A study of anglers preferences
- valuation of different quality attributes at Lycksele FVO in the north of Sweden

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Abstract

This paper examines angler’s preferences of different quality attributes of angling in Lycksele FVO. With the choice experiment method the willingness to pay for pike and perch is derived together with some other quality attributes concerning angling. A binary logit model was used together with the maximum likelihood estimator to derive the results. Since Lycksele FVO today don’t regulate angling on pike and perch this paper will with a trip frequency model, based on a Poisson regression, see how implementation of rules and regulations affects the angling conditions. This is done by introducing scenarios with different regulations and comparing them with the situation today. The results show that catch of a pike weighing more than five kg is valued to SEK 21 and catch of a perch weighing more than 0.6 kg is valued to SEK 16. Depending on what regulation implemented the different scenarios of regulations will increase the trip frequency with 21-138 days per year and due to this increase the total socio economic value will increase with between SEK 57 000 to SEK 502 000. Another effect due to the regulations is increasing fish stocks which in turns generate an increasing catch of fish. The result implies that better angling conditions increases returns for companies specialized on angling as well as other retail companies due to increasing trip frequency.
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Introduction

In 2006 the turnover of recreational fishing in Sweden exceeded SEK 1 700 million, corresponding to SEK 125 spent per fishing day and SEK 1 700 spent per angler and year. More than one million Swedes fish each year and the number of fishing days was close to 14 million in 2006. Overall, the total willingness to pay for recreational fishing is almost 2 500 million SEK. The net user-value of recreational fishing reported by the Swedish Board of Fisheries (2007) is just under one billion SEK and corresponds to a consumer surplus of about 55 SEK per fishing day. There are more than 1 300 companies that are based on recreational fishing in Sweden and its turnover is around 500 million SEK. Adding the producer surplus (net benefits) from the companies and fishing rights owners to the net user-value will give us a net socio-economic value of well above one billion SEK (Swedish Board of Fisheries, 2007).

The most important species for recreational fishing is pike and perch which dominate the total catch in Sweden. Pike and perch account for 42 percent of all fish species caught and retained with fishing rods and a significantly large proportion of this catch is from lakes (Swedish Board of Fisheries, 2007). To maintain and perhaps increase the demand for recreational fishing, companies and fishing rights owners need to be able to manage and improve the fishing conditions.

The four main motives to engage in recreational fishing is the relaxation from everyday life, the outdoor experience, socializing with family and friends and the actual possibility of catching fish. The latter together with the environmental surroundings, water quality, accessibility and the absence of other people is the most important issues when an individual is choosing a fishing site (Swedish Board of Fisheries, 2007). One way, as a decision maker, to influence these four issues is through better management by regulations and rules of how the fishing should be conducted. Some examples of regulations used today that can improve the stock development and reproduction possibilities is closing waters during spawning seasons and closing waters for longer time periods or even close whole areas for fishing. Examples of less drastic but common measures is minimum size restrictions that counteracts anglers to bring home small fish, the bag limit regulation that prohibits too large amount of fish take outs. Less common regulations such as rod restrictions that regulate the amount of angling permits aloud per day is also used to improve or preserve angling conditions. Other
actions to consider is for example whitewashing waters to prevent acidification and improving the water quality.

In this survey we will examine how people value angling, its quality attributes and the willingness to pay for pike and perch. It is important to know how the angler’s preferences look like in order to improve and preserve the angling conditions in the Lycksele fishing right owner association (FVO). If one can identify the preferences of the anglers it will be much easier for the decision makers to develop sustainable rules and regulations that have a positive effect on future angling i.e. in terms of numbers of visitors, expected catch etc.

The purpose of this study is to examine angler’s preferences of angling in Lycksele FVO. With the choice experiment method the willingness to pay for catching pike and perch is derived together with some other quality attributes concerning angling. Furthermore these results are used in a trip frequency model to see how implementation of rules and regulations affect the angling conditions.

This study is delimited to only analyze angling, i.e. subsistence fishing is not included. The respondents are from Lycksele and only anglers have taken part in the survey. Only pike and perch are studied. The study only looks at values that can be linked to sport fishing which means that only user values are analyzed and how they affect companies based on recreational fishing, holders of fishing rights, etc.

In the second chapter of this paper the reader will be introduced to previous studies made on this topic. In the third chapter methods that will be used to evaluate and execute the purpose of the study is shown and provides an insight of how Lycksele FVO operates and also some descriptive statistics of the “typical angler” at Lycksele FVO. In the fourth chapter Estimates of the different models are shown. In chapter five a review of different scenarios are described and in chapter six the results of changes in fishing conditions are derived. Chapter seven contains a discussion of results and in chapter eight the main findings are presented.
Previous studies

Valuation studies of angling are extensive and to get an overview of how different studies are conducted two tables are presented with summaries of some previous studies in this field. Table 1 shows the method used in the studies and a brief summary of the results are presented. In table 2 marginal values of different fish species are presented. In general, the results of the various surveys differ. Paulrud (2006) examines whether there is an incentive to remove the dam at Storsjö-Kapell. The study concludes that there is a major economic value to remove the regulation dam. Rolfe (2007) concludes that the benefits of improving the fishing experience are limited. The conclusion in Paulrud (2004 A) is that changes in fishing rules can both increase and decrease the welfare for individuals.

Paulrud (2004 B) examines the marginal valuation on sport-fishing in the Bohus region. The study concludes that the marginal willingness to pay suggest how the fishing can be improved. When carrying out management actions priority should be given to the site with the highest marginal value because the pay-back is highest there. Another conclusion is that a high marginal value for catching an extra fish is not equivalent with the marginal value of an extra kilo of fish.

Concerning regulations the bag limit regulation is the most widely analyzed in the studies presented below. In general this regulation has a negative impact on angler’s utility. In Paulrud (2004 A) the marginal value of increasing the bag limit with one extra fish is SEK 44 and in Paulrud (2006) the willingness to pay for bag limit increases after removal of the regulation dam.

**Table 1. Some previous economic studies of angling.**

<table>
<thead>
<tr>
<th>Author</th>
<th>Content</th>
<th>Method</th>
<th>Countries</th>
<th>Species</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paulrud et.al. (2004 A)</td>
<td>Valuation of management policies for sport-fishing in Sweden’s Kaitum river.</td>
<td>CE</td>
<td>Sweden</td>
<td>Grayling Brown-Trout</td>
<td>The results show that fishermen value both the number and size of fish high. Furthermore the various species are valued equally. The results also show that fishermen prefer to catch fish while to take home and eat fish are less important. Changes in fishing rules can increase or decrease social utility for individuals.</td>
</tr>
<tr>
<td>Paulrud et.al. (2006)</td>
<td>Angler’s valuation of restoration to a natural mountain environment thru removal of the regulation dam in Storsjö-Kapell.</td>
<td>CE</td>
<td>Sweden</td>
<td>Grayling Brown-Trout</td>
<td>Overall, the results show that there is some major economic potential in a dismantling of the regulatory dam in Storsjö.</td>
</tr>
</tbody>
</table>

6
<table>
<thead>
<tr>
<th>Author</th>
<th>Study Title</th>
<th>Method/Location</th>
<th>Country</th>
<th>Fish Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paulrud (2004 B)</td>
<td>Marginal valuation of improving the catch for sport-fishers in Bohus region.</td>
<td>CVM</td>
<td>Sweden</td>
<td>Pike Perch and more</td>
<td>Angling in rivers is valued higher than other types of angling. The marginal willingness to pay (WTP) decreases as the catch increases. A final conclusion is that the payback is highest were the marginal value is highest.</td>
</tr>
<tr>
<td>Håkanson (2007)</td>
<td>Cost and benefit of improving wild salmon passage in a regulated river</td>
<td>CBA/CVM</td>
<td>Sweden</td>
<td>Salmon</td>
<td>The results show that diverting more water from electricity generation to increase the ability of salmon to reach their spawning grounds generally gives the cost, in terms of lost electricity, which is larger than the estimated gains. The results also show that the existence value of increasing the population of salmon in the Vindel River is the most contributing factor.</td>
</tr>
<tr>
<td>Rolfe et al. (2007)</td>
<td>Estimating values for recreational fishing at freshwater dams in Queensland</td>
<td>TCM/CVM</td>
<td>Australia</td>
<td></td>
<td>With TCM it was found that recreational values vary between the two types of visitors, one time visitors and returning visitors. With CVM, it was found that fishermen have diminishing marginal utility to catch an extra fish so that the benefit of improving the fishing experience is limited.</td>
</tr>
<tr>
<td>Toivonen et al. (2004)</td>
<td>The economic value of recreational fisheries in Nordic countries</td>
<td>CVM</td>
<td>Denmark Iceland Norway Sweden</td>
<td>The study analyzes the differences in valuation of recreational fisheries between the five Nordic countries.</td>
<td></td>
</tr>
<tr>
<td>Söderqvist (2005)</td>
<td>Valuation studies carried out in the Swedish research program Sustainable Coastal Zone Management, (SU/COZOMA).</td>
<td>TCM</td>
<td>Sweden</td>
<td>Perch</td>
<td>With TCM this study can estimate the profits of an increased catch per hour for various fish species and compare the cost of improving fishing condition in the Stockholm archipelago.</td>
</tr>
<tr>
<td>Tseng et al. (2008)</td>
<td>Valuing the potential economic impact of climate change on the Taiwan trout.</td>
<td>CVM</td>
<td>Taiwan</td>
<td>Brown-Trout</td>
<td>The CVM study concluded that there was a WTP to avoid a reduction in trout population caused by climate changes.</td>
</tr>
<tr>
<td>Johnston et al. (2005)</td>
<td>What Determines Willingness to Pay per Fish? A Meta-Analysis of Recreational Fishing Values.</td>
<td>Meta-analysis</td>
<td>USA</td>
<td>Perch Pike Bass</td>
<td>The study gives a broad overview of the WTP analysis of various fish species and shows to main results. The first is that the WTP per fish is very different depending on the species, demographic and economic attributes. The second finding is that WTP differs depending on the method used.</td>
</tr>
<tr>
<td>Swedish Board of Fisheries (2008)</td>
<td>Presents four assignments the Swedish board of fisheries received by the Swedish government.</td>
<td>Various</td>
<td>Sweden</td>
<td>Salmon Trout Pike Perch and more</td>
<td>Regardless of which method used, results show that there are huge potentials and socio economic values in businesses linked to angling. The total turnover of angling in Sweden is almost one billion SEK which answers to a consumer surplus of SEK 55 per day of angling.</td>
</tr>
</tbody>
</table>

When looking at the willingness to pay for different fish species one can note that salmonids are valued higher than other fish species. Johnston (2005) have complied different studies and the studies differ in valuation depending on which method is used. One can see that in one study the willingness to pay (WTP) for pike is SEK 18 and in another the WTP for pike is SEK 120. The value differs for perch as well but not as sharply.\(^1\) Comparing these WTP values with Söderqvist (2005) one can see that Söderqvist has a WTP for perch that is approximately twice as large as in Johnston (2005). That result may be due to different calculations i.e. Söderqvist value one extra perch caught per hour and in Johnston’s survey the WTP for an extra perch caught is calculated. If one would recalculate Söderqvist (2005)

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\(^1\) One should be aware that the species may differ. Meaning that pike in Sweden is not necessarily the same species as pike in USA. Likewise for perch.
results into catch per day that figure would be significantly larger than Johnston (2005). Concerning trophy fish, the results in the different studies indicate that anglers value big fish preferably to small fish. In some studies like Paulrud (2004 A) the willingness to pay for big brown trout and grayling are exponentially higher valued than small brown trout and grayling. This means that the difference in WTP is not growing proportionally to size. One small fish in Paulrud (2004) are valued to SEK 17 and a trophy fish is valued at SEK 333. One can see the same result in Paulrud (2006) where a small fish is valued to SEK 1 and a trophy fish are valued to SEK 60.

**Table 2. Previous studies of marginal values in monetary terms for fishing site attributes.**

<table>
<thead>
<tr>
<th>Author</th>
<th>WTP (SEK)</th>
<th>Countries</th>
<th>Species</th>
<th>Specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paulrud et. al. (2004)</td>
<td>17, 109, 333</td>
<td>Sweden</td>
<td>Grayling Brown Trout</td>
<td>The WTP to catch one extra fish per day. The smallest value reflects small fish (&lt;30cm), the highest value reflects bigger fish (&gt;40cm) and the medium sized fish (30-40) is the value in between</td>
</tr>
<tr>
<td>Paulrud et. al. (2006)</td>
<td>20-134, 69-204</td>
<td>Sweden</td>
<td>Grayling Brown Trout</td>
<td>The WTP to catch one extra large fish per day. The first interval concerns fishing with the regulation dam and the other without the dam.</td>
</tr>
<tr>
<td>Paulrud (2004)</td>
<td>25 and 26</td>
<td>Sweden</td>
<td>Pike Perch</td>
<td>WTP for doubling the catch in both number of fishes and kg.</td>
</tr>
<tr>
<td>Håkansson (2007)</td>
<td>309 000 000 *</td>
<td>Sweden</td>
<td>Salmon</td>
<td>The WTP for increasing the salmon in the Vindelälven from 3 000 to 4 000 individuals. Estimated from the population in Sweden.</td>
</tr>
<tr>
<td>Söderqvist (2004/2005)</td>
<td>56</td>
<td>Sweden</td>
<td>Perch</td>
<td>WTP for a doubling of the margin catch per hour from 0.8 kg to 1.6 kg.</td>
</tr>
<tr>
<td>Tseng et. al. (2008)</td>
<td>123.27-255.44 **</td>
<td>Taiwan</td>
<td>Brown Trout</td>
<td>WTP to maintain the existing trout population. The interval shows the increase in WTP for preventing the population the decrease from 638 to 1466.</td>
</tr>
<tr>
<td>Johnston et. al. (2005)</td>
<td>13.60-22.42 **</td>
<td>USA</td>
<td>Perch</td>
<td>An angler’s WTP for an extra fish caught.</td>
</tr>
<tr>
<td>Johnston et. al. (2005)</td>
<td>6-11.93 **</td>
<td>USA</td>
<td>Perch</td>
<td>An angler’s WTP for an extra fish caught.</td>
</tr>
<tr>
<td>Johnston et. al. (2005)</td>
<td>17.78 **</td>
<td>USA</td>
<td>Pike</td>
<td>An angler’s WTP for an extra fish caught.</td>
</tr>
<tr>
<td>Johnston et. al. (2005)</td>
<td>119.17 **</td>
<td>USA</td>
<td>Pike</td>
<td>An angler’s WTP for an extra fish caught.</td>
</tr>
<tr>
<td>Johnston et. al. (2005)</td>
<td>34.96-78.81 **</td>
<td>USA</td>
<td>Bass</td>
<td>An angler’s WTP for an extra fish caught.</td>
</tr>
</tbody>
</table>

The table shows marginal values in monetary terms for different fish species. * Note that Håkansson (2007) is not measured in marginal values, but instead is measured in 1000 additional units and not as catch rather as number of spawning adults. ** Recalculated into SEK.
Methodology

Method used for valuation – Stated preference

Traditionally one can divide methods for valuating non-market goods into two broad categories, indirect and direct methods. The indirect method is also called revealed preference and the direct method is called stated preference (Adamowicz, Louviere, and Williams, 1994). These two methods are normally used in valuation studies on recreational fishing even though fishing cannot entirely be seen as a non-market good. Indirect methods, such as the travel cost method (TCM), is based on what respondents actually would or has spent on different environmental goods as revealed by market choices. For an example when an angler travels to a fishing site the benefit of being there has to be at least as large as the actual cost of traveling to the site, otherwise he wouldn’t have gone (Paulrud, 2004 A). To be able to observe this actual behavior of the individual can be seen as one of the main advantages of the indirect method. One disadvantage with indirect methods is that you cannot estimate future environmental changes (Adamowicz, Louviere, and Williams, 1994). For example if one would be interested in evaluating a future quality change on an environmental good it would be very complicated to estimate the willingness to pay for this change, using this method, because it is not reflected from purchasing behavior or other observable actions (Adamowicz, Boxall, Louviere, and Williams, 1998). One aim of this paper is to suggest future improvements of angling conditions in Lycksele FVO and therefore it is not possible to use indirect methods.

With direct methods, or stated preference methods, it is possible to estimate total value of natural resources, both use values and non-use values (Brännlund and Kriström, 1998). A non-use value is the gain or loss in an individual’s utility of a change in a good that the individual is not actually using. The use value is defined as the value associated with the consumption of a good (Kolstad, 2000). The methods are based on individual’s statements about hypothetical objects in an artificial decision situation (Laitila and Westin, 1997). The most frequently used direct method is the contingent valuation method (CVM) which is based on direct questions to the respondents that ask what they are willing to pay for environmental changes. In this way it is possible to derive the actual value on the non-market good, instead of an approximation of the value derived from an indirect method as was mentioned above.
Since the need for altering attributes in order to make suggestions of improvements in Lycksele FVO this study will adopt an extension or alternative method to estimate the willingness to pay (WTP) called choice experiment (CE). This method was mainly used in fields of transport and marketing to study tradeoffs between characteristics of transport projects and private goods but have in recent years been more frequently used in valuation of non-market goods. Alpizar, Carlsson, and Martinsson (2001) claims that the first non-market valuation study to apply the CE method was Adamowicz et al. (1994). The method differs from the CVM in the way that the respondents are given different choice sets were the attributes (such as size or weight on fish) vary between questions and will therefore focus on actual trade-offs between different attributes of the recreational experience. In this way the researcher have the possibility to value both the attributes and situational change and can therefore be seen as a more explicit analytic tool than the CVM (Lawrence, 2005). In a CE study it is possible to vary the attributes in a more detailed manner so you might get more information from each respondent. This means that you have greater flexibility in varying the “environmental product” and its attribute (Brännlund and Kriström, 1998) One of the most common criticisms to CE studies is that hypothetical questions are formed, which implies that actual behavior is not observed. Worth mentioning is that the design of a CE survey is very vital to the outcome and depending on how the design is made different results may occur. See Hencher (1994) for further design issues. This design bias and the hypothetical bias are two of the main drawbacks using this method, if the survey is not correctly performed (Adamowicz, Louviere, and Williams, 1994).

Theoretical background and model development

The purpose of a choice experiment is to estimate welfare effects of changes in different attributes. In this study a random utility function derived by McFadden (1973, 1974 and 1978) will be used to do so. To explain this utility function one has to define the attributes and restrictions. Let $X$ denote a vector of different attributes of a fishing site, such as the distance to the site or probability of catching fish. There are $j$ different fishing sites ($X_1, X_2, \ldots, X_j$) that the respondents have to consider. Utility is then related to the attributes such that

$$U = u(X_1, X_2, \ldots, X_j).$$
In this survey there are several choice sets where each choice set contains two alternatives of sites, e.g. site A and B, which implies a binary model. Let $U_{iA}$ be the utility of fishing site A for the $i$th individual and $U_{iB}$ the utility of fishing site B for the same individual. Under the utility maximization principle it has to be true that the $i$th individual will choose site A over B if and only if

$$U_{iA} > U_{iB}.$$ 

Assume a linear utility function that is defined as $U_{ij} = \alpha + \beta X_{ij} + \varepsilon_{ij}$ were $\alpha$ is the intercept, $\beta$ is the marginal utility coefficient, $X_i$ is the vector of attributes presented to the $i$th individual and $\varepsilon$ is the additive error term. The utility rule above can now be rewritten as

$$\alpha + \beta X_{iA} + \varepsilon_{iA} > \alpha + \beta X_{iB} + \varepsilon_{iB}.$$ 

To estimate the probability that the $i$th individual will choose site A over B the logit estimation technique will be used, which means that the probability for choosing site A can be written as

$$P_{iA} = \frac{e^{\beta X_{iA}}}{\sum_{j \in C_i} e^{\beta X_{ij}}}$$

where $C$ is the choice set. Since the choice sets in this particular case contains two alternatives, the binary logit model gives the following expression

$$P_{iA} = \frac{e^{\beta X_{iA}}}{e^{\beta X_{iA}} + e^{\beta X_{iB}}} = \frac{e^{\beta \Delta X_i}}{1 + e^{\beta \Delta X_i}}$$

where $\Delta X_i = X_{iA} - X_{iB}$ (Paulrud, 2004). The use of the binary logit model requires that the error term is independent type I extreme value distributed (Louviere et al., 2000).

The use of the binary logit model technique avoids the unboundedness of the linear probability model. This means that, no matter what large or small value the $\beta$-coefficient will receive, the dummy dependent variables in the binary logit model will not accept values outside the meaningful range of zero and one. The $\beta$-coefficients, that reflect the marginal utility of a site, are not possible to estimate with OLS due to the nonlinearity. Instead the maximum likelihood (ML) estimator is applied and the function can be written as (Studenmund, 2006)
\[ \log L = \sum_{i=1}^{I} \sum_{j=1}^{J} c_{ij} \log P_{ij} \]

where \( c_{ij} \) is an indicator variable which take the value \( c_{ij} = 1 \) if the \( j \)th site is chosen and \( c_{ij} = 0 \) if not. By maximizing \( \log L \) with respect to the vector of \( \beta \)-coefficients, one can estimate these unknown parameters. Since the \( \beta \)-coefficients represent the marginal utility of the different attributes it is possible to convert these values into monetary terms. The most common measures of welfare changes used in economics are compensation variation (CV) and equivalent variation (EV). In order to better understand how the willingness to pay (WTP) and willingness to accept (WTA) are associated with CV and EV a simple and general review will be derived.

Welfare measures of changes in quantities were proposed by Mäler (1971, 1974) as an extension of Hicks (1943) standard theory of welfare measurement on price changes. Suppose the quantity of a good \( q \) changes from \( q_0 \) to \( q_1 \), this implies that individual’s utility changes from \( U_0 = v(p, q_0, y) \) to \( U_1 = v(p, q_1, y) \) (income \( y \) and price \( p \) are constant). Mäler defined CV as

\[ v(p, q_1, y - CV) = v(p, q_0, y) \]

and EV as

\[ v(p, q_1, y) = v(p, q_0, y + EV). \]

If \( \Delta U = U_1 - U_0 \geq 0 \), this implies an improvement, CV measures the individual’s maximum willingness to pay (WTP) for the change, on the other hand EV measures the minimum willingness to accept (WTA) to refrain from it. If instead \( \Delta U \leq 0 \), which means that the change in \( q \) makes the individual worse off, \( -EV \) will measure the WTP for the individual to avoid the change and \( -CV \) measures the WTA to tolerate it. Note that in this case and in reality the WTP and WTA always adopt non-negative values (Bateman and Willys, 1999).

This theoretical background gives us the tools to estimate the parameters of the binary logit model which in turn generates the opportunity to estimate the marginal utility coefficients for each attribute and also the marginal WTP for changes in attribute levels. For example, assume a change in an attribute level \( (x) \), one can estimate the marginal willingness to pay (MWTP)
for that attribute. This is done by dividing the marginal change in the attribute level with the marginal utility of income (price coefficient ($p$)).

$$MWTP = \frac{\partial U_x / \partial x}{\partial U_p / \partial p}$$

To be more detailed, one can derive the MWTP by dividing the attribute coefficients by the price coefficient received from the ML estimator ($MWTP_x = \frac{\beta_x}{\beta_p}$) where $\beta_x$ denotes the attribute coefficients and $\beta_p$ the price coefficient.

In addition to evaluate the MWTP of the different attributes this paper will also evaluate how changes in the different attributes, thru regulations, will affect the number of future angling days in Lycksele FVO. In the CE question the respondents were asked, given the conditions of the site chosen, how many days he or she would visit that site the coming year. To be able to estimate how days of fishing is effected of changes in angling conditions a trip frequency analysis will be executed where the stated numbers of days was related (three responses per respondent). When deriving the trip frequency it is appropriate to use a poisson regression model because estimated occurrences over a specific interval of time or space, such as fishing days per year, can be assumed to be Poisson distributed (Anderson, 2009). A Poisson regression model has a log-linear functional form meaning that the dependent variable has a logarithmic form and the independent variables have a linear form (Olsson, 2002). A Poisson regression model is used where the mean $Y_{ij}$ (the number of visits to the site by the $i$th individual) is modeled as

$$\log Y_{ij} = Z_i \gamma + \delta \hat{U}_{ij} + \mu_i.$$ 

In this model, $Z_i$ denotes a vector of individual characteristics, $\gamma$ is the associated coefficient vector, $\hat{U}_{ij}$ is estimated utility of the site (derived from using choice model), $\delta$ is the corresponding coefficient, and $\mu_i$ is a random, individual specific component. $\mu_i$ is assumed to be distributed such that $\exp(\mu_i)$ has a gamma distribution.

$$E(Y) = \exp(Z \gamma + \delta \hat{U})$$
where \( Y \) is the stated number of visits, assumed described by a Poisson distribution, \( Z \) is a vector of individual characteristics, \( \gamma \) is the associated coefficient vector, \( U \) is the estimated utility of a visit to the site, and \( \delta \) is the corresponding coefficient.

The binary logit regression model, the Poisson regression model and its variables will be tested with the Likelihood ratio test. The test is used to verify if the models significantly differs from zero. This test takes the functional form

\[
D = -2 \times (\text{Log likelihood 1} - \text{Log likelihood 2})
\]

where Log Likelihood 1 is the Log Likelihood function for the initial model, Log Likelihood 2 is the Log Likelihood function for the alternative model and \( D \) will be compared to a chi squared distributed critical value. If the test statistic \( (D) \) exceeds the critical value the null hypothesis that the initial model is the one to use is rejected (Verbeek, 2008).

Design of the survey

Our application involves a local fishing rights owner association, namely Lycksele FVO. The association was formed by local landowners in 1986 and after an expansion in 1989 the area looks like it does today (see figure 1). Their opinion is that more effective fishery enforcements will be the foundation for a successful angling environment and their goal is long-term and sustainable fishing in the municipality (www.alltomlycksele.se).

At present, Lycksele FVO has implemented a number of specific rules to maintain sustainable fishing:

- Fishing permits is required for angling. It is personal and should always be brought to the fishing site.
- Only one fishing rod with a maximum of three hooks is aloud per angler.
- Fishing with net is not allowed were restocking of fish takes place.
- Only brown trout over 40 cm and grayling over 35 cm may be retained.
- A maximum of five brown trout’s and graylings may be retained each fishing day.

To get a better idea of angling conditions Lycksele FVO is also grateful of anglers reporting to them catch of brown trout, grayling and perch over one kg and also pikes over five kg.
This study is delimited to only analyze angling, i.e. subsistence fishing is not included. The data from the sites was collected in 2007 in a mail survey sent to a sample of 338 anglers that had bought licenses to angle during 2006. The questionnaire was sent by traditional mail. A reminder letter followed the first questionnaire. A new questionnaire and an additional reminder were sent a week after the first reminder if the individual had not yet responded. After adjusting the sample for wrong addresses etc, the final response rate was 63%.

The questionnaire contained background questions on socio-economic variables and questions on the angler’s previous angling trip to the site, such as fishing days, catch etc. The questionnaire also contained a CVM (not further analyzed here) and two different types of CE
questions, one general in sense that the sites described in the CE were new and one CE where the sites described was Lycksele FVO. The second CE is not further analyzed in this study. The two types of CE questions were repeated in the questionnaire 3 and 4 times, respectively.

In the first type of CE question analyzed in this study the choice were, as mentioned before, between two new hypothetical angling sites given. The sites were described using ten characteristics varied among respondents. The characteristics were accessibility from car-road, bag-limit, expected catch per day of pike between 2-5 kg and perch between 0.3-0.6 kg, expected catch per day of pike over 5 kg and perch over 0.6 kg, distance from residence, exclusiveness (number of other anglers on site), and fishing fee. The characteristics were varied in three levels. For each pair of sites, the respondent was asked to choose the most preferred alternative. The CE questions were followed by a frequency questions that inquired about the number of days he/she would have visited the chosen site if it were real. The CE and subsequent frequency questions were repeated in the questionnaire three times.

The CE question analyzed is illustrated in Appendix 1 (translated into English). The characteristics and their levels for the CE questions analyzed are shown in Table 3. Previously done surveys to solicit information about anglers on the Ammerån (1998), Kaitum (1999-2002) and Storsjö-Kapell (2004) provided background material for the design of the CE, e.g., normal catch rates and costs per day etc. (see Paulrud and Laitila, 2004 and Laitila and Paulrud, 2006 and 2008). Assuming linearity, an orthogonal design was developed in the SPSS statistical computer software. In this experiment, we use 27 pairs of alternative angling conditions for the rivers. These 27 pairs are distributed across nine different questionnaires, yielding three CE questions per respondent.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from car-road</td>
<td>250, 750, 1500</td>
</tr>
<tr>
<td>Bag limit perch</td>
<td>0, 4, 6</td>
</tr>
<tr>
<td>Bag limit pike</td>
<td>0, 2, 4</td>
</tr>
<tr>
<td>Expected catch of perch 0.3-0.6 kg</td>
<td>1, 5, 10</td>
</tr>
<tr>
<td>Expected catch of perch &gt; 0.6 kg</td>
<td>0, 2, 5</td>
</tr>
<tr>
<td>Expected catch of pike 2.0-5.0 kg</td>
<td>0, 2, 10</td>
</tr>
<tr>
<td>Expected catch of pike &gt;5.0 kg</td>
<td>0, 1, 3</td>
</tr>
<tr>
<td>Distance from home (km)</td>
<td>10, 100, 300</td>
</tr>
<tr>
<td>Exclusiveness*</td>
<td>0, 5, 10</td>
</tr>
<tr>
<td>Fee</td>
<td>100, 200, 300</td>
</tr>
</tbody>
</table>

*Number of anglers at the site.
The last part of the questionnaire contained an additional socio-economic question on household income and an open question that encouraged other comments from the respondents.

**Homogeneity and preferences**

We want to test whether different segments of anglers affect preferences of different attributes because it is interesting to know how homogeneous the angler population in this study is in order to make generalized conclusions. This is done by fitting a model with an interaction variable for each segment with our explanatory variables. This means in practice that each attribute will receive an additional coefficient value for every observation if some particular condition is met i.e. that lies within the segment. This interaction variable or slope dummy variable allows the slope of the linear relationship to change which in contrast to a regular dummy variable only changes the intercept (Studenmund, 2006) that is constant and therefore is canceled out when modeling the difference between two utility states.

In this study age, fishing days and income will be segmented to test the homogeneity of the population. The different segments are divided so that the breakpoint is the median value in each segment. The breakpoint in the segment for age is 50 years old, breakpoint in fishing days is 20 days per year and income is SEK 20 000 per month and household after tax.

Our expectations are that *distance from road* is more important for older anglers because they cannot manage to walk as far as younger people. *Bag limit* for both perch and pike have a more negative effect for older anglers because of our preconceived notions that older anglers are taking all the fish they catch home. While *distance from home* have a more adversely affect of the elderly, they are more comfortable in their fisheries. We do not believe that the expected preferences for catch differ between ages. We think that the exclusivity have a more negative impact if you are young because we believe that the higher the age the more socially is fishing. We also expect that older anglers don’t want to pay as much as younger anglers in fishing fees.

We believe that *bag limit* have a greater negative impact on those who fish less. Expected catch of small fish have a greater negative impact on those who fish a lot. Trophy fish is more important for those who fish a lot. As the number of fishing days per year, reflects an interest of angling we believe that the route and access to a fishing site affects those who fish less more because those who fish a lot can be more willing to travel further for better fishing sites.
If you have a great interest in fishing exclusivity is important therefore a positive relationship between exclusivity and fishing days are expected.

We believe that those who have a high income are less affected by the license fee and choice of site. People earning less would probably not pay as much as the high income earner. For high earners the length of the itinerary is not that important as for those who earn a bit less. We believe that fishing in itself, and rules of fishing do not differ considerably depending on income.

In addition to these segments this study also checks for interaction effects of households with children. This variable was fitted with the characteristics distance from road, bag limit and expected catch of small perch. Our expectation is that families with children don’t want to walk as long as others to a fishing site. Furthermore we believe that the interaction effect with bag limit is positive because children want to take home their catch to show off. We also believe that children have a higher utility of catching small perch then the rest of the population.

**Description of the typical anglers and the angling in Lycksele FVO**

The typical angler in Lycksele FVO is 51 years old and has in total 26 angling days per year in Sweden. Nine days is spent on angling on other sites then Lycksele FVO and five days are fishing tourism. In this study fishing tourism is defined as traveling more than 100 kilometers from home. Meaning that the average angler at Lycksele FVO fish 17 days at Lycksele FVO. Five of the 17 angling days are during winter (ice-fishing). He or she spends about SEK 846 on fishing at Lycksele in one year. These figures can be compared with the Swedish Board of Fisheries study on Swedes recreational fishing (2007) where the average age for an angler in Sweden is between 25-44 years and he or she fishes an average of 14 days per year and has annual expenses for its fishing on SEK 895.\(^2\) The results can also be compared with the average angler in Sweden who spends approximately one day on ice fishing and one day on fishing tourism.

Table 4 shows descriptive statistics, from the survey in Lycksele FVO. The typical household of the anglers in Lycksele FVO consists of 2.6 persons of which 2 persons are over 18 years

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\(^2\) Recalculated from the study by the Swedish Board of Fisheries (2007) to figures per angler.