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**Abstract**

This paper elicits local and semi-local citizens' preferences for water quality attributes explicitly related to the water framework directive. A river basin in southeast of Sweden is used as a case study. The sample consists of 502 respondents living in the municipalities through which the river passes, or neighboring municipalities. By the use of a choice experiment tailored to the specific case study area, the paper analyzes public attitudes and willingness to pay for selected attributes related to water quality management. The attributes and their corresponding levels are based on real criteria for ecological water status, used in the implementation of the WFD in the river basin. Although participants live in or close to the catchment area, the results reveal a general lack of knowledge and interest in matters related to the environmental quality of the river. All attributes included in the choice experiment proved to have a statistically significant impact on the choice probabilities. There was however no significant evidence that the preferences differ between respondents with regard to self reported previous experience or knowledge about the water body, nor with regard to differences in recreational habits in the area. The results can potentially be used as inputs in practical policy making with its inevitable trade offs and priorities.

***Keywords:*** choice experiment; Water framework directive; water quality; willingness to pay

## 1. Introduction

According to the European Water Framework Directive (WFD), all water bodies (surface waters, groundwater, estuaries, and coastal waters) should have been in ecologically and chemically good status by 2015 (EC 2000/60). Although the larger part of the WFD focuses on ecological issues, it stresses the role of public participation and explicitly acknowledges the role of economics when reaching environmental quality objectives. In addition, according to the WFD, water resource management should no longer be organized by existing administrative hierarchies, but rather by the natural logic of the water catchment areas transcending geographical boundaries (EC 2000/60). As a consequence, actors at multiple levels and sectors are generally involved in the implementation of the WFD. Since Sweden is a highly decentralized country leaving substantial power to the local (municipal) level, decision makers and officials at the local level are key actors in the implementation of the WFD in Sweden. The focus in this paper is to elicit the local and semi-local citizens' preferences for water quality attributes explicitly related to the directive in a specific case area. Importantly, the chosen population is people living in the municipalities through which the river passes, or neighboring municipalities. By this approach, the study focuses on the preferences of the relevant population (according to the WFD) for the attributes characterizing the WFD in the case of Alsterån. The paper contributes by analyzing public attitudes related to water quality management. In addition, given the willingness to pay measures obtained, it is possible to calculate the citizens' willingness to pay for the river Alsterån to reach good status. The results are important inputs for policy makers in their work to implement measures and in their, more or less necessary, prioritizations between expected outcomes.[1] It is important to recall that not all European waters, including Alsterån, have yet reached good status. This means that it is still much work to be done and this paper may guide policy makers to consider the cost effectiveness of different measures in a better way. The paper also contributes with guidance for policy-makers related to a distributional dimension. Specifically, the paper elaborates on socio-economic factors underlying the willingness to pay to avoid the status quo situation, as well as factors underlying each respective attribute level.

While the directive stresses the role of e.g. economic principles and participatory processes, it leaves to the member states to choose between available instruments and measures, such as administrative and legal standards and controls, economic and fiscal instruments, management measures and capital works, that can be implemented to reach the standard. Not a single but rather several goals typically characterize environmental standards and to be cost

[1] See e.g. Birol et al., 2006 for a review on the use of economic valuation techniques in environmental water resource management.

efficient the trade off between goals needs to be considered. It is not likely that all goals defining the standard will be reached simultaneously. Decision makers, often at the local or regional scale, typically need to prioritize between instruments and measures targeted towards different goals or aspects of water quality. The WFD implicitly gives equal weight to each criterion (i.e. they are all absolute) and does thus not guide policy makers on how to make such prioritizations. In this context, the quantification of environmental values held by the citizens constitutes an important input for policy makers and authorities responsible for implementing environmental standards. Often neglected, the WFD also points at the importance of considering distributional aspects in policy making. In a Swedish context, Håkansson et al. (2016) analyze the distributional effects of implementing environmental policy in Swedish coastal environments using a choice experiment. They show how the estimation of latent class specifications may reveal distributional effects of different policy actions. The present paper relates to their paper by eliciting public preferences in Sweden for attributes of water quality, although focusing on river water instead of coastal areas.

To consider the expected benefits and costs of different measures available for improved water quality, the implementation requires information about how different water quality attributes are valued by the citizens. Water quality attributes are not goods (or bads) traded on regular price setting markets. Instead, the attributes correspond to non-market values that are typically analyzed indirectly through stated preferences. Several studies have applied stated preference techniques to assess the willingness to pay for policies that can be used to improve the environmental status of water bodies (e.g. Bateman et al., 2006; Hanley et al., 2006; Loomis et al., 2000). A key challenge for choice experiments is that the attributes and levels presented need to be understandable and perceived as meaningful for non-scientists while the outcome must also have an ecological interpretation to be useful for scientists and policy makers. In many stated preference studies, ecological changes are however defined and described in quite vague or even arbitrary measurement units (see e.g. Johnston et al., 2012; Zhao et al., 2013 for a discussion about ecological indicators and content validity in stated preference studies). The present paper contributes in this dimension via its close link to local and practical policy making in the case area.

The method used in this paper is a choice experiment where respondents to a questionnaire are faced with hypothetical and repeated choices between future scenarios of the river Alsterån. The paper differs from the lion's share of the existing literature in the field with respect to the selected attributes and levels; these are based on real criteria for different levels of water status, used by officials and decision makers involved in the implementation of the WFD in the catchment (and elsewhere in Sweden). The attributes characterizing each scenario are chosen with great care and in close collaboration with public officials involved in water management to reflect realistic and relevant scenarios, both from a policy and ecological perspective. The purpose of the paper is to analyze how important criteria for low, moderate, good and high ecological status are valued by the local population, using the river Alsterån in the southeast of Sweden as our case study. In the actual formulation of the attributes, these were somewhat simplified and described in a way that it was possible for the ordinary citizen to comprehend and evaluate (see section 2 for a more detailed description of the survey design). The literature on willingness to pay and preferences for water quality attributes is rather extensive. However considering the Swedish case and inland water bodies and rivers, the literature is more limited. Kataria (2009) elicits peoples' preferences through a choice experiment for hydropower-regulated rivers in Sweden.[2] The results suggest that substantial values are attached to improvements in birdlife, fish, species richness and river-margin vegetation. Other studies focus on marine water quality. One example is Eggert and Olsson (2009) who also apply a choice experiment and focus on the necessary trade-offs in practical policy making. The attributes in focus in their study are bathing water, fishing possibilities and biodiversity levels. In general, they also find that substantial values are attached to the considered attributes. Another study is Kosenius and Ollikainen (2015) who show that the preferences over coastal marine ecosystems differ significantly across Finns, Swedes and Lithuanians.

The relevant population to study for the implementation of the WFD in Alsterån could possibly be debated. Given the purpose of this paper, we argue that it is relevant to elicit preferences among residents living very close to the Alsterån River, as well as people semi-close to the area of Alsterån. This is interpreted to include people living in municipalities through which the river runs, as well as neighboring municipalities. The area approximates to a geographic circle with a diameter of about 100 kilometers. The underlying motive for the definition of the study area is basically the administrative structure prevalent in Sweden for water management, i.e. river basins. The identified population potentially covers both use values and non-use values. At the same time, the population is likely to include people without specific knowledge of the river of interest. The latter makes it possible to study potential differences in preferences related to e.g. knowledge, recreation habits and familiarity. From the policy maker's perspective, this is of interest since it points at the difficult task of considering not only the preferences of the most involved inhabitants but also of "common people" in the area. In case the results indicate large differences between people

[2] Sundqvist (2002) is another example using a choice experiment to value environmental impacts in Sweden from hydro electrical production.

living close to the river and/or regularly visits the area for recreational purposes and those who don't, the implication would be that the scope for benefit transfers is limited; it would be difficult to bring values from one study area to another. On the other hand, if it turns out that preferences for the certain attributes are not highly dependent on distance, recreational habits etc., the results would possibly carry over to other (similar) rivers.[3] In a practical policy perspective, such results would of course be valuable since it may guide policy makers in a wider context than this case study specifically.[4] Finally, the paper contributes by analyzing public attitudes, e.g. knowledge and interest, related to water quality management. This section is a result of a number of attitudinal questions included in the questionnaire underlying this paper.

The reminder of the paper is organized as follows. Section 2 includes a description of the case study and the survey design while section 3 presents survey responses and econometric results. Section 4 concludes and discusses the policy implications.

## 2. Data and method

To elicit preferences for services or goods not traded and priced on regular markets, the perhaps most popular methods in the given context are the contingent valuation method and the choice experiment method[5] The contingent valuation method is typically applied in cases where a specific good, or service, can be clearly defined with fixed attributes attached to it (for example, specific policy measures such as well defined restoration programs for river areas). If the attributes characterizing the good or service are of particular interest as such, the choice experiment approach is more appropriate. The choice experiment method is commonly used to estimate monetary values for non-market goods (or bads) and facilitates the valuation of product specific characteristics or attributes. In terms of water quality and the implementation of the WFD, it is possible to estimate the value people attach to characteristics such as water clarity, number of fish species, benthic fauna, as well as availability, physical view, etc. While the method of choice experiment is flexible and potentially may capture a wide variety of river or surface water characteristics, the researcher must consider both the relevance of the outcome from a policy perspective and the complexity and cognitive limitations on the behalf of the respondents. People in general cannot be expected to be familiar with ecological concepts or changes in ecological quality and simplified communication is thus necessary. Still, attribute levels in choice experiments should be unambiguously related to

[3] Still, it is important to note that we do not explicitly test the potential for value transfers in this paper.
[4] See Hanley et al. (2006) for a study explicitly relating to benefits transfer and the WFD.
[5] Another rather common method to elicit preferences and willingness to pay is the travel cost method, although it captures only use values.

measurable ecological conditions; oversimplification may reduce content validity (Bateman et al., 2002; Johnston et al., 2012; Johnston et al., 2007; Mitchell and Carson, 1989) .

In the specific context of the present paper, the choice experiment method allows for an assessment of attributes of particular interest for the implementation of the WFD in the river Alsterån. To elicit the preferences, people are supposed to choose between hypothetical scenarios for the water quality of the river. The scenarios are selected in close collaboration with water officials working with the implementation of the WFD in the Alsterån River. The attributes are further selected to reflect the actual situation; i.e. aspects of the ecological status of the water body that need to be improved so as to reach the goal of good water status as stipulated by the WFD. Different levels of water clarity, variety of fish species, variety of benthic fauna species and a monthly cost (more on this below) define the scenarios. By choosing the preferred scenario in repeated choice situations, the respondents implicitly reveal their preferences for the attributes. By the inclusion of an explicit cost attribute the preferences are potentially translated to monetary values.

## 2.1 The choice experiment

The point of departure is a questionnaire where people are asked to choose between different scenarios for the Alsterån River by the year 2020. Each choice set is defined as a choice between three realistic scenarios, of which one is representing the ecological status "as today", or status quo. The respondents were informed that there is a European Union Directive stating that all European waters are required to have good quality, or status. It was also explained that important ecological criteria for the status of the river Alsterån are the level and variety of fish species, benthic fauna species, and water clarity. The catchment area consists of a number of different water bodies and to make the choice task comprehendible to respondents, the estimated average status for the whole area was described.

The respondents were further informed about the current status of the river with respect to the different attributes, and possible changes. It is important to highlight that our main focus was to construct relevant and realistic scenarios for the implementation of the directive, given the objective to provide guidance to local authorities and policy makers in their trade offs when prioritizing across measures, regulations, etc. The exact definition and formulation of scenarios were therefore developed in close collaboration with local expertise at the Water authority (e.g. Samuelsson, 2012), local reports and policy documents (e.g. Water Authorities, 2010) together with deliberations in a number of focus groups and pre-tests. Three different levels define the attribute water clarity: clear, moderate, and turbid and colored – where moderate is the current state. Four different levels define the level of fish species: very high, high, moderate and low – where moderate is the current state. Three different levels define the level of species in the benthic fauna: very high, high and moderate – where high is the current state. The environmental valuation literature has been criticized for using overly simplified descriptions of the attributes of ecological change, which may imply that the output from this research is not very useful for policy makers (e.g. Johnston et al., 2012). Although the attribute levels for e.g. biodiversity in this study are qualitative, we differ from many previous environmental valuation studies (e.g., Birol et al., 2006; Carlsson et al., 2003; Hanley et al., 2006; Håkansson et al., 2016; Kosenius and Ollikainen, 2015; McGonagle et al., 2005) since the levels correspond to the ecological criteria used for water quality assessments in the implementation of the WFD by water managers in the study area.

Table 1. Attributes and attribute levels.

| **Attribute** | **Levels** |
| --- | --- |
| Water clarity | Clear – very little turbidity, little colored and oxygen rich water.<br>Moderate – mildly turbidity, colored and/or less oxygen rich.<br>Turbid and colored – very turbid, highly colored and/or anoxic or almost anoxic. |
| Fish - variety of species | Very high – lots of sea migrating fish (salmon, trout), brook trout and other fish species (e.g. pike, minnow, sculpin, burbot, dace).<br>High – some sea migrating fish and viable population of brook trout and other fish.<br>Moderate – no sea migrating fish but possibly brook trout and viable populations of other fish. Implanted fish species may exist.<br>Low – low stocks of all fish species but some resistant fish species (e.g. tench and bream). Implanted fish species may exist. |
| Benthic fauna – variety of species | Very high – a large number of rare species (e.g. rare water beetles and dragon flies)<br>High – a smaller number of rare species.<br>Moderate – no rare species but some resistant species may exist. |
| Monthly cost[a] (until 2020) | SEK 30, 50, 70 |

[a] € 1 ≈ SEK 9.

Table 1 summarizes the attributes and their respective levels. In the questionnaire, respondents faced the same information prior to the choice tasks. The level of each attribute corresponds to the criteria for low, moderate, good (high) and high (very high) water quality. During the pre-tests some respondents expressed uncertainty about how to understand the difference and relative ordering of "good" and "high" water status. To reduce such uncertainty, these levels of water quality were instead called high (good) and very high (high) water status.

## 2.2 Experimental design and data

Besides the formulation of relevant attributes and attribute levels, the design of a choice experiment needs to consider the explicit variation of attribute levels across and within choice scenarios (choice sets). It is crucial to design the experiment in a way such that the parameters of the econometric model can be identified. Given the results from focus groups and a small pilot study, the design (variation in attribute levels) was made in the software Ngene following a process related to "efficient design". Based on the econometric model, number of choices and priors, Ngene produced a design indicating the lowest possible number of choice sets to identify parameters and the minimum number of observations needed.[6] In total, eight randomly ordered choice sets were used in the final survey.[7] To avoid forced choices a status quo, or opt-out, alternative ("as today") was included in all choice sets. The main concern with forced choices is that respondents may protest by choosing alternatives not considering trade offs between the attributes, which is the focus for the researcher. The "as today" alternative was characterized by predetermined and fixed attribute levels to reflect the current status of the Alsterån water basin. An example of a choice set is given below.

Figure 1. Choice set – an example

Considering the Alsterån river, which of the following scenarios, A, B or C, do you prefer? Note that option C is the current state and that it has not changed until 2020. Choose one of the options.

| | **Scenario A** | **Scenario B** | **Scenario C – As today** |
|---|---|---|---|
| **Water clarity** | Clear | Moderate | Moderate |
| **Fish – variety of species** | Moderate | Low | Moderate |
| **Benthic fauna – variety of species** | High | Very high | High |
| **Monthly cost** | 70 | 70 | 0 |
| **My choice** | [ ] | [ ] | [ ] |

Remember that in all options, characteristics other than those listed are considered unchanged.

Data originates from a web survey that was sent out to people living in southeast of Sweden, close to the Alsterån river basin. From a panel of approximately

[6] More information related to Ngene and efficient design can be found at http://www.choice-metrics.com/.

[7] According to the literature, eight choice sets seem reasonable (see e.g. Carlsson and Martinsson, 2008 and Hensher et al., 2001).

90,000 randomly phone-recruited Swedish citizens, 502 respondents were collected in 2014. The respondents were collected to be representative for the population in the region of Alsterån. The geographic criterion was to have a place of residence in the municipalities where the river crosses, or in a neighboring municipality, while also age and gender were considered. The actual geographic stratification was based on the idea of consulting people with some experience and knowledge about the river, but at the same time not only focus on people living in direct connection to Alsterån or on-site sampling. By using a somewhat larger geographic area, it is possible to capture potential differences in preferences related to the distance to the area of interest. In practice, the choice of geographic area means a distance to Alsterån to up to around 100 kilometers for some of the respondents.

It is well known that the survey mode may influence the representativeness of samples (see e.g. a review in Lindhjem and Navrud, 2011). In stated preferences studies such as the present, weak representativeness may potentially translate to biased welfare measures. Today, internet-based surveys are very common and possibly less questioned than about a decade ago. The underlying reason for this is basically that the population coverage has improved substantially, and e.g. for Sweden, more than 90 percent of the population had access to Internet already about five years ago. Still, there are of course issues related to the survey mode but this in not particular for web-based surveys.[8] Although a rather large panel of respondents, there is a potential risk of "panel conditioning" meaning that respondents may be affected by the experience from conducting many other surveys. Experienced respondents may however also lead to more correct and truthful answers (see e.g. Dillman et al., 2009).

The survey consisted of three parts. The first part collected information about respondents' interest and previous knowledge regarding environmental water quality in general and in the Alsterån river basin. The second part introduced the choice experiment and the attributes with corresponding levels were repeated briefly before each respondent was faced with the choice sets. The third and final part of the survey collected socio-economic information. Table 2 presents relevant descriptive statistics for the sample.

Table 2. Descriptive statistics.

| Variable | | Variable | |
|---|---|---|---|
| Age (mean) | 49.4 | University edu. (share) | 0.50 |
| Men (share) | 0.53 | Know about Alsterån (share) | 0.41 |
| Children <18 years, Yes (share) | 0.25 | Unemployment (share) | 0.05 |
| Individual monthly income, SEK | 20,000 – | Env. organization (share) | 0.14 |

[8] See e.g. Ek and Persson (2014) for a discussion on the representativeness of web-panelists.

| | | | |
|---|---|---|---|
| (mean category) | 24,999 | | |
| Household size (mean) | 2.36 | Dedicated in env. issues (share) | 0.33 |
| Recreation Alsterån (share) | 0.10 | Pensioner | 0.29 |
| Distance to Alsterån (mean km for those who knew about Alsterån) | 54.3 | | |

### 2.3 Empirical specification

In the choice between scenarios, it is assumed that each alternative corresponds to a specific utility level, and that the respondent chooses the alternative that provides the highest expected level of utility. In the econometric specification, this is interpreted as the probability of choosing a specific scenario for Alsterån given the attribute levels in the choice set. The analysis of this type of data is typically done within the logit framework. The multinomial logit model (MNL) is based on the rather strong assumption that unobserved factors affecting the choice of scenarios are strictly independent of each other. It is however reasonable to believe that unobserved factors affecting the utility of each respective scenario might be correlated with observable factors included as attributes in the experiment. To move away from this shortcoming of the MNL model, it has become common practice to analyze responses in the random parameter logit (RPL) framework.[9] The RPL model is a more general and less restrictive version of the MNL and allows unobserved factors underlying choices to be random and to follow a pre-specified distribution; see e.g Train (2009). The following description of the RPL specification works to increase the ability to interpret and discuss the results.

In general, individual $q$'s utility from choosing scenario $j$ in choice situation $t$ can be defined as

$$U_{qtj} = \beta'_q X_{qtj} + \varepsilon_{qtj} \quad (1)$$

where $X_{qtj}$ is a vector of observable variables related to the alternative and the respondent. The unobserved parts of equation (1) are $\beta_q$, which is a vector of coefficients corresponding to the variables (including alternative specific constants, ASC), and $\varepsilon_{jtq}$, which is the error component. Given this specification, $\beta_q$ represents individual taste among the respondents. In the behavioral process, the respondent knows the utility and the true value of his/her own $\beta_q$ and $\varepsilon_{qtj}$ for all j and chooses the scenario with the highest utility. In the RPL framework taste is allowed to vary across individuals and the coefficients are characterized by a distribution $f(\beta)$, which is assumed to depend on underlying parameters captured by $\theta$. These underlying parameters could be the mean and the

[9] Also known as the mixed logit model in the literature.

covariance of the distribution. Note that the researcher observes only the variables $X_{qtj}$ in equation (1). Hence, assuming that $\beta_q$ is observable and that $\varepsilon_{qtj}$ is independent and identically distributed (IID) extreme value type 1, the choice probability would be of a standard logit type. That is, given the values of $\beta_q$ the probability is defined by:

$$L_{qj}(\beta_q) = \exp(\beta'_q X_{qj}) / \sum_k \exp(\beta'_q X_{kq}) \qquad (2)$$

However, since $\beta_q$ is unknown (follows a random distribution) it is not possible to use this probability. Instead, the unconditional probability is defined as the integral of $L_{jq}(\beta_q)$ for all possible values of the coefficients,

$$P_{qj} = \int \left( \frac{\exp(\beta' X_{qj})}{\sum_k \exp(\beta' X_{kq})} \right) f(\beta|\theta) d\beta \qquad (3)$$

Given a specified distribution for the coefficients, the parameters, $\theta$, of the distribution for the coefficients, $f(\beta)$, can be estimated through a simulated maximum likelihood estimator using Halton draws.[10] As for the choice of distribution, it can take on any distributional form such as normal, lognormal, triangular, etc. In the present study, there is no prior information suggesting any other distribution than the normal, or similar, which will be the starting point in the estimations.

The output of the RPL model described above gives (i) estimates of the coefficients with corresponding standard errors and (ii) the standard deviation of each random coefficient reflecting preference heterogeneity. In general, the interpretation of the coefficients as such is analogous to the standard logit and measures the effect on the probability of choosing an alternative (although the absolute numbers requires a transformation to be directly comparable). A statistically significant standard deviation is interpreted such that the coefficient actually varies across individuals and preference heterogeneity is present. This is in contrast to the MNL where the coefficients are assumed to be the same for all individuals in the population and no heterogeneity is accounted for. In the actual choice experiment, one of the scenarios illustrates a status quo situation where the attributes are supposed to represent the situation today. Including a coefficient for the status quo alternative to represent the unobserved sources of utility from keeping Alsterån as today captures this.

[10] Halton draws are more efficient than standard random draws. Still, although as few as 25 draws may produce stability and 100 draws produce good coverage, larger numbers such as 1000 are typically found in the literature (see e.g. Bhat (2001) and Train (2009) for a more thorough discussion on this topic).

## 3. Results

The results are presented in four subsections. The first points at lessons to be learned from the part of the questionnaire collecting data about the respondents' knowledge and attitudes towards water quality and water management. The other three sections elaborate on the choice experiment by presenting a main effects model followed by two specifications analyzing the heterogeneity in preferences for the status quo alternative and for the attribute levels, respectively.

### 3.1 Attitudes related to water quality and management

Besides the choice experiment, the questionnaire consisted of a number of questions related to previous knowledge and experience about the particular river, as well as to attitudes and preferences related to water quality and policy issues in a more general context. Despite the rather limited geographic area and relative proximity to the catchment that respondents are collected from, it is interesting to note that 85 percent of respondents report that they have never given any thoughts to the water quality in Alsterån before receiving the survey. Not thinking about Alsterån water quality before this survey is however not necessarily a problem. Given the purpose to estimate environmental preferences, it rather reflects the limited general public awareness level with regards to environmental water quality.[11] Many respondents further claim that they have not received any information regarding the environmental status of the river basin during the last five years. In addition, almost three quarters of the respondents, 74 percent, answer that they "don't know" when asked about their beliefs about the current environmental status of the river. These results are perhaps not that surprising considering that we approach the general public rather than frequent users or visitors, but they still point at a potential gap in knowledge and problem awareness. A knowledge gap between citizens and experts may challenge the legitimacy of any policy aiming at improved water status. It will also be interesting to analyze whether the preferences disclosed from the choice experience differs depending on individual differences in knowledge, familiarity with the river etc. (see coming sections).

[11] This is potentially country specific since Sweden is a country with very high water quality in general, and drinking water in particular. It is probably safe to say that water quality is not a top priority when it comes to environmental issues in Sweden. This is consistent with results from another question in the survey where respondents report relatively more concern about the water quality at the European level than about the Swedish level.

Still, in spite of the limited access to information, when asking about the respondent's confidence in the effectiveness of policies undertaken to improve water quality, the results show that a majority agree, completely or almost, with the statement that "measures that are taken have large impact on the water quality" (it was however not strictly specified to Alsterån). Almost half of the respondents report that they are rather, or completely, confident that policy-makers and officials will make the best choice among measures to reach the target of water status. They also report strong preferences for rather local decision-making (no more centralized than at the county level). When choosing across explicit instruments and measures, 54 percent report that they prefer regulations, 19 percent prefer economic incentives, while 14 percent state that they prefer information campaigns.[12] Finally, when asked about how to distribute the costs associated with achieving a better water status, 43 percent report that everyone in Sweden should contribute, while 29 percent support the idea of "the polluter pays".

### 3.2 The base model – attributes only

The estimation starts from the multinomial logit model (MNL) and the random parameter logit (RPL) framework.[13] These two estimations serve as benchmarks for other estimation procedures and the parameter estimates are presented in Table 3. Extended versions of the RPL model is presented in Table 4 and 5 in the following sections. The extension refers to the elaboration on the preference heterogeneity by allowing for interaction effects. The idea is that preferences over the status quo versus the other alternatives and/or over the attributes may be related to other/additional factors than the attributes themselves. By including a number of interaction variables we capture additional factors that may explain the probability of choosing a specific alternative.

In the RPL specification, all parameters except for the monthly cost attribute are characterized as random parameters with a normal distribution. We have elaborated on other distributions (uniform and triangular) and the results indicate that there is essentially no difference across distributions.[14] To compare the RPL and the MNL, a likelihood ratio test is performed. The result suggests that the RPL specification is preferred over the more restrictive MNL model at the 1 percent significance level. Since most of the standard deviations are statistically significant, there is evidence of preference heterogeneity in the

[12] It is however not possible to know of they subjectively considered differences in effectiveness.

[13] All estimations are done with the NLOGIT 5 software. The cost attribute was scaled down by factor 10 in the estimation process.

[14] For example, the likelihood values for the specifications are not statistically different at any relevant level.

sample. With respect to signs, the estimation results are similar across specifications, although the statistical significance of some parameter estimates is stronger in the RPL specification.

The results from estimating these base models reveal that the level of water clarity in the Alsterån has a significant impact on the respondents' utility. The parameter estimate for *water clear* is positive and statistically significant while the estimate for *water turbid* is negative and statistically significant. Compared to the prevailing level of water clarity, i.e. *moderate*, increasing clarity would increase utility while reducing it would generate a reduction in the utility of the respondents'. Also the variety of fish species affects the wellbeing of the respondents'; *fish very high* and *fish high* are positive and statistically significant (although the parameter for *fish high* only at the 10 percent level) while reducing the variety of species from moderate to *fish low* is negative and statistically significant. According to these results, the average respondent is willing to pay about 106 SEK per month for improving water clarity (about 12 Euro). For increasing the diversity of fish species in the river Alsterån, respondents are willing to pay 42 SEK per month for achieving *very high* and 25 SEK for *high* levels of diversity of fish species (corresponding to about 5 Euros and 3 Euros). The results further indicate a presence of loss aversion; the willingness to pay is significantly higher to avoid deteriorations in water clarity and to avoid deteriorations in variety of fish species in the river than the willingness to pay for improving these characteristics.

With regard to the variety of species of the *benthic fauna,* the results somewhat differ from water clarity and fish diversity. The benthic fauna parameters indicate that the present *high* level is preferred over both further improvements, to *very high*, and over a deterioration, to *moderate*. Both parameter estimates *Benthic fauna very high* and *Benthic fauna moderate* are negative and statistically significant. Turning to the alternative specific constant related to the status quo, the result points at the fact that people in general prefer a change away from today's status. The willingness to pay estimate is negative and amounts to about 90 SEK.

Table 3. MNL and RPL estimation results including WTP estimates

| Attributes | MNL<br>Coeff (s.e.) | RPL<br>Coeff (s.e.) | Std dev | Willingness to pay, SEK [a] |
|---|---|---|---|---|
| Water clear | 0.404***<br>(0.053) | 0.659***<br>(0.080) | *** | 106.414**<br>(47.274) |
| Water turbid | -0.888***<br>(0.076) | -1.238***<br>(0.116) | *** | -199.813***<br>(67.025) |
| Fish very high | 0.056<br>(0.081) | 0.261***<br>(0.101) | | 42.149**<br>(16.868) |
| Fish high | 0.041 | 0.158* | | 25.523* |

| | | | | |
|---|---|---|---|---|
| | (0.072) | (0.091) | | (14.909) |
| Fish low | -0.675*** | -1.781*** | *** | -287.545** |
| | (0.077) | (0.228) | | (132.143) |
| Benthic fauna very high | -0.195*** | -0.382*** | *** | -61.644** |
| | (0.053) | (0.075) | | (30.490) |
| Benthic fauna moderate | 0.150** | -0.325*** | | -52.406*** |
| | (0.066) | (0.079) | | (19.148) |
| ASC (status quo) | -0.179** | -0.562*** | *** | -90.746** |
| | (0.080) | (0.140) | | (39.345) |
| Monthly cost | -0.270** | -0.619*** | Fixed | |
| | (0.132) | (0.164) | | |
| Log-likelihood | -4085.726 | -3491.065 | | |
| Restricted Log-likelihood | | -4412.027 | | |
| R2 adjusted | 0.070 | | | |
| McFadden Pseudo $R^2$ | | 0.210 | | |
| AIC/N | 2.039 | 1.747 | | |
| No. of respondents | 502 | 502 | | |
| No. of observations | 4016 | 4016 | | |
| No. of Halton draws | | 1000 | | |

***, **, *: Significant at 1, 5 and 10%-level, respectively.
[a] Estimated by the Wald command (Limdep), Krinsky-Robb, 1000 draws. SEK/€≈9.

The statistically significant standard deviation for the alternative specific constant indicates preference heterogeneity in the choice between the status quo alternative and the other two alternatives. Finally, the parameter estimate for the *monthly cost* is negative and statistically significant, as expected.

### 3.3 Who wants a change?

This section extends the analysis and examines potential factors explaining the preferences for the status quo alternative over the alternatives with changed ecological characteristics. Specifically, we elaborate on the preference heterogeneity characterizing the status quo choice by allowing for interaction effects.[15] By including a number of status quo constant interaction variables, we capture impacts of factors that explain the preference for a change away from today's situation in the river. The results of this analysis, for the variables that proved to explain individual differences in the probability to choose the status quo alternative, are presented in Table 4.

Table 4. Status quo interactions

| | Main effects | | Status quo specific constant interactions | |
|---|---|---|---|---|
| Attributes | RPL | | | |
| | Coeff (s.e.) | Std dev | Interactions*SQ | Coeff (s.e.) |

[15] We have also and analyzed heterogeneity in preferences for environmental water quality by applying a latent class specification. In contrast to the results reported by e.g., Håkansson et al. (2016) and Kosenius and Ollikainen (2015) the latent class model did not fit our data very well, and the results are therefore not presented here. These results can be obtained from the authors on request.

| | | | | |
|---|---|---|---|---|
| Water clear | 0.648*** (0.080) | *** | Envorg | -0.562* (0.316) |
| Water turbid | -1.233*** (0.115) | *** | Dedicated | -0.522** (0.232) |
| Fish very high | 0.262*** (0.101) | | University | 0.422** (0.215) |
| Fish high | 0.160* (0.091) | | Age | 0.030*** (0.006) |
| Fish low | -1.760*** (0.225) | *** | Children | 0.529** (0.260) |
| Benthic fauna very high | -0.374*** (0.074) | * | | |
| Benthic fauna moderate | -0.325*** (0.079) | | | |
| ASC (status quo) | -2.125*** (0.375) | *** | | |
| Monthly cost | -0.629*** (0.164) | Fixed | | |
| Log-likelihood | -3475.693 | | | |
| Restricted Log-likelihood | -4412.027 | | | |
| McFadden Pseudo $R^2$ | 0.212 | | | |
| AIC/N | 1.742 | | | |
| No. of respondents | 502 | | | |
| No. of observations | 4016 | | | |
| No. of Halton draws | 1000 | | | |

***, **, *: Significant at 1, 5 and 10%-level, respectively.

First, it can be noted that the relative sizes, signs and statistical significance of the estimated main effects remain stable between the RPL base model presented in Table 3 and the extended model including status quo interaction effects. With regard to the preferences for the status quo alternative versus the alternatives representing change, respondents indicating an environmental orientation are less likely to choose the status quo alternative. The parameter estimates for *Envorg* (*Envorg* is a dummy variable equal to one if the respondent states that he or she is a member of an environmental organization, zero otherwise) and *Dedicated* (which is equal to one if the respondent considers himself or herself as being dedicated in environmental issues, zero otherwise) are both negative and statistically significant. People with a *university* degree (also a dummy variable) and higher *age* are however more likely to choose the status quo alternative than less educated and younger respondents. This is also the case for respondents with *children* in the household; they are more likely to choose the status quo alternative than people without children in the household. The *children* variable is dummy coded, set equal to one if there are children younger than 18 in the household, zero otherwise.

As described above, the sample was selected so that people living relatively close to the catchment area of Alsterån should participate in the survey; the motive for this choice was that the preferences of those most affected are most relevant for policy makers to consider when deciding about measures aiming at improved water status. As shown above in Section 3.1, less than half of the respondents reported that they are familiar with the river. When we evaluate whether individual differences in previous knowledge about the river affects the probability to select the status quo alternative, our results differ from those of e.g. Håkansson et al., (2016); we did not find any statistically significant support for any such differences. We have also tested a number of additional specifications; including e.g. additional socio-demographic variables (such as gender and income), self-reported recreational habits close to the river and distance of residence from the area. None of these variables proved to be statistically significant and they were therefore not included in the final specification presented in Table 4. Finally, it is worth mentioning that although several interaction effects proved to be statistically significant, the alternative specific constant still contain heterogeneity. The parameter estimate for the alternative specific constant is still characterized by a significant standard deviation.

### 3.3 Attribute level interactions

In this section we address respondent heterogeneity by studying factors potentially affecting the preferences for the specific attribute levels. This is done by interacting socioeconomic variables with the attribute levels. The results from this analysis, for the socioeconomic interaction parameter estimates that proved to be statistically significant, are presented in Table 5 below.

The only evidence of differences in the preferences for *water clarity* with respect to socioeconomic factors is that older people consider *turbid water* worse than younger people do. Respondents considering themselves as being environmentally oriented (*dedictated)* are more likely to choose alternatives including improvements in the levels of diversity of *fish species* than people who do not consider themselves as environmentally dedicated.

Table 5. Socioeconomic and attribute level interactions

| Attributes | Main effects RPL | | Attribute-to-socioeconomic interactions RPL | |
|---|---|---|---|---|
| | Coeff (s.e.) | Std dev | Interaction | Coeff (s.e.) |
| W_clear | 0.648*** (0.080) | *** | F_vhigh*Dedicated | 0.481*** (0.169) |
| W_turbid | -0.432* (0.229) | *** | F_high*Dedicated | 0.465*** (0.155) |
| F vhigh | 1.001*** (0.227) | | Benthic_avg*Dedicated | -0.283** (0.142) |
| F high | 0.764*** (0.206) | | F_low*Knowledge | -0.758** (0.336) |
| F low | -1.148*** (0.280) | *** | W_turbid*age | -0.017*** (0.004) |

| | | | | |
|---|---|---|---|---|
| Benthic vhigh | 0.498*** (0.165) | | F_vhigh*age | -0.018*** (0.004) |
| Benthic avg | -0.243*** (0.092) | | F_high*age | -0.015*** (0.004) |
| ASC_SQ | -0.597*** (0.137) | *** | Benthic_vhigh*Age | -0.018*** (0.003) |
| Monthly cost | -0.681*** (0.165) | Fixed | F_low*University | -0.685** (0.325) |
| Log-likelihood | -3450.546 | | | |
| Restricted Log-likelihood | -4412.027 | | | |
| McFadden Pseudo $R^2$ | 0.218 | | | |
| AIC/N | 1.731 | | | |
| No. of respondents | 502 | | | |
| No. of observations | 4016 | | | |
| No. of Halton draws | 1000 | | | |

***, **, *: Significant at 1, 5 and 10%-level, respectively.

With regard to variety of benthic fauna, respondents with a self-reported environmental engagement (*dedicated*) are less willing to accept deteriorations in diversify of *species of benthic fauna*. There are however no statistically significant evidence that people who consider themselves as environmentally *dedicated* has stronger preferences for improvements in the diversity of benthic fauna than less dedicated people. Moreover, respondents claiming to be familiar with the Alsterån river (*knowledge*) and people with higher education (*university degree*) are less likely to choose alternatives with deteriorations in the diversify of *fish species*, attribute. Finally, older respondents are generally less concerned about improvements in diversity of species of fish and benthic fauna.[16]

It is important to note that several other interaction variables have been tested for. Examples are children in the household, pensioner, unemployment, recreational visits in the area (several types of recreation), member in an environmental organization and income. Interacting these variables with the attribute levels did however not result in statistically significant parameters.

## 4. Discussion and concluding remarks

This paper has analyzed local and semi-local citizens' preferences for water quality attributes explicitly related to the implementation of the WFD in the river Alsterån. A choice experiment approach was applied to elicit preferences over

[16] It is important to note that all the interaction variables were tested for all attributes levels. The presented results are the statistically significant ones.

the ecological water characteristics and respondents were asked to choose between hypothetical future scenarios representing different ecological status of the river Alsterån. The choice experiment application in this paper differs from many other studies valuing environmental water quality with respect to the selected attributes and levels. In the present study, these are based on versions of real criteria for different levels of water quality used by water managers and officials involved in the implementation of the WFD in the catchment (and elsewhere in Sweden). In other words, the attributes characterizing each scenario were chosen with great care and in close collaboration with public officials involved in water management to reflect realistic and relevant scenarios, both from a policy and an ecological perspective. The sample was selected to be representative for the population living in municipalities through which the river passes, or neighboring municipalities. In this way, it has been possible to study potential differences in preferences related to distance to the river, knowledge, recreational habits, etc.

All attributes included in the choice experiment proved to have a statistically significant impact on the choice probability. The prevailing status of both water clarity and fish quantity and diversity was described as moderate. Increased water quality was then found to be preferred over the present situation, while reducing clarity was considered a change for the worse. These results are very much in line with our expectations. Moreover, improved variety of fish species would increase utility while reducing fish diversity, compared to the present situation, would be a change for the worse. Both for water clarity and for diversity of fish species the results showed evidence of loss aversion; the marginal willingness to pay to avoid deterioration was higher than the willingness to pay for an improvement. Turning to the benthic fauna attribute, the results suggest that the prevailing status (which corresponds to good water status) was the most preferred, as the parameter estimates for both higher and lower levels were negative and statistically significant. Commenting on our explicit willingness to pay measures for changes in attribute levels, they were consistent with the existing literature on Swedish water bodies. In general, our WTP measures are somewhat lower than found in other studies in the Swedish context.

Respondents reporting membership in environmental organizations and respondents that consider themselves as engaged in local environmental issues did seem to be less likely to stick with the business as usual alternative. People considering themselves as being engaged in local environmental issues however also attach higher values to biodiversity than people who are not considering themselves as environmentally engaged. If the costs for measures implemented to improve water status would be distributed evenly across citizens in the area, people valuing ecological water quality highest would thus receive the largest benefits of environmental water policy (this type of reasoning relates to the literature on distributional effects from environmental policies).

Although the sample was collected in the very near or relative distance to the river, there is very little evidence that distance, interest, knowledge about the environmental quality of the river or the recreational habits of the respondents explain heterogeneity in preferences. Only the valuation of the variety of fish species attribute was found to be different for respondents with previous knowledge than for respondents without this knowledge. Respondents claiming to be familiar with the river were less likely to choose alternatives with deteriorations in the diversity of *fish species* attribute. We did not find any evidence that factors related to interest, knowledge or recreational habits had any impact on the probabilities to choose the status quo alternative. This somewhat unexpected lack of differences in preferences distinguish our results from e.g. Håkansson et al. (2016) and may indicate that preferences for the environmental water quality, to some extent, are generic rather than site specific.

Since the WFD states that all water bodies should reach good status, it gives (implicitly) equal weight and infinite value to all aspects of environmental water status up to the point of good status (where it implicitly also gives zero value to improving water status further to reach high status). If local water managers and decision makers would give equal priority to different aspects of the ecological quality of the river Alsterån, the net benefits of the local and semi-local society would not be maximized. Moreover, in light of the emphasis in the WFD on the role of public participation, the lack of knowledge and limited interest about issues concerning ecological water status among the respondents may challenge the legitimacy and acceptance of the environmental water management. It is, for instance, possible that people in the area would be reluctant to accept increased costs associated with measures used to reach good water status, in particular if these are targeted towards increasing the diversity of the benthic fauna (which has a negative value for the respondents).
As for future research, it would be interesting to further elaborate on whether public preferences differ between officials, decision makers and the general public. If no significant difference, the legitimacy of future policies is then possibly easier to obtain. For comparative and value transfer reasons, it would also be useful to make a similar study in another case study area. Finally, it seems important to further elaborate on the uncertainty aspect of respondents.

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