intervals reported from a meta study conducted by the Swedish EPA (Naturvårdsverket) in 2009. CVM-based estimates of CS in this meta study lie in the interval SEK 21-308 per fishing day, while corresponding CS calculated from TCM-models vary from SEK 38 to 229 per day (in 2006 prices). Finally, a change in the expected catch per fishing days mainly affect the summer period.

4.2 Distribution of recreational fishing values and costs over areas and age classes

Since Statistics Sweden used a stratified sampling strategy over the respective seasons to obtain a balanced set of observations, weights (provided by Statistics Sweden) were used to sum up the consumer surplus estimates over the seasons to obtain an estimate of the total consumer surplus for the full calendar year in 2013. For comparison, cost-figures and number of fishing days for the country as a whole, and for the nine different fishing areas are also presented. From the bottom of Table 3 we see that Swedish inhabitants spend about 15.86 million days on recreational fishing in 2013. Of these days, around two-thirds were spent on inland fishing, and one third on marine and costal fishing.

Table 3 further shows the estimated average consumer surplus per day, depending on the area where the fishing takes place. As shown, the value is relatively independent of where the fishing takes place. The highest value is for fishing in the Skagerrak, SEK 135, while the lowest value, SEK 114, is found in the great lakes and in the southern Baltic Sea. According to these estimates, the average value of a day of fishing in Sweden is SEK 129. It should be remembered that all these estimates are subject to statistical uncertainty.

Table 3. Number of fishing days, consumer surplus (CS), variable expenditure, investments and total expenditure per fishing day, divided into fishing areas.

	Millions of fishing days	*CS per day*	*Variable expenditure per fishing day*	*Investment outlay per fishing day*	*Total expenditure per fishing day*
Inland fishing in Götaland and Svealand (except the great lakes of Sweden)	5,914	131	124	154	278
Inland fishing in Norrland	3,100	126	197	110	307
Inland fishing in the great lakes (Vänern, Vättern, Mälaren, Hjälmaren, Storsjön)	1,608	114	169	183	352
Marine and coastal fishing in the Gulf of Bothnia	0,660	129	164	1 251	1 415
Marine and coastal fishing in the central Baltic Sea	2,007	130	132	216	348
Marine and coastal fishing in the southern Baltic Sea	0,426	114	159	1 726	1 885
Marine and coastal fishing in the Öresund strait	0,161	135	191	50	241
Marine and coastal fishing in the Kattegatt	0,680	132	227	93	320
Marine and coastal fishing in the Skagerrak	1,308	138	84	406	490
Sum	15,863	129	148	261	409
Of which is:					
Inland fishing	10,621	127	152	145	297
Marine and coastal fishing	5,242	131	140	496	636

The variable expenditure include fishermen's outlays directly connected to the fishing day. These outlays include fees, petrol, travel cost and alike. These variable expenditure varies between the different areas, however looking at the aggregates, for inland fishing versus marine and costal fishing, the difference is quite low on the average, SEK 152 and 140, respectively. Investments outlays on the other hand, include expenditures on equipment such as clothing, tools, engines, boats etc. These numbers should not be interpreted as annual investment cost, because that would demand further calculations using information on appreciation horizons etc. These outlays also vary over the different fishing areas. For three of the areas, the number is higher than SEK 250, and it is especially high in the areas Marine and costal fishing in the Gulf of Bothnia and southern Baltic Sea, SEK 1 251 and 1 726, respectively. For inland fishing in total, the average investment outlay is SEK 145 while the corresponding value for marine and costal fishing is SEK 496.

Finally, looking at the total expenditure the average values vary between SEK 241 and 352 for all but two areas. Marine and costal fishing in the Gulf of Bothnia and southern Baltic Sea are reporting remarkably higher values on total expenditure, SEK 1 415 and 1 885 per fishing day, respectively. There is no obvious reason explaining these exceptional values, however as these two areas are among the three areas with the least number of fishing days, the estimated average value may be sensitive to outliers among the reported observations. Looking at the aggregate values, it seems like marine and costal fishing is about twice as expensive and inland fishing on the average, SEK 636 and 297, respectively.

Furthermore, it can be concluded that there is no obvious connection between the expenses the fishers have for a day of fishing and the consumer surplus.

It is important to distinguish between the value, defined here as the consumer surplus, per day and the total consumer surplus for various fishing areas. Although consumer surplus per day is high, the total consumer surplus doesn’t have to be high if only a few days of fishing is practiced in the area. This is illustrated in Figure 1, where total consumer surplus and total expenditures are reported for each area by multiplying the value per day by the number of fishing days in each area. Although consumer surplus per fishing day for inland fisheries in Götaland and Svealand (except the great lakes of Sweden) is approximately the same as the corresponding consumer surplus for sea and coastal fishing in the Öresund strait, the total consumer surplus for inland fishing in Götaland and Svealand is many times greater than the total consumer surplus for sea and coastal fishing in the Öresund strait. The reason is that thetotal number of fishing days in Götaland and Svealand is much larger.

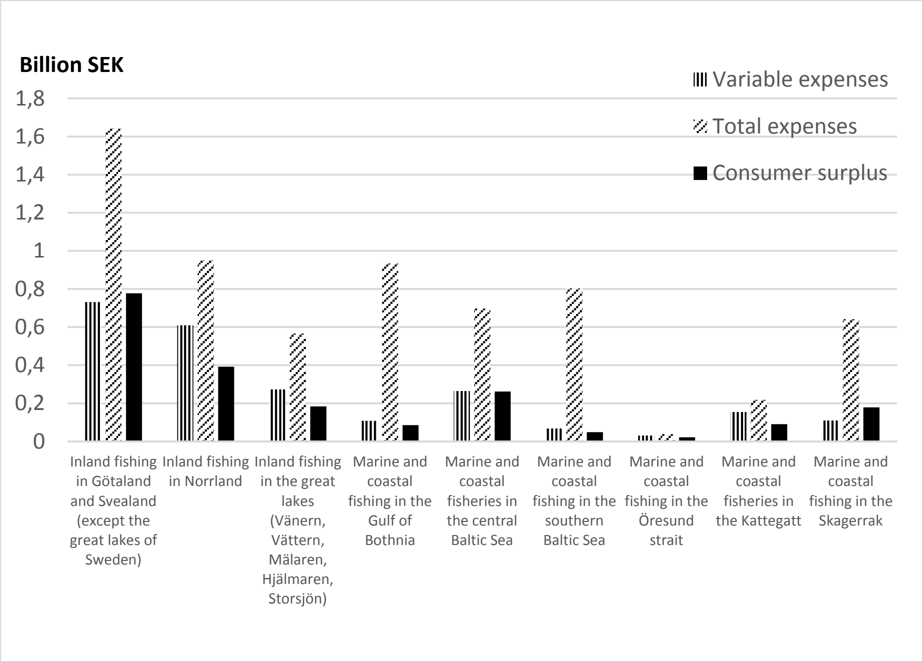

Figure 1. Variable expenses, total expenses and consumer surplus for fishing in the various fishing areas, billion SEK.

As shown in Figure 1 there are relatively large differences in the total value of fishing in the different regions. This is due, as mentioned above, to the fact that the number of fishing days varies greatly between regions. Inland fishing in small lakes and rivers in Sweden sum up to about 56 percent of the total number of fishing days. Regarding coastal areas, the central Baltic sea and Skagerrak are the two most visited areas for recreational fishing, approximately about 14 percent of the total number of fishing days. It is worth noting that inland fishing contributes with the highest value, which is a result of the fact that inland fishing is more common than coastal fishing. Furthermore, it can be noted that the difference between variable expenditure and total expenditure are generally higher for marine and coastal than inland fishing. The reason is that marine and coastal fishing often is associated with increased fixed investment in terms of equipment, such as boats and quantity-catching gear such as nets and fish traps.

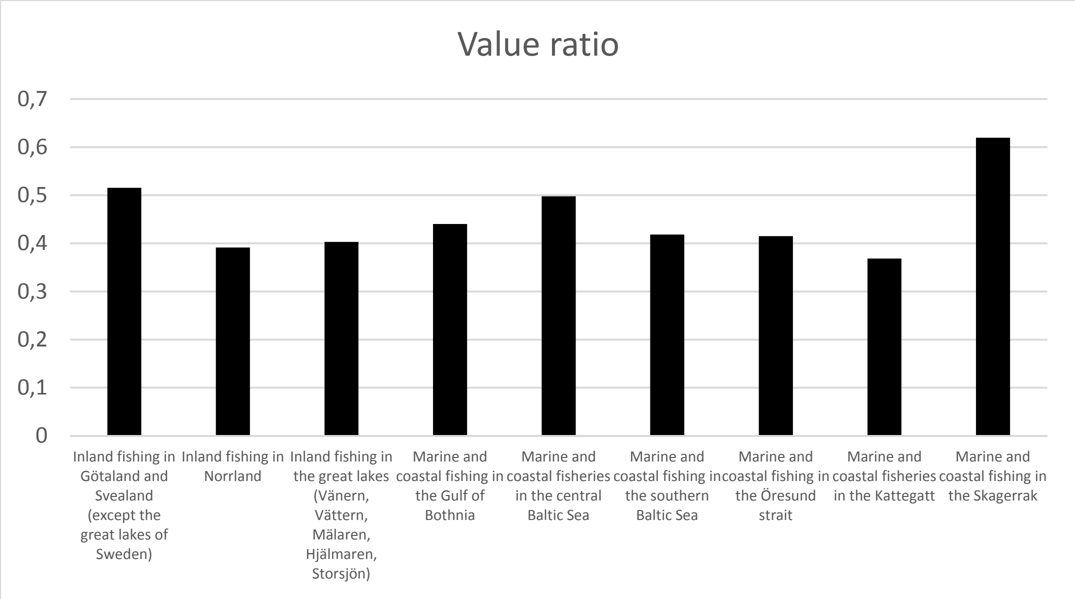

Figure 2. Value Ratio (consumer surplus/(variable expenses + consumer surplus) for fishing in various fishing areas.

Figure 2 shows the so-called value ratio, i.e. the proportion of total consumer surplus to the sum of consumer surplus and variable expenses. The value ratio shows relatively small differences between the different areas and generally lies around 0.5. A value of 0.5 means in this case that the variable expenditure associated with recreational fishing is equal to the size of the consumer surplus. Three areas have ratio of 0.5 or higher, implying that the consumer surplus is equal to or higher than the variable expenses. These areas are inland fishing in Götaland and Svealand, marine and costal fishing the central Baltic Sea, and marine and costal fishing in the Skagerrak, which also is the area with the highest value, about 0.62. The other areas have ratio lower than 0.5, implying the consumer surplus is lower than variable expenses, and marine and costal fishing in the Kattegatt gets the lowest value, which is about 0.37.

Table 4. Sum of variable expenses, sum of total expenses, sum of consumer surplus (Million SEK), and consumer surplus per fishing day (SEK) with regard to age-classes.

Age-class (Year)	*Sum of variable expenses*	*Sum of total expenses (including investments)*	*Sum of consumer surplus*	*Consumer surplus per fishing day*
15-19	33	45	50	140
20-24	210	353	152	126
25-29	350	587	144	132
30-34	329	611	221	134
35-39	298	517	224	128
40-44	241	399	274	132
45-49	200	433	169	129
50-54	126	1 315	118	103
55-59	250	1 441	140	124
60-64	115	267	140	128
65-69	112	187	191	132
70-74	66	291	121	128
75-79	20	046	95	142
Sum	2 349	6 491	2 040	129

To complete the results, we present Table 4, which shows how consumer surplus and expenditures are distributed regarding to age. Looking first at the final row of the table, we see that Swedish fishers spend about SEK 2,349 million on variable expenses, and the total expenses sum to SEK 6,491 million. The total consumer surplus is SEK 2,040 million, and the average consumer surplus per day is SEK 129.

Fishers with ages ranging from 25 to 44 and between the age range 55-59 have the largest sums of variable expenses. The pattern is similar for the sum of total expenses. However, fishers with ages ranging from 50 to 59 seem to spend exceptionally more money on recreational fishing than fishers in other age-classes.

Furthermore, table 4 shows that fishers with ages ranging from 30 to 44 receive the larger amounts of consumer surplus compared with other fishers. Not surprisingly, the youngest and the oldest age-class receives the smallest amount of the consumer surplus.

Finally, the consumer surplus per day vary closely to the average value (SEK 129) for most of the age classes, however there are three exceptions. The two highest values are found among the youngest (SEK 140) and the oldest fishers (SEK 142), while a remarkably lower value is found for fishers between 50 and 54 years of age (SEK 103). It should also be noted that the vast majority of fishers are male, meaning that most of both spending and the economic surplus is for men in Sweden.

5. Concluding remarks

In this paper, we have described the scope and value of recreational fishing in Sweden in 2013 based on a unique recreational fishing survey conducted under the auspices of the SwAM. The purpose of the paper is to give a picture of where, how and who engaged in recreational fishing in Sweden, and to describe and estimate the value of recreational fishing including reporting fishers' expenses on recreational fishing. The economic value, or consumer surplus, has been estimated through the travel cost method with data from the survey. In conclusion, we note that in 2013 the estimated number of fishing days is about 15.9 million, and the fishers spent an estimated 2.3 billion SEK on these fishing days. If investments in fishing equipment and other more durable equipment is included the estimated total expenditure on recreational fishing in 2013 is about 6.5 billion. Given the available data set and the model used to estimate economic value, the consumer surplus is estimated to about 2 billion SEK, which is equivalent to on average 129 SEK per fishing day. Furthermore, the results show that the value per day is highest for inland fishing in Götaland and Svealand. This is due to the fact that the maximum number of fishing days is conducted in this region. Thus, recreational fishing is one of the most important recreational activities in Sweden, but the benefits differ widely between region, age groups and time of the year. This has important implications for fisheries policy. For instance, the consumer surplus seems most sensitive of increases in the catch during the summer period, when a 50 percent increase in catch would increase consumer surplus by 7 percent.

This paper establishes that the SwAM Recreational Fishing Survey is an important instrument for analyzing and monitoring recreational fishing in Sweden. From the starting point of this paper we see a couple of research questions that need to be addressed in future research. In a social perspective, it is of interest to study whether fishing habits differ between different social groups, and thus how the value of the recreational fishing is distributed. Common distributional dimensions like income, education, age, gender and geographical affiliation can all be studied using this survey. If it turns out that certain groups are over- or under-represented, and/or that there are large differences in valuation, it may be important for policy makers and politicians to consider how this type of information should be used. In other words, the importance and value of recreational fishing is affected by whether it concerns enough people in society.

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Appendix

Table A1 lists the nine different fishing areas defined in the survey.

Table A1. Fishing areas in the Recreational Fishing Survey.

Inland fishing in Götaland and Svealand (except the great lakes of Sweden)
Inland fishing in Norrland
Inland fishing in the great lakes (Vänern, Vättern, Mälaren, Hjälmaren, Storsjön)
Marine and coastal fishing in the Gulf of Bothnia
Marine and coastal fisheries in the central Baltic Sea
Marine and coastal fishing in the southern Baltic Sea
Marine and coastal fishing in the Öresund strait
Marine and coastal fisheries in the Kattegatt
Marine and coastal fisheries in the Skagerak*

* Excluded when estimating the catch-equations

Table A2 below shows the estimated catch-per-fishing day equations (using equation 1), respectively. For all models, marine and coastal fishing in the Skagerrak is the reference alternative for the area dummies. As been stated above, these equations are needed to get an estimate of expected catch per fishing day, which then is used a one explanatory variable in the ZIP-model. As this is just an intermediate step in this analysis, we abstain from commenting the results.

Table A2. Tobit regression for calculating the expected catch in kg per fishing day all periods (respectively). The table also reports the average catch per fishing day and period.

Dependent variable	Jan-Apr		May-Aug		Sep-Dec	
	Mean	*Coeff.. (t-value)*	*Mean*	*Coeff. (t-value)*	*Mean*	*Coeff. (t-value)*
Catch in kg per fishing day (incl. released catches)	0.237		0.319		0.280	
Independent variables						
Constant		–16.420 (–10.30)		–5.323 (–21.84)		–6.380 (–14.53)
Inland fishing in Götaland and Svealand (except the great lakes of Sweden), dummy variable	0.031	14.687 (7.96)	0.102	4.380 (15.36)	0.058	5.770 (11.39)
Inland fishing in Norrland, dummy variable	0.018	19.496 (9.33)	0.060	4.830 (14.34)	0.028	6.649 (10.24)
Inland fishing in the great lakes (Vänern, Vättern, Mälaren, Hjälmaren, Storsjön), dummy variable	0.006	5.014 (1.68)	0.029	2.953 (6.83)	0.013	5.116 (5.98)
Marine and coastal fishing in the Gulf of Bothnia, dummy variable	0.003	–10.061 (–1.87)	0.017	4.403 (8.19)	0.008	5.703 (5.54)
Marine and coastal fisheries in the central Baltic Sea, dummy variable	0.012	18.096 (7.44)	0.046	3.751 (10.35)	0.026	5.465 (8.37)
Marine and coastal fishing in the southern Baltic Sea, dummy variable	0.007	12.618 (4.44)	0.009	3.161 (4.23)	0.008	3.798 (3.70)
Marine and coastal fishing in the Öresund strait, dummy variable	0.003	–16.316 (–3.17)	0.008	3.163 (4.03)	0.006	8.162 (6.93)
Marine and coastal fisheries in the Kattegatt, dummy variable	0.006	12.362 (4.03)	0.016	3.140 (5.46)	0.008	4.252 (3.91)
Sigma		7,284 (11.94)		3.341 (29.47)		3.522 (17.93)
R^2 decomposition *		0.49		0.48		0.48
Number of observations	1 256		2 566		1 592	

*As for all nonlinear models there is no exact measure of goodness of fit like R^2 in linear regressions. R^2 decomposition is a reported measure of goodness of fit that roughly mimics the standard R^2 measure and converges to the R^2 measure as the censoring probability goes to zero (Veall & Zimmermann (1994)).