



ANALYSIS

Willingness to pay, values, and attitudes: Exploring preferences for river restoration measures in Finland

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ABSTRACT

In Finland, where only few major river systems run free without hydropower production or other artificial constructions, the demand for river restoration efforts is increasing. In a choice experiment for river restoration measures using a latent class model, we identified five distinct preference classes. Classes ranged from cost-conscious supporters of nationwide restoration to respondents favoring measures regardless of costs, as well as those emphasizing new trout and salmon waters or preferring the status quo. The main differences across classes concerned sensitivity to costs, the relative importance of restoring free-flowing river sections versus creating new fish waters, and whether restoration should be geographically restricted. To gain insight into the underlying values and attitudes guiding respondents' choices, we employed constructs of cognitive hierarchy model. Our analysis revealed that individuals favoring new restoration measures without concern for costs exhibited the strongest values and attitudes associated with environmental protection. Conversely, the class preferring the status quo displayed the weakest values and attitudes related to environmental protection. We provide insights into respondents who do not respond to the cost attribute as expected and for whom it is not meaningful to calculate willingness-to-pay estimates.

1. Introduction

Cost–benefit analysis (CBA) provides a means to compare the costs of environmental protection measures, such as river restoration initiatives, with their benefits. These benefits can be quantified in monetary terms through valuation studies, such as a choice experiment (CE). A choice experiment is a survey-based method that assesses respondents' preferences for environmental changes by presenting them with choices among mutually exclusive alternatives defined by attributes, including a personal cost attributed to environmental change, to gauge their willingness to pay (WTP) (Bateman and Carson, 2002). Choice experiments can provide valuable insights into the management of water resources due to their ability to estimate values for various aspects of environmental quality (i.e., attributes) and different combinations of these attributes (scenarios), providing support for decision-making.

Comparing costs and benefits in practice poses several challenges. Previous CE studies have observed benefit estimates to vary among different population groups. This preference heterogeneity has been addressed using latent class models, which classify individuals into meaningful, mutually exclusive, and exhaustive groups known as latent

classes (Boxall and Adamowicz, 2002). Occasionally, latent class models reveal choice behavior in which the bid does not influence the choices or may even have a positive impact on the choice probabilities, and calculation of willingness to pay is not meaningful (Carlsson et al., 2010). In cost–benefit analysis, the WTP estimates of individuals are aggregated to assess the total benefits of a policy or project. A question arises regarding how to handle the choices that do not align with assumptions and for which WTP cannot be estimated. In practice, there is no commonly accepted process to incorporate this class to WTP estimates.

One possible explanation for a positive or non-significant cost could be altruistic values: For instance, Svenningsen and Thorsen (2020), in a latent class model, identified a group with a positive price coefficient. The authors labeled the class as the strategic class, with individuals demonstrating a commitment to a good cause, such as climate action in their case. Svenningsen and Jacobsen (2018) argued that choices deviating from the expected cost response can be anticipated in research contexts strongly related to moral aspects. For CBA, it becomes problematic if the valuations of individuals with altruistic values towards nature are excluded from the estimated benefits.

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Heterogeneous preferences have been explained by socio-demographic variables (Chen et al., 2017; Dias and Belcher, 2015). However, research into pro-environmental behavior (López-Mosquera et al., 2014; Sauer and Fischer, 2010) has found psycho-social constructs such as attitudes, beliefs, and values to be more successful in predicting pro-environmental behavior than socio-demographic variables alone. Valuation studies have also started to explore the potential of these psycho-social constructs to explain heterogeneity (Hess et al., 2013; López-Mosquera et al., 2014; Sauer and Fischer, 2010). Incorporating these constructs into valuation studies can provide insights into the respondents' reasoning behind their choices that a plain valuation may not achieve (Gkargkavouzi and Halkos, 2025). A number of CE studies have used environmental attitudes to explain choice behavior and WTP, usually finding a positive association (Bartczak, 2015; Börger and Hatam, 2017; Faccioli et al., 2020). Some CE studies have dug deeper, beyond the level of attitudes, in the psycho-social constructs. For instance, Sauer and Fischer (2010) applied cognitive hierarchies, from fundamental values to more generic attitudes, to understand variation in WTP among individuals in a contingent valuation study. They found stated WTP to be informed by rather generic cognitions, such as beliefs about the need for environmental action and fundamental values such as conformity and universalism.

We employ an exceptionally comprehensive selection of measures for psycho-social constructs to provide insights into how they are linked with willingness to pay for environmental change. We apply constructs of the cognitive hierarchy model (CHM) (Homer and Kahle, 1988; Vaske et al., 2001; Sauer and Fischer, 2010) to reveal how underlying values and attitudes are associated with choice behavior. Our case is associated with measures aimed at mitigating the adverse ecological impacts of hydropower production in Finland. By using a choice experiment and employing a latent class model, we analyze preference heterogeneity among respondents to identify distinct preference groups. This approach also allows us to identify groups of individuals with unexpected choice behavior, whose environmental valuations would typically be excluded from CBA.

1.1. Case study

Hydropower accounted for on average of 17% of Finnish national electricity needs between 2013 and 2022 (Official Statistics of Finland, 2024). Hydropower production takes place in 29 river systems in Finland, of which six account for approximately 95% of the total capacity, with around 138 hydropower stations. The remaining 23 smaller river systems host about 80 stations. Only three major river systems remain free-flowing, all located in northern Finland. The River Teno (Tana in Norway), a transboundary river with Norway, has been of the most productive Atlantic salmon (*Salmo salar*) rivers in northern Europe (Pokki et al., 2018). However, salmon populations in its tributaries have declined drastically, and the river increasingly suffers from invasion of pink salmon (*Oncorhynchus gorbuscha*) from the Barents Sea (Erkinaro et al., 2022). The River Tornio, also a salmon river, forms part of the Finnish-Swedish border and discharges into the Baltic Sea (Pokki et al., 2020). Similarly, the nearby River Simo flows into the Baltic Sea and provides salmon habitats (Immerzeel et al., 2022). Finnish brown trout (*Salmo trutta*) stocks and genetic variability have declined drastically from the early 1900's, especially for lake migrating populations (*Salmo trutta m. lacustris*). This is attributed to loss of habitats and migratory routes due to damming, land-based pressures by forestry and fishing and stocked fish strains replacing original ones (Syrjänen et al., 2017). Due to the different life-cycle patterns of brown trout, some resident, some migrating within the river, some migrating to lakes or the sea (Huusko et al., 2017) populations have different levels of endangerment. This is reflected in the Finnish legislation which separates brown trouts above the 67 degrees parallel of latitude as near-threatened, and those below as endangered species (Koljonen et al., 2019).

Unlike in many other countries, Finnish hydropower has not been

subject to periodic relicensing. Instead, permanent licenses protected by the constitution from amendments without full compensation are used (Iho et al., 2023). The rapid historical expansion of hydropower caused significant environmental impacts in northern Finland (Autti, 2022). More recently, collaborative governmental and private initiatives have aimed at river restoration, most notably the removal of three small dams of the River Hiitola along the Russian border.

Despite pressures related to climate change, ecological restoration, and energy security the costs, benefits and social acceptance of potential large-scale actions concerning Finnish hydropower production remain largely unknown.

2. Cognitive hierarchy

To understand preference heterogeneity across the latent classes, we explore how choice behavior might be embedded in respondents' fundamental value systems and environmental attitudes. We utilize the constructs of the cognitive hierarchy model, which can be used to describe individuals' behavior as being influenced by a hierarchy of cognitions leading from general fundamental values to more specific nature-related value orientations (VOs), attitudes, beliefs, and finally to behavioral intentions and behaviors (Homer and Kahle, 1988; Vaske et al., 2001). According to the model, behavioral intentions, such as stated WTP, stem from a complex system of cognitions that consist of stable and abstract values and more specific and concrete cognitions such as attitudes.

Values are core social cognitions that are formed in early childhood and remain stable throughout one's life (Rokeach, 1973 in Vaske et al., 2001). They are rather abstract constructs that transcend specific situations and serve as guiding principles in life (De Groot and Steg, 2008). To measure held values, we apply the Schwartz value measures (Schwartz, 2012), which includes ten values based on basic human needs distinguished by the type of goal or motivation they express. The values include power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, traditions, conformity, and security. They form two dimensions that can be linked to environmentally friendly beliefs, attitudes, preferences, and actions (Steg et al., 2014): first, a dimension that reflects openness to change and values that advocate conservatism, and second, a dimension that emphasizes self-enhancement, reflecting concern for one's own interest, and values that emphasize self-transcendence, i.e., concern for common interests. Self-enhancement values, which are also referred to as egoistic values, imply a focus of individuals on personal costs and benefits and have been found to typically correlate negatively with pro-environmental beliefs, attitudes, preferences, and actions. On the other hand, strong self-enhancement can also support environmentally friendly actions if they produce more benefits for the individual than costs. Sometimes, hedonistic values such as pleasure and comfort can make a person refrain from pro-environmental behavior, even if it would produce personal benefits (Steg et al., 2014).

Value orientations (VO) are a step in a more specific direction from values. They have been described as 'basic beliefs' about general objects and correspond to the stance an individual will take when some values are more important than others. Compared to values, they are easier to measure and to link to specific attitudes and behaviors concerning natural resources than values (Gamborg and Jensen, 2017; Vaske et al., 2001; Whittaker et al., 2006). One way to measure nature-related VOs is the new environmental paradigm (NEP) (Dunlap, 2008; Whittaker et al., 2006), a scale widely used to examine how concerned people are about the environment and their beliefs regarding the relationship between humans and nature. Individuals with a high NEP value believe that there are limits to growth, that humans cannot control and dominate the environment, and that human activities can easily upset the balance of nature (Steg et al., 2017). Individuals' value orientations can also target specific ecosystem services operationalized with the importance of these different services (Grammatikopoulou et al., 2021).

In the cognitive hierarchy model, an even closer concept to behaviors or behavioral intentions is context-specific attitude. Attitude is a psychological tendency to respond with some degree of favorableness or unfavorableness to a particular entity and is considered a key factor when predicting behavior (Fishbein and Ajzen, 2011). Numerous studies have examined individuals' environmental attitudes and beliefs and found they are among the most important factors explaining support for environmental conservation (Faccioli et al., 2020).

At the top of the cognitive hierarchy model are behavioral intentions and behaviors. The responses to a CE survey, in which individuals make choices between several policy alternatives and the associated stated WTPs for the alternatives, can be interpreted as behavioral intentions (Börger and Hattam, 2017; Grammatikopoulou et al., 2021; Grilli et al., 2018). Interpreting CE choices as behavioral intentions facilitates the investigation of how the other constructs of the cognitive hierarchy model are linked to willingness to pay.

3. Data and methods

3.1. Survey design and implementation

The data used in the analysis were collected through an online questionnaire (Appendix H) developed in collaboration with researchers working in environmental economics, ecology, and environmental law. The survey comprised six parts. The first section aimed to understand the respondents' connection with river environments, whether through their permanent residence, possible leisure home, or recreational visits to river environments. Respondents were also asked to rate the importance they attribute to various ecosystem services produced by river ecosystems. In the second section, respondents were introduced to the role of hydropower in the Finnish energy system, its environmental impacts, and the current measures to mitigate these impacts. The third section focused on respondents' attitudes towards hydropower production and its environmental impacts before presenting the choice experiment. Following the valuation exercises and the related follow-up questions, the survey presented questions on the Schwarz values and NEP. Background questions included, among others, the political party the respondents were most likely to vote for in the next elections.

Before the main data collection, the survey underwent piloting and was finalized based on the feedback. The pilot survey was conducted via the Internet in mid-November 2021, and the final survey took place from December 8 to 22, 2021, also using an Internet survey. The sample was drawn from the online panel of a private survey company, Taloustutkimus, which comprises a large number (approximately 30,000) of panel members, allowing representative random sampling of Finns.

Following the pilot survey with 229 respondents, a random sample of the Finnish adult population was selected, from which 2008 completed the survey. The survey was sent to 13,907 individuals and the response

Table 1
Descriptive statistics for the sample.

Variable	Sample	Finnish population ^a
Age, years, mean	53.5	43.7
Gender, woman, %	43.5	50.5
University-level education, %	51.4	33.3
Household annual net income (€), median		27,072
Pre-tax household annual income		
none, %	4.2	
under EUR 23000, %	26.3	
EUR 23000–30,999, %	20.5	
EUR 31000–46,999, %	25.5	
over EUR 47000, %	23.6	
Lives in an urban area, %	72.8	
n	2008	

^a Source: Statistics Finland (https://www.stat.fi/index_en.html).

rate was thus 14.4%. Descriptive statistics for the data are presented in Table 1.

3.2. Choice experiment

In conducting the choice experiment, our goal was to investigate how much Finns would be willing to pay for the restoration of constructed rivers with the aim of enhancing biodiversity and establishing water bodies supporting wild reproductive trout and salmon populations. Furthermore, we sought to determine whether willingness to pay is influenced by the geographical location of the restoration activities, or by whether the activities are conducted in rivers with a high volume of hydropower production, rivers with small-scale hydropower, or in both settings. The attributes and their levels are detailed in Table 2.

The attributes of the choice experiment and their associated levels were chosen to outline a hypothetical program aimed at reducing the adverse environmental impacts of hydropower production in Finland. Background information for the formation of these attributes was derived from previous research literature (Botelho et al., 2015; Kataria, 2009; Riepe et al., 2019; Ruokamo et al., 2024). In these studies, choice experiments exploring preferences related to the reduction of hydropower's negative environmental impacts have included attributes such as the percentage increase in fish stocks, fish species that currently exist or may potentially occur in the river, modification of the water flow due to hydropower dams, and accessibility of the river banks for people.

The respondents were informed that a river ecosystem restoration program aimed to address the adverse environmental effects of hydropower production through the implementation of new restoration measures. The anticipated changes in river ecosystems were indicated to be observable by the year 2025. The payment vehicle in the CE was

Table 2
Description of the attributes and their levels in the choice experiment.

	Description	Levels
Geographical location of the restoration measures	The geographical location of restoration measures describes whether new measures are carried out in northern Finland, southern Finland, or throughout the country	Reference level: Whole of Finland. Alternative levels: southern Finland, northern Finland
Target rivers of the restoration measures	The target rivers of the restoration measures describe whether the new measures take place in rivers with small or large-scale hydropower production, or in all types of hydropower producing rivers.	Reference level: All hydropower-producing rivers. Alternative levels: rivers with large-scale hydropower production, rivers with small-scale hydropower production
Free-flowing river kilometers	A diverse river environment requires free-flowing water. Currently, less than 30% of river kilometers in Finland are free flowing. Free-flowing river kilometers can be increased by restoration measures, such as dam removals.	Reference level: 100 km. Alternative levels: 450 km, 900 km
Water systems with wild migratory fish populations	Migratory fish populations in a natural state require habitats with free-flowing water. Restoration measures can enable the return of trout alone, or both trout and salmon to the water systems with suitable habitats.	Reference level: No new trout or salmon waters will emerge. Alternative levels: new trout water systems, new trout and salmon water systems
Cost	Impact on your taxation in 2022–2031, €/year.	Reference level: 0. Alternative levels: 10, 25, 50, 100, 200, 400.

annual income tax, to be collected over the period 2022–2031. The decision to use income tax as the payment vehicle instead of increasing a household's electricity bill was based on the perception that the impacts of restoration efforts on electricity prices would be unrealistic as in Finland electricity prices are determined by the Nordic electricity markets and river restoration would likely not have a significant impact on them.

Before the choice experiment section, the survey provided respondents with background information on the role of hydropower in Finnish energy production, its impacts on river ecosystems, and the measures used to mitigate these impacts (see the questionnaire in Appendix H).

Respondents were presented with four choice tasks, each containing three alternatives: the status quo with no additional cost and two restoration programs. The status quo was defined as maintaining the current situation, while the restoration programs involved the introduction of new river restoration measures compared to the existing level. Each program was associated with an annual cost to the respondent, ranging from €10 to €400 in six discrete levels. An example choice task is presented in Fig. 1.

3.3. Survey measures for the cognitive hierarchy constructs

3.3.1. Values

To minimize respondent burden, we used the concise ten-item version of the original 57-item Schwartz Value Survey (Table A1). Although the short version of the questionnaire may not yield as detailed and comprehensive information as the longer version, previous research has demonstrated its consistency with the original questionnaire (Lindeman and Verkasalo, 2005). Descriptive statistics for the responses to the questions are presented in Table A1.

To group the items into a smaller set of variables suitable for further analysis, we employed factor analysis, a statistical method for summarizing a collection of variables with a smaller set of variables representing underlying factors that describe the relationships and patterns among the original variables (Appendix A). Factors are formed by regrouping the original variables based on shared variance (Yong and Pearce, 2013). Several methods are available for extracting factors (Costello and Osborne, 2005). In this study, we used principal component analysis in SPSS. We determined the number of factors based on their eigenvalues, with an eigenvalue higher than one as the limit. To enhance the interpretability of the factors, we rotated them using

varimax rotation. The final factor scores for the resulting factors were calculated in SPSS with the regression method. It should be noted that factor scores should be regarded as approximate indicators of latent constructs rather than precise respondent characteristics, since their values depend on the estimation method and contain measurement error.

The analysis yielded three factors (Table A2). The first factor emphasizes traditions, conformity, and security, the second emphasizes power, achievement, hedonism, and stimulation, and the third factor refers to self-direction, universalism, and benevolence.

3.3.2. Value orientations: NEP

We measured the new environmental paradigm (NEP) with the shortened 6-item scale, which gauges respondents' agreement or disagreement with statements related to beliefs in the ability of humans to upset the balance of nature, the existence of limits to growth, and the right of humans to rule over the rest of nature (Hawcroft and Milfont, 2010, Table B1). The final NEP score for each respondent was calculated as the mean score of the NEP item ratings (Table B2).

3.3.3. Perceived importance of river ecosystem services

To assess respondents' value orientation towards river ecosystem services, we asked them to rate the perceived importance of 12 different river ecosystem services in Finland (Table C1). We employed factor analysis to identify how the presented ecosystem services form groups (Appendix C). The factor analysis yielded three factors (Table C2). The first factor emphasizes the Importance of intangible ecosystem services, such as opportunities to explore the river environment and its flora and fauna, inspiration and artistic experiences, and the preservation of river environments in their natural state. The second factor refers to appreciation of the built river landscape, including hydropower production, flood regulation, and structures such as dams, bridges, and power plants. The third factor involves opportunities for fishing and self-caught fish from a river as a food source. The final factor scores for the resulting factors were calculated in SPSS with the regression method.

3.3.4. Attitudes

We measured two types of attitudes with the questionnaire. Firstly, we asked about attitudes towards the production of hydropower itself using eight statements (Appendix D). Secondly, we explored attitudes towards measures to reduce the adverse environmental impacts of hydropower production with 10 statements (Appendix E). We performed

Choice task X. Please choose your preferred option from the following. Please remember that the amount you are willing to pay would reduce the money you have available for other spending. If you choose the current development, there will be no additional costs. The effects of the programme would begin to be seen in water areas from year 2025 onwards.

	Current development	Alternative 1	Alternative 2
Location of restoration actions	All of Finland	North-Finland	South-Finland
Focus of restoration actions in different river systems	All hydropower producing river systems	Major hydropower producing river systems	Minor hydropower producing river systems
New free running river-kilometers	100 kilometers	450 kilometers	900 kilometers
New naturally producing migratory fish river systems	No new trout or salmon producing areas	New trout producing areas created	New trout or salmon producing areas created
Effect on your taxation between 2022-2031	0 € per year (in 10 years totalling 0 €)	10 € per year (in 10 years totalling 100 €)	400 € per year (in 10 years totalling 4000 €)

Fig. 1. An example of a DCE question.

factor analysis separately for both types of attitudes.

Factor analysis on attitudes towards hydropower production identified only one factor (Appendix D), which reflects a positive or negative attitude towards hydropower production (Table D2).

Factor analysis of the statements on reducing hydropower production's adverse impacts on nature identified two factors (Table E2). The first factor relates to support for increasing the restoration efforts. The second factor relates to support for restoration measures that are convenient and inexpensive for hydropower producers, such as "in my opinion, in Finland, hydropower producers may compensate for the harm to fish stocks by stocking fish" and "in my opinion, in Finland, hydropower companies may compensate for the environmental damage they cause with monetary compensation". The final factor scores for the resulting factors were calculated in SPSS with the regression method.

3.4. Statistical analysis

3.4.1. Latent class model

To allow preference heterogeneity and to obtain further information on different types of respondents, we applied a latent class model (Boxall and Adamowicz, 2002) for respondents' preferences to estimate willingness to pay for restoration programs. The latent class model assumes that the population consists of distinct subgroups or 'latent classes' with different preference patterns. These latent classes are not directly observable but are inferred from individuals' choices and characteristics. Each latent class represents a group of individuals who share similar preferences for the attributes of the alternatives.

The model assumes that individuals within the same latent class have similar decision-making processes and preferences, while those in different classes may have distinct preferences. The goal is to identify these latent classes and understand the characteristics that differentiate them. We estimated the models using LatentGold 5.1.

In a latent class model, every respondent has a positive probability of being a member of each identified class (Boxall and Adamowicz, 2002). To examine how the classes differ from each other in terms of the cognitive hierarchy model, each respondent is assigned to the class with the highest probability.

3.4.2. Differences between latent classes

To explore differences in psycho-social constructs between latent classes, we applied one-way analysis of variance (ANOVA). We assessed differences in the means of Schwartz value factors, NEP, ecosystem services factors, the attitudes towards hydropower production factor, and factors for attitudes towards restoration efforts in hydropower production between the latent classes. We employed the Levene statistic to test for the homogeneity of variance and performed robust tests of equality of means for variables where the hypothesis of homogeneity of variance was rejected. To identify which individual classes differ statistically significantly in their means, we conducted post hoc pairwise comparison tests. For variables with equal variances, we used the Bonferroni test, and for those with unequal variances, we employed the Tamhane test.

We employed cross-tabulation and the chi-squared test to test for statistically significant differences in socio-demographic variables.

3.4.3. Logistic regression

We employed logistic regression to assess, how value and attitude variables and socio-demographic characteristics of respondents explained the resulting class membership. A logistic regression model for each class was estimated.

4. Results

4.1. Latent class model

The latent class model revealed five classes with different

preferences towards increasing restoration efforts (Table 3). The optimal number of classes was determined by minimizing the BIC (Bayesian information criteria). We tested the model with the number of classes varying between one to eight. BIC had the lowest value when the number of classes was five. The log-likelihood of the model is -5982.72 and the R-squared value is 0.64, the latter indicating a relatively good fit to the data.

In the five-class model, for some of the attributes, their effects on choices did not differ statistically significantly between the classes. We decided to limit the coefficients of these attributes to be equal between the classes (a model without such restrictions can be found in Appendix G). First, we restricted the attributes for rivers with a high volume of hydropower production, the rivers with a low volume of hydropower production only, and finally, new water bodies with wild reproductive trout populations. After these restrictions, the remaining attributes differed statistically significantly between the classes. For comparison, the appendix includes a model in which all respondents belong to the same class (conditional logit model) (Appendix F) and a 5-class latent class model in which the attribute coefficients are not restricted in any way (Appendix G). The profiles of the classes can be described as follows:

Class 1 – More restoration while considering the costs

Comprising 26% of the respondents, this class favored increasing restoration efforts, with the aim of enhancing both the extent of free-flowing river sections and number of water bodies with wild populations of trout and salmon. Additionally, they preferred the measures not be limited to northern Finland only. The costs of the measures influenced their choices, as they preferred options with lower costs.

Class 2 – More restoration regardless of the costs

Consisting of 23% of the respondents, this class desired an increase in the extent of free-flowing river sections and the number of water bodies with wild trout and salmon populations, irrespective of costs. They preferred the measures to be implemented throughout the country.

Class 3 – Conditional restorers

This class represents 23% of the respondents. Negative and statistically significant ASC:s for alternative 1 and 2 indicate that this class preferred the status quo alternative to the increased restoration alternatives in their choices. The alternative-specific constant captures an option's intrinsic utility relative to the reference alternative, beyond what is explained by observed attributes. However, they did express a preference for new water bodies with wild trout and salmon populations. Interestingly, the coefficient for new trout and salmon waters in this class was the highest among the classes. The costs of the measures had no effect on their choices.

Class 4 – Emphasis on fish waters

Encompassing 17% of the respondents, this class favored the creation of new trout and salmon water bodies, with the extent of restored free-flowing river sections having no influence on their choices. They did not want measures to be limited to southern Finland only. The positive and statistically significant ASC for alternative 1 indicates that respondents tended to emphasize alternative 1 in the choice tasks. Costs also had a

Table 3
Results of the latent class model.

	Class 1	Class 2	Class 3	Class 4	Class 5		
	More restoration while considering the costs	More restoration regardless of the costs	Conditional restorers	Emphasis on fish waters	Cost-conscious restoration throughout the country		
Class size	0.262	0.226	0.226	0.165	0.120		
Attributes	Coefficients (standard errors) and significance levels					Wald, p-value	Wald (=), p-value
ASCs (Reference: Status quo)						0.000	0.000
ASC Alternative 1	2.464 ^a (0.349)	2.758 ^a (0.773)	-4.413 ^a (0.523)	1.173 ^a (0.295)	0.325 (0.422)		
ASC Alternative 2	2.431 ^a (0.391)	3.123 ^a (0.790)	-4.781 ^a (0.664)	0.216 (0.344)	0.296 (0.440)		
Cost (Continuous variable)	-0.012 ^a (0.001)	0.000 (0.000)	-0.002 (0.001)	-0.001 ^b (0.001)	-0.048 ^a (0.008)	0.000	0.000
Geographical location of the methods (Reference: whole of Finland)							
Southern Finland only	-0.137 (0.188)	-0.618 ^a (0.133)	-0.954 ^c (0.493)	-0.948 ^a (0.189)	-0.960 ^a (0.260)	0.000	0.011
Northern Finland only	-0.724 ^a (0.183)	-0.774 ^a (0.141)	-0.841 ^c (0.470)	-0.073 (0.167)	-0.653 ^a (0.653)	0.000	0.021
Target rivers (Reference: All hydropower producing rivers)							
Rivers with a high volume of hydropower production only	-0.067 (0.086)	-0.067 (0.086)	-0.067 (0.086)	-0.067 (0.086)	-0.067 (0.086)	0.440	.
Rivers with a low volume of hydropower production only	-0.108 (0.087)	-0.108 (0.087)	-0.108 (0.087)	-0.108 (0.087)	-0.108 (0.087)	0.210	.
Kilometers of free-flowing river achieved (continuous variable)	0.0010 ^a (0.000)	0.0010 ^a (0.000)	-0.0004 (0.001)	0.0001 (0.000)	0.0005 ^c (0.000)	0.000	0.000
Waterbodies with wild reproductive migratory fish population achieved (Reference: No new native trout or salmon rivers will emerge)							
New water bodies with wild reproductive trout populations	1.265 ^a (0.110)	1.265 ^a (0.110)	1.265 ^a (0.110)	1.265 ^a (0.110)	1.265 ^a (0.110)	0.000	.
New water bodies with wild reproductive trout and salmon populations	1.437 ^a (0.169)	1.917 ^a (0.164)	1.999 ^a (0.431)	0.939 ^a (0.164)	1.647 ^a (0.224)	0.000	0.000

^a p-value <0.01.

^b p-value <0.05.

^c p-value <0.1.

Table 4
Willingness to pay estimates for the attributes of the choice experiment in the separate latent classes.

Attribute	WTP, €/person/year in ten years (95% confidence interval)				
	Class 1	Class 2	Class 3	Class 4	Class 5
Geographical location of the measures					
Southern Finland only	-	-	-	-867.85 (-1587.92 to -147.78)	-20.02 (-24.20 to -15.83)
Northern Finland only	-58.57 (- 85.01 - 32.01)	-	-	-	-13.62 (-86.63-59.39)
Target rivers					
Rivers with a high volume of hydropower production only	-	-	-	-	-
Rivers with a low volume of hydropower production only	-	-	-	-	-
Kilometers of free-flowing river achieved, EUR/km	0.083 (0.05-0.12)	-	-	-	0.010 (-0.05-0.070)
Waterbodies with wild reproductive migratory fish population achieved					
New trout waters	102.3 (76.26-128.37)	-	-	1158.5 (1136.79-1180.20)	26.4 (-98.61-151.38)
New trout and salmon waters	116.2 (91.75-140.73)	-	-	859.4 (832.05-886.73)	34.3 (22.83-45.85)

significant influence on the choices.

Finland.

Table 4 presents the willingness-to-pay estimates for the classes.

Class 5 – Cost-conscious restoration throughout the country

Comprising 12% of the respondents, this class shared similarities with Class 1. They preferred increasing both the extent of free-flowing river sections and the number of water bodies with wild trout and salmon populations while considering the costs of the measures. Additionally, they wanted the measures to be implemented throughout

Since the cost had no influence on the choices for Classes 2¹ and 3,² it is not meaningful to calculate the willingness to pay estimates for them.

In Classes 1, 4, and 5, respondents were particularly willing to pay for an increase in the number of water bodies with wild migratory fish populations. WTP was highest in Class 4, in which respondents were willing to pay as much as EUR 1159/person/year over a ten-year period for new trout waters and EUR 859.4 for new trout and salmon waters.³ Respectively, Class 1 was willing to pay EUR 102.3–116.2 and Class 5 EUR 26.4–34.3.

For new free-flowing river kilometers, Class 1 was willing to pay EUR 0.08 per kilometer and Class 5 EUR 0.01 per kilometer. For Class 4, the bid did not have a statistically significant effect on the choices. Class 4 had the highest negative WTP for only implementing the restoration measures in a part of the country.

4.2. Values and attitudes of the latent classes

To investigate the values and attitudes that underlie the choices made by the five classes, we employed one-way ANOVA. The results of the potential differences in values and attitudes among the classes are presented in Table 5. Statistically significant differences (p -value < 0.05) between the classes were observed for all of the variables related to values and attitudes. The superscripts in the table cells indicate the classes between which statistically significant differences occurred. For example, in Class 1 the superscript three for the variable values_traditions indicates that this variable differed statistically significantly between classes 1 and 3.

The variables with the highest number of statistically significant differences among classes were NEP mean, Restoration attitudes_more restoration, Values_self_transcendence and Intangible_ES. All other classes differed from each other at a statistically significant level with respect to these variables, with the exception of Classes 1 and 4, which did not differ significantly from one another.

The results indicate that Classes 2 and 3, the classes for which willingness to pay was not possible to assess, exhibit the biggest differences from both the other three classes and from each other. Specifically, Class 2 (*More restoration regardless of the costs*) demonstrated the strongest,

¹ We used choice experiment debriefing questions to analyze Class 2's preference for increased restoration regardless of costs in more detail (Appendix I). Of all the classes, Class 2 rated free-flowing river kilometers, new natural migratory fish waters, and the targeting of restoration measures to different water bodies as the most important attributes, and cost as the least important on average. Respondents in this group agreed that too little money is currently spent on nature conservation and were the least likely to report that they could not afford such investments, reinforcing the CE finding that they supported more ambitious restoration and were largely insensitive to cost.

² From the choice experiment debriefing questions, Class 3 showed a clear status quo orientation. Class 3 rated all attributes except cost as the least important for their choices among the classes, consistent with their preference for maintaining current conditions. This group most strongly agreed that they could not afford nature conservation at present, and together with Class 4, cost was the most important attribute for their choices. These attitudinal patterns contradict the CE result suggesting that cost did not affect Class 3's choices, showing a discrepancy between stated WTP and underlying attitudes on class level. We note the status quo oriented class is price-sensitive in the model reported in Appendix G (unrestricted model) but are generally unresponsive to environmental attributes. For CBA purposes this may have implications, by underestimating disutility perceived by SQ class.

³ Interestingly, respondents in Class 4 exhibited a higher willingness to pay (WTP) for restoring trout waters alone (€1159/person/year) than for restoring both trout and salmon waters (€859/person/year). The confidence intervals for these estimates do not overlap, confirming that the difference is statistically significant. A likely explanation is that trout fishing is more widely accessible across Finland, whereas salmon fishing is geographically restricted. This interpretation remains speculative because the data do not permit a direct investigation of this question.

while Class 3 (*Conditional restorers*) displayed the weakest attitudes and values towards protecting the environment and increasing efforts to reduce the adverse impacts on nature from hydropower production.

The NEP mean differed across all classes except for Classes 1 and 4, with its highest value observed in Class 2 (*More restoration regardless of the costs*) and the lowest in Class 3 (*Conditional restorers*). Similarly, the variable Restoration attitudes_more_restoration exhibited differences across all classes except for Classes 1 and 4, being highest in Class 2 and lowest in Class 3.

The value of the variable Intangible_ES differed across all classes except for Class 1 (*More restoration while considering the costs*) and Class 4 (*Emphasis on fish waters*). Its highest value was found in Class 2, while the lowest was in Class 3. Likewise, Values_self-transcendence varied among all classes except for Classes 1 and 4, with its highest value in Class 2 and its lowest in Class 3.

Hydropower attitudes_pro hydropower production varied significantly among almost all classes, except for Classes 1 and 4, and Classes 3 and 5. The variable had its highest value in Class 3 and lowest in Class 2.

The variable with least differences among groups was Values_self_enhancement, which only differed between Classes 2 and 3. Self-enhancement-related values were most important to Class 3 and least important to Class 2. Regarding the variable fish and fishing ES, only Class 4, which emphasized fish waters in their choices, differed from the other classes, being the class that appreciated fish-related ecosystem services the most.

Table 6 presents the socio-demographic characteristics of the latent classes. Statistically significant differences among the classes were observed for gender, type of residential area, educational level, current working life status, income, and political view.

In terms of gender distribution, Class 3 (*Conditional restorers*) stands out: 33% of the respondents in this class are female, compared to the 46–47% share of females other classes. Additionally, Class 3 has fewer urban residents than other classes. Class 2 (*More restoration regardless of the costs*) has the highest share of respondents with a university degree (59%), while the lowest shares are in Class 4 (*Emphasis on fish waters*) (43%) and Class 3 (*Conditional restorers*) (44%). Classes 1 and 5 have the highest share of respondents currently in the workforce, while Classes 3 and 4 have the lowest. The highest share of respondents with a gross annual income of over EUR 47000 is in Class 2 (26%) and the lowest in Class 5 (21%). Respondents in Classes 4 and 5 are the most active recreational visitors of river environments, while respondents in Classes 1 and 3 are the least active.

In addition to comparing how the values of attitude and value variables differed between classes, we used logistic regression to examine how they influenced respondents' likelihood of belonging to each class (Table 7). For each class, the model compares that class with the rest of the sample.

Although Class 1 differed to some extent from Classes 2, 3, and 5 in terms of attitude and value variables, the results of the logistic regression analysis showed that only NEP_mean had a statistically significant positive effect, suggesting that pro-environmental worldviews slightly increase the likelihood of membership.

Class 2 differed statistically significantly from all other classes with respect to several value and attitude variables, and this is also reflected in the results of the logistic regression: Class 2 is characterized by support for additional protection and by pro-environmental worldviews. In contrast, support for easy environmental measures for companies reduces the likelihood of belonging to this class. Higher levels of self-transcendence values also marginally increase the probability of membership. Socio-demographic effects indicate that individuals with higher education and higher income are more likely to belong to Class 2. Overall, this group seems to represent a pro-environmental class that combines attitudinal support, ecological values, and relatively advantaged socio-economic status.

Similarly, Class 3 differed statistically significantly from all other classes in several value and attitude variables, and this is also reflected

Table 5
Descriptive statistics for the values, value orientations, and attitudes of the latent classes.

Variable	Class 1	Class 2	Class 3	Class 4	Class 5	Differences between classes (ANOVA)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	P-value
Values_Traditions	-0.09 (1.00) ³	-0.09 (1.07) ³	0.11 (0.99) ^{1,2}	0.1 (0.94)	0.06 (0.92)	0.002 ^a
Values_Self enhancement	0.00 (0.99)	-0.13 (0.97) ³	0.12 (1.00) ²	-0.05 (1.03)	0.06 (1.02)	0.004 ^b
Values_Self transcendence	0.13 (0.94) ^{2,3,5}	0.36 (0.83) ^{1,3,4,5}	-0.5 (1.05) ^{1,2,4,5}	0.12 (0.93) ^{2,3,5}	-0.14 (1.01) ^{1,2,3,4}	0.000 ^a
NEP mean	4.09 (0.62) ^{2,3,5}	4.3 (0.55) ^{1,3,4,5}	3.51 (0.74) ^{1,2,4,5}	3.96 (0.66) ^{2,3,5}	3.78 (0.61) ^{1,2,3,4}	0.000 ^a
Intangible ES	0.13 (0.90) ^{2,3,5}	0.42 (0.79) ^{1,3,4,5}	-0.57 (1.05) ^{1,2,4,5}	0.14 (0.84) ^{2,3,5}	-0.14 (0.89) ^{1,2,3,4}	0.000 ^a
Constructed river ES	-0.07 (0.94) ^{3,5}	-0.16 (1.00) ^{3,5}	0.17 (1.07) ^{1,2}	-0.01 (1.01)	0.16 (0.94) ^{1,2}	0.000 ^a
Fish and fishing ES	-0.08 (1.00) ⁴	0.01 (1.08) ⁴	-0.01 (0.94) ⁴	0.24 (0.97) ^{1,2,3,5}	-0.05 (0.95) ⁴	0.000 ^a
Hydropower attitudes_pro hydropower production	-0.07 (0.91) ^{2,3,5}	-0.45 (0.96) ^{1,3,4,5}	0.4 (1.01) ^{1,2,4}	-0.1 (0.98) ^{2,3,5}	0.34 (0.89) ^{1,2,4}	0.000 ^b
Restoration attitudes_more restoration	0.1 (0.84) ^{2,3,5}	0.51 (0.78) ^{1,3,4,5}	(1.12) ^{1,2,4,5}	0.28 (0.90) ^{2,3,5}	(0.88) ^{1,2,3,4}	0.000 ^a
Restoration attitudes_easy ways to companies	-0.1 (0.97) ^{3,4,5}	-0.26 (1.09) ^{3,4,5}	0.13 (0.92) ^{1,2}	0.2 (1.06) ^{1,2}	0.26 (0.82) ^{1,2}	0.000 ^a

^{1,2,3,4,5}Numbers in superscript indicate classes that differ statistically significantly at 5% level from the class indicated by the column label.

^a p-value<0.01.

^b p-value<0.05.

Table 6
Socio-demographic characteristics of the latent classes.

Variable	Class 1	Class 2	Class 3	Class 4	Class 5	All	χ^2 test for differences among the classes, p-value
	More restoration while considering the costs	More restoration regardless of the costs	Conditional restorers	Emphasis on fish waters	Cost-conscious restoration throughout the country		
Female, %	47	46	33	48	46	43	0.000
Resides in an urban environment, %	76	75	64	77	73	73	0.000
Holds a university degree, %	56	59	44	43	50	51	0.000
Currently in the workforce, %	61	54	52	51	57	55	0.018
A family with children, %	18	18	18	16	19	18	0.036
Gross annual income							0.072
No income, %	4	3	7	3	4	4	
Under €23,000, %	26	22	27	32	25	26	
€23,000–€30,999, %	22	21	18	20	21	20	
€31,000–€46,999, %	23	29	25	24	29	25	
Over €47,000, %	24	26	23	22	21	24	
Number of days of leisure time spent by a river in the past 12 months, mean	35	44	34	47	48	40	0.048

in the logistic regression results: Class 3 members are distinct in their negative associations with additional protection and with NEP. Self-transcendence values also reduce the odds of Class 3 membership. In contrast, traditional values are positively associated, while perceiving intangible ecosystem services as important is negatively associated. Higher income further reduces the likelihood of membership. Taken together, Class 3 seems as a group more skeptical of additional protection and pro-environmental values, with a stronger orientation towards traditional values. In terms of socio-demographic characteristics, lower income increases the probability of belonging to this class.

Class 4 differed from Classes 2, 3, and 5 in several variables, and from all classes in the variable ES_f2_fish and fishing. These differences are reflected in the logistic regression results, showing that Class 4 is positively associated with support for additional protection, support for easy environmental measures for companies, and fishing-related values. Among socio-demographic variables, higher education decreases the likelihood of membership. Overall, this group seems to combine orientations towards fishing with pragmatic attitudes to restoration.

Class 5 differed statistically significantly from the other groups in several attitude and value variables, but in the logistic regression only support for easy environmental measures for companies strongly

increased the likelihood of membership. This group had the highest mean value for this variable, while the means of other attitude and value variables were at a mid-level compared to the other groups. Thus, Class 5 appears to be characterized primarily by pragmatic assessments of environmental measures rather than by strong environmental values or cultural orientations.

5. Discussion and conclusions

The CE results demonstrate that the restoration of river environments to provide habitats for wild migratory fish populations enjoys widespread support among Finns, irrespective of their socio-demographic background or values and attitudes towards environmental protection. All identified preference classes demonstrated a willingness to increase the number of water systems with wild migratory fish populations, even if the actions involved costs. Likewise, more than 60% of the sample expressed willingness to pay for increasing the length of free-flowing river sections in Finland.

The creation of new trout and salmon habitats increased benefits across all groups. Previous studies have likewise shown that these species are highly valued: Riepe et al. (2019) found that among different

Table 7
Logistic regression explaining class membership.

Variables	Class 1	Class 2	Class 3	Class 4	Class 5
	More restoration while considering the costs	More restoration regardless of the costs	Conditional restorers	Emphasis on fish waters	Cost-conscious restoration throughout the country
	Coefficient (z-value)	Coefficient (z-value)	Coefficient (z-value)	Coefficient (z-value)	Coefficient (z-value)
Hydropower attitudes_pro hydropower production	0.100 (1.25)	-0.126 (-1.36)	-0.101 (-1.00)	0.0141 (0.13)	0.222 (1.87)
Restoration attitudes_more restoration	0.0264 (0.31)	0.507*** (4.70)	-0.593*** (-5.76)	0.308** (2.62)	-0.232 (-1.92)
Restoration attitudes_easy ways to companies	-0.0914 (-1.47)	-0.167* (-2.35)	0.152 (1.85)	0.172* (2.07)	0.275** (2.87)
Intangible ES	0.0814 (1.18)	0.107 (1.21)	-0.197* (-2.55)	0.0268 (0.28)	0.0893 (0.94)
Constructed river ES	-0.0657 (-1.09)	0.141* (1.97)	-0.0286 (-0.38)	0.00860 (0.11)	-0.0777 (-0.88)
Fish and fishing ES	-0.0667 (-1.28)	0.00505 (0.08)	-0.0599 (-0.91)	0.224** (3.15)	-0.0487 (-0.64)
Values_Traditions	-0.0536 (-1.03)	-0.0295 (-0.47)	0.180** (2.75)	-0.0308 (-0.42)	-0.00937 (-0.12)
Values_Self enhancement	0.0943 (1.75)	-0.0799 (-1.27)	0.0763 (1.14)	-0.125 (-1.75)	-0.00458 (-0.06)
Values Self transcendence	0.0123 (0.20)	0.154* (2.02)	-0.254*** (-3.59)	0.129 (1.52)	-0.0480 (-0.56)
NEP mean	0.372*** (3.73)	0.523*** (4.18)	-0.567*** (-5.05)	-0.241 (-1.84)	-0.127 (-0.95)
Gender	-0.0130 (-0.12)	0.242 (1.88)	0.0319 (0.24)	-0.159 (-1.08)	-0.283 (-1.78)
High education (1 = high education)	0.157 (1.48)	0.260* (2.03)	-0.234 (-1.83)	-0.324* (-2.24)	-0.0500 (-0.33)
Income class	-0.0256 (-0.57)	0.151** (2.78)	-0.169** (-3.12)	0.0356 (0.57)	0.00361 (0.06)
Constant	-2.294*** (-5.46)	-4.419*** (-8.18)	1.396** (3.00)	-0.860 (-1.59)	-1.453** (-2.59)
N	2008	2008	2008	2008	2008
AIC	2449.7	1842.1	1809.3	1560.5	1424.5
BIC	2528.2	1920.6	1887.8	1639.0	1502.9
Log likelihood	-1210.9	-907.1	-890.6	-766.3	-698.2

*** p-value < 0.01.

** p-value < 0.05.

* p-value < 0.1.

fish species in rivers, citizens particularly appreciate the presence of native salmonids. The importance of fish also emerged in the study by Ruokamo et al. (2024), which demonstrated that respondents valued fish stock improvements more highly than recreational use and ecological conservation. Also in our study, a broader group of respondents valued improvements in fish stocks compared to achieving free-flowing river kilometers. In Kataria's (2009) study conducted in Sweden respondents were willing to pay the most for river margin vegetation and erosion, followed by species richness of benthic invertebrates - increases in fish stocks had smaller willingness to pay than the other two attributes.

Whether river restoration measures were implemented only in rivers with high hydropower production, only in rivers with low hydropower production, or in both types of rivers had no statistically significant effect on respondents' choices. Respondents may find hydropower production intensity an abstract attribute; many may not perceive or understand differences between high and low production on a river. In complex choice experiments, respondents sometimes ignore attributes they consider less relevant or hard to interpret (Colombo et al., 2013).

The geographical location of the restoration measures was more influential. Three out of five classes—including Class 2, which was the most supportive of conservation actions, and Class 3, which was the least supportive—preferred that the measures be implemented across the whole of Finland rather than only in certain regions. One possible explanation is that if respondents were expressing non-use values, their preferences might be insensitive to spatial details. Another possible explanation is that respondents may have perceived nationwide

implementation as a fairer option, since it avoids the impression of regional favoritism.

For Class 1, the main concern was that the measures should not be carried out exclusively in Northern Finland, while for Class 4 it was important that they not be implemented solely in Southern Finland. These preferences for geographical locations may be influenced, for example, by respondents' place of residence and place attachment: valuation studies have shown that the farther an individual lives from a site, the less willing they are to pay for it (Artell et al., 2019), but also that strong place attachment (Faccioli et al., 2020) or preferences for iconic sites (Artell et al., 2019) can increase willingness to pay for a site even if it is located far away.

For two of the classes, the cost attribute was not significant: Class 2 preferred increasing restoration activities regardless of the costs, and Class 3 preferred the status quo, the cost being irrelevant in their choices. Cost insensitivity may be due to respondents considering other attributes more important than the cost attribute, or to their unwillingness to make trade-offs between environmental attributes and cost (Alemu et al., 2013), or to difficulties in cognitively processing all attributes (Lew and Whitehead, 2020). It may also have been influenced by the design of the cost vector, which has been shown to affect choices (Ahtiainen et al., 2023; Glenk et al., 2019). Regardless of the underlying reason for cost insensitivity, it is noteworthy that the classes exhibiting this pattern, Class 2 and Class 3, also displayed the most extreme positions in terms of attitudes and value variables—showing both the highest and the lowest scores across all classes. This suggests that cost insensitivity may not only be a methodological artefact but could also

reflect deeper heterogeneity in respondents' underlying belief systems. Attribute non-attendance has been widely studied in the literature (Lew and Whitehead, 2020), and our study suggests that it would be interesting in future research to examine it in relation to the attitudes and values that respondents associate with the subject of the choice experiment.

When examining whether attitude and value variables influenced the latent class model's classification of respondents, we found that a supportive attitude towards additional restoration measures increased the probability of belonging to Classes 2 (More restoration regardless of the costs) and 4 (Emphasis on fish waters), while decreasing the probability of belonging to Class 3 (Conditional restorers). Similarly, higher NEP scores increased the probability of belonging to Classes 1 (More restoration while considering costs) and 2 (More restoration regardless of the costs), and decreased the probability of belonging to Class 3 (Conditional restorers). This aligns with previous studies showing that a positive attitude towards the issue under consideration increases willingness to pay or strengthens other pro-environmental behavioral intentions: In previous CE studies, Bartczak (2015) found that high NEP increased WTP for achieving a high state of naturalness in the commercial and second-growth parts of the Białowieża Forest. Faccioli et al. (2020) observed that people with more positive environmental attitudes tend to display higher WTP for peatland restoration.

From Schwartz's value dimensions, we found that tradition values were positively associated with membership in Class 3 (Conditional restorers us quo preferers), while self-transcendence values were negatively associated. At the same time, self-transcendence was positively related to membership in Class 2 that supported more restoration regardless of costs. This is consistent with the findings of Sauer and Fischer (2010), who observed in a structural equation model that willingness to pay was linked to beliefs about environmental actions and, indirectly, to the values of universalism and conformity. The more important universalism was to a respondent, the more positive their beliefs were regarding environmental measures and the effects of their own pro-environmental behavior. Conversely, the greater the importance attached to conformity, the more negative were the beliefs related to environmental actions and their impacts.

Among the socio-demographic variables, we found that higher education and higher income increased the likelihood of belonging to Class 2, whereas higher income decreased the likelihood of belonging to Class 3. In addition, high education decreased the likelihood of belonging to Class 4. Previous studies have reported mixed results. For instance, our findings contrast with those of Faccioli et al. (2020), who observed that stronger pro-environmental attitudes, associated with higher willingness to pay, were linked to lower income, and that university education had no statistically significant effect. Dias and Belcher (2015) found that higher education was positively associated with willingness to pay for increased wildlife populations but negatively associated with willingness to pay for improved water quality. In turn, Chen et al. (2017) reported no effect of income or education on preferences for river restoration in Belgium, but found that men were more likely to prefer maintaining the status quo. In our study we gender did not have a statistically significant impact in the logistic regression.

This study shows that Finnish citizens express strong support for river restoration, particularly for improving fish stocks, although preferences regarding the geographical location of measures differ. Some respondents support restoration regardless of cost, a tendency associated with strong environmental attitudes, self-transcendence values, higher income, and higher education. By contrast, individuals with more moderate preferences and a tendency to favor the status quo often place less emphasis on these values and may be less attuned to immaterial ecosystem services. These results provide insights not only into public preferences for restoration but also into how its benefits are distributed

across groups with distinct attitudes and values.

As WTP could not be calculated for the class with the most positive attitude towards nature nor for the Class 3, which preferred the status quo, their benefits would be excluded from the CBA results. These findings prompt the question of how methods for the valuation of non-market benefits should be developed or their results interpreted to better account for preferences that do not align with traditional economic theories. Yet, the differences in values and attitudes among the classes align with the results of the choice experiment, indicating consistency with the respondents' choices. Individuals who placed the highest emphasis on the need for restoration measures in their choices exhibited the strongest values and attitudes associated with environmental protection. Therefore, the results suggest that the choices made in the choice experiment are grounded in the attitudes and values of the respondents.

The focus of this study was to examine how heterogeneous preference classes differ from one another in terms of attitude and value variables. We did not explore in detail the underlying reasons why the cost attribute was not statistically significant for all respondents. Future research could simultaneously investigate both the reasons for cost insensitivity and their connections to attitudes and value variables.

Since landowners play an important role in biodiversity restoration, it would be valuable in future studies to examine their views in particular, and how their preferences compare to those of the general population. It would also be of interest to study how people with differing views could be brought together to engage in dialogue and to identify common solutions to restoration challenges. Furthermore, future research could examine the influence of social norms on preferences, as well as conduct international comparisons on the links between restoration preferences and attitude and value variables.

Understanding the public's attitudes towards biodiversity conservation is important when public resources are to be directed towards biodiversity conservation. It is well known that social acceptance of environmental protection measures is essential for successful conservation activities. To this end, it is essential to understand the attitudes and values of citizens towards environmental protection, so that efforts can be made to strengthen nature-positive behaviors and citizen involvement in conservation activities.

CRediT authorship contribution statement

Tuija Lankia: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Eija Pouta:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Janne Artell:** Writing – review & editing, Project administration, Funding acquisition.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Janne Artell reports financial support was provided by Research Council of Finland. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Descriptive statistics and factor analysis of Schwarz values

Table A1

Descriptive statistics for the Schwarz value items.

Schwarz value items	Not important at all (1)	Somewhat unimportant (2)	Neither (3)	Somewhat important (4)	Extremely important (5)	Mean	S. D.
	% of respondents						
Power (e.g., control of others, prestige, social power, wealth)	16.9	37.6	31.9	11.8	1.7	2.4	1.0
Achievement (e.g., success, ability, ambition, hard work, achieving goals, influencing people and events)	6.3	21.6	33.6	32.2	6.3	3.1	1.0
Hedonism (e.g., satisfying cravings, self-indulgence, enjoying life)	1.4	9.1	31.2	45.6	12.7	3.6	0.9
Stimulation (e.g., adventures, risk-taking, a diverse and exciting life)	6.9	22.6	36.9	27.8	5.8	3.0	1.0
Self-direction (e.g., creativity, freedom, curiosity, independence, choosing your own goals)	1.1	4.2	18.2	49.2	27.3	4.0	0.9
Universalism (e.g., broad-mindedness, beauty of nature and arts, social justice, peace of mind, equality, mature understanding of life, protection of nature)	3.0	6.9	17.9	38.4	33.8	4.9	1.0
Benevolence (e.g., helpfulness, honesty, forgiveness, loyalty, trustworthiness, friendship)	0.3	1.1	7.7	36.3	54.5	4.4	0.7
Tradition (e.g., respect for traditions, humility, acceptance of one's lot in life, adherence to faith, moderation, temperance)	3.8	13.7	22.0	38.8	21.6	3.6	1.1
Conformism (e.g., obedience, respect for older people, self-discipline, politeness)	1.5	5.9	19.5	42.7	30.4	3.9	0.9
Security (e.g. national security, family security, social order, cleanliness, reciprocity of services)	0.4	1.0	6.4	32.0	60.2	4.5	0.7

N = 2008.

Table A2

Factor analysis of the Schwarz value items.

Schwarz value items	1	2	3
	Traditions	Self-enhancement	Self-transcendence
Value items	Factor loadings		
Power (e.g., control of others, prestige, social power, wealth)	0.048	0.753	-0.248
Achievement (e.g., success, ability, ambition, hard work, achieving goals, influencing people and events)	0.147	0.762	-0.078
Hedonism (e.g., satisfying cravings, self-indulgence, enjoying life)	0.147	0.541	0.315
Stimulation (e.g., adventures, risk-taking, a diverse and exciting life)	-0.081	0.678	0.227
Self-direction (e.g., creativity, freedom, curiosity, independence, choosing your own goals)	-0.040	0.291	0.709
Universalism (e.g., broad-mindedness, beauty of nature and arts, social justice, peace of mind, equality, mature understanding of life, protection of nature)	-0.038	-0.069	0.777
Benevolence (e.g., helpfulness, honesty, forgiveness, loyalty, trustworthiness, friendship)	0.456	-0.154	0.648
Tradition (e.g., respect for traditions, humility, acceptance of one's lot in life, adherence to faith, moderation, temperance)	0.770	0.091	-0.172
Conformism (e.g., obedience, respect for older people, self-discipline, politeness)	0.825	0.056	0.032
Security (e.g., national security, family security, social order, cleanliness, reciprocity of services)	0.707	0.082	0.235

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Appendix B. Descriptive statistics for the responses to the NEP questions

Table B1

Descriptive statistics for the responses to the NEP items.

NEP items	Completely disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Completely agree	Mean	S. D.
	(5)	(4)	(3)	(2)	(1)		
	% respondents						
The delicate balance of nature is easily disturbed by human activity	1.6	4.5	10.3	36.9	46.8	1.8	0.9
The Earth has only limited space and resources	1.0	1.9	7.4	25.4	64.3	1.5	0.8
Plants and animals do not exist primarily for humans	4.6	8.6	15.4	24.2	47.3	2.0	1.2
Changing the environment for human use rarely causes serious problems	3.1	7.3	14.8	41.9	32.8	3.9	1.0
Economic growth has no limits	27.8	31.1	19.7	13.0	8.3	3.6	1.3
Humans have the right to control the rest of nature	22.5	29.4	24.8	17.9	5.4	3.5	1.2

N = 2008.

Table B2 Descriptive statistics for the NEP mean variable. In the NEP mean variable, the average of the NEP items was calculated. Before calculating the mean, the scale of items 1–5 was reversed so that a higher number corresponds to a higher degree of endorsement of an ecological

worldview.

Table B2
Descriptive statistics for the NEP mean variable.

	Min	Max	Mean	S.D.
NEP mean	1.0	5.0	3.95	0.7

N = 2008.

Appendix C. Descriptive statistics and factor analysis of the responses to the questions on the perceived importance of different ecosystem services provided by river ecosystems

Table C1
Descriptive statistics for the perceived importance of different ecosystem services provided by river ecosystems.

Ecosystem services provided by river ecosystems	Not important at all (1)	Somewhat unimportant (2)	Neither important nor unimportant (3)	Somewhat important (4)	Extremely important (5)	Mean	Std. deviation
	% of respondents						
Opportunities to get to know the river environment and its flora and fauna	2.8	7.6	26.4	39.5	23.6	3.7	1.0
Inspiration and new ideas, artistic experiences	12.5	18.3	36.3	23.7	9.2	3.0	1.1
The existence of river habitats in their natural state	1.8	2.6	12.9	34.7	34.7	4.2	0.9
Preservation of natural river environments for future generations	2.0	2.3	13.5	33.2	49.0	4.3	0.9
Economic activities associated with rivers, excluding hydropower	7.9	14.6	42.6	27.7	7.1	3.1	1.0
Opportunity to get to know cultural destinations	5.1	9.8	29.9	39.8	15.3	3.5	1.0
Fishing opportunities	17.7	16.6	27.6	25.5	12.5	3.0	1.3
Self-caught fish from a river as food	25.1	20.2	30.1	16.5	8.1	2.6	1.2
Other outdoor recreation and leisure facilities in the river environment besides fishing	2.0	4.7	17.9	44.8	30.5	4.0	0.9
Hydropower production	6.9	12.1	31.6	34.3	15.2	3.4	1.1
Flood management and water level regulation in nearby water bodies	5.5	8.8	29.1	38.5	18.1	3.5	1.1
Built river landscape (e.g., paved embankments, dykes, dams, bridges, power plants)	5.7	11.8	38.9	34.2	9.4	3.3	1.0

N = 2008.

Table C2
Factor analysis of ecosystem service importance ratings.

Ecosystem services provided by river ecosystems	1	2	3
	Intangible ecosystem services (ES_f1_intangible)	Built river landscape (ES_f2_constructed river)	Fishing (ES_f2_fish and fishing)
Factor loadings			
The opportunity to get to know the river environment and its flora and fauna	0.783	0.079	0.178
Inspiration and new ideas, artistic experiences	0.628	0.163	0.090
The existence of river environments in their natural state	0.824	-0.086	0.120
Preservation of natural river environments for future generations	0.828	-0.124	0.100
Opportunity to get to know cultural destinations	0.675	0.342	-0.035
Fishing opportunities	0.151	0.055	0.909
Self-caught fish from a river as food	0.146	0.088	0.906
Other outdoor and recreational opportunities in the river environment besides fishing	0.749	0.137	0.102
Hydropower production	-0.149	0.790	0.046
Flood regulation	0.147	0.660	0.267
Built river landscape (e.g., paved embankments, dams, bridges, power plants)	0.253	0.746	-0.098

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The item “Economic activities associated with rivers, excluding hydropower” was removed from the final factor solution because it exhibited strong loadings on both factor two (factor loading 0.497) and factor three (factor loading 0.467). A high correlation with multiple factors makes it challenging to attribute the items to a single underlying factor in the analysis.

Appendix D. Descriptive statistics and factor analysis of attitudes towards hydropower production

Table D1

Descriptive statistics for attitudes towards hydropower production.

In my opinion, hydropower production in Finland...	Completely disagree (1)	Partly disagree (2)	Neither agree nor disagree (3)	Partly agree (4)	Completely agree (5)	Mean	S. D.
	% of respondents						
is an environmentally friendly way to produce energy	4.5	10.0	18.5	41.5	25.4	3.7	1.1
does not hinder recreation in rivers	11.2	26.7	26.4	26.1	9.6	3.0	1.2
is crucial to mitigate climate change	5.7	8.8	23.9	37.7	23.9	3.7	1.1
can in the future be replaced by other energy sources for regulating energy	8.4	16.7	45.4	20.6	8.9	3.0	1.0
is more important than free-flowing rivers as a habitat for migratory fish	22.7	31.4	24.8	16.0	5.0	2.5	1.2
is more important than free-flowing rivers for human recreation	14.3	28.5	28.3	21.5	7.3	2.8	1.2
as a cultural and cultural-historical destinations are more important than free-flowing rivers	19.0	26.4	33.9	16.9	3.8	2.6	1.1
is a significant factor in Finland's energy self-sufficiency	3.1	9.0	21.0	38.3	28.6	3.8	1.0

N = 2008.

Table D2

Factor analysis of attitudes towards hydropower production.

Attitude statements towards hydropower production	1 Pro hydropower production (hydropower attitudes_fl_pro hydropower production)
Factor loadings	
Hydropower is an environmentally friendly way to produce energy	0.782
Hydropower production does not hinder recreation in river environments	0.749
Hydropower production is crucial to mitigate climate change	0.720
Hydropower production is more important than free-flowing rivers as habitats for migratory fish	0.787
is more important than free-flowing rivers for human recreation	0.795
Hydropower plants as cultural-historical destinations are more important than free-flowing rivers	0.673
Hydropower production is a significant factor in Finland's energy self-sufficiency	0.723

Extraction Method: Principal Component Analysis.

The item “Hydropower production can in the future be replaced by other energy sources for regulating energy” was removed from the final factor solution. The initial factor analysis produced a one-component solution, in which the factor loadings of the other items were above 0.66, but the factor loading of the hydropower item was negative. It was therefore excluded from the final factor solution in order to facilitate the interpretation of the factor.

Appendix E. Descriptive statistics and factor analysis of attitudes towards biodiversity restoration measures in hydropower production

Table E1

Descriptive statistics for attitudes towards biodiversity restoration measures in hydropower production.

Attitude statements	Completely disagree (1)	Partly disagree (2)	Neither agree nor disagree (3)	Partly agree (4)	Completely agree (5)	Mean	Std. deviation
	% of respondents						
In my opinion, in Finland...							
All constructed rivers should be restored as close as possible to their natural state	20.8	25.1	23.8	21.3	8.9	2.7	1.3
Only the most important rivers for hydropower production should be retained for hydropower generation	3.9	10.4	26.3	38.8	20.9	3.6	1.0
Hydropower companies are already taking sufficient measures to reduce environmental damage	19.9	26.9	36.5	12.9	3.8	2.5	1.1
Hydropower companies can compensate for their environmental damage with financial compensation	19.1	27.1	25.5	20.9	7.4	2.7	1.2
Hydropower companies can compensate for the harm to fish stocks by stocking fish	6.5	15.0	19.4	40.3	18.9	3.5	1.1
The migratory connections of fish must be opened primarily by means of fishways, not by dismantling dams	3.2	10.3	25.0	36.5	25.0	3.7	1.1
River environments must be protected considerably more than at present	2.7	7.6	24.7	34.4	30.7	3.8	1.0
Protecting migratory fish stocks is very important	1.0	2.6	12.8	35.5	48.1	4.3	0.9
Mitigating nature impacts must not affect the fluctuation of the water level in nearby water systems	4.9	16.4	44.0	24.4	10.3	3.2	1.0

(continued on next page)

Table E1 (continued)

Attitude statements	Completely disagree (1)	Partly disagree (2)	Neither agree nor disagree (3)	Partly agree (4)	Completely agree (5)	Mean	Std. deviation
	% of respondents						
Mitigating climate change through hydropower is more important than the damage it causes to biodiversity	13.4	23.4	32.7	21.9	8.7	2.9	1.2

N = 2008.

Table E2

Factor analysis of attitudes towards biodiversity restoration measures in hydropower production.

Attitude statements	1	2
	More restoration	Easy ways for companies
Factor loadings		
In my opinion, in Finland, all constructed rivers should be restored as close as possible to their natural state	0.732	-0.132
In my opinion, in Finland, hydropower companies are already taking sufficient measures to reduce environmental damage	-0.668	0.382
In my opinion, in Finland, hydropower companies can compensate for their environmental damage with financial compensation	-0.029	0.735
In my opinion, in Finland, hydropower companies can compensate for the harm to fish stocks by stocking fish	-0.118	0.814
In my opinion, in Finland, the migratory connections of fish must be opened primarily by means of fishways, not by dismantling dams	-0.362	0.570
In my opinion, in Finland, river environments must be protected considerably more than at present	0.875	-0.087
In my opinion, in Finland, protecting migratory fish stocks is very important	0.793	0.049
In my opinion, in Finland, mitigating nature impacts must not affect the fluctuation of the water level in nearby water systems	-0.026	0.583

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The items “Only the most important rivers for hydropower production should be retained for hydropower generation” and “Mitigating climate change through hydropower is more important than the damage it causes to biodiversity” were removed from the final factor solution because they exhibited relatively strong loading on two factors. Only the most important rivers for hydropower production should be retained for hydropower generation had a factor loading of 0.434 for factor one and 0.215 for factor two. Mitigating climate change through hydropower is more important than the damage it causes to biodiversity had a factor loading of -0.674 for factor one and 0.355 for factor two.

Appendix F. Conditional logit model for the choice experiment

Table F1

Conditional logit model for the choice experiment data.

Constants	Class 1	WTP, €
ASC SQ		
ASC Alternative 1	0.154	
ASC Alternative 2	0.036	
Cost, €	-0.029 ^a	
Location of restoration measures (ref: throughout the country)		
Southern Finland only	-0.484 ^a	-166.8
Northern Finland only	-0.450 ^a	-155.2
Target rivers (ref: all kinds of rivers)		
Rivers with a high volume of hydropower production only	-0.099 ^c	-34.07
Rivers with a low volume of hydropower production only	-0.173 ^a	-59.59
Kilometers of river ecosystem restored	0.0004 ^a	0.138
Waterbodies with wild reproductive migratory fish population achieved		
New water bodies with wild reproductive trout populations	0.669 ^a	230.6
New water bodies with wild reproductive trout and salmon populations	0.790 ^a	272.3

Table F1 shows a conditional logit model in which all respondents are in one class. Based on the model, the respondents are willing to pay for river restoration and for restoration measures that will restore wild trout and salmon populations to waterways. The negative coefficients for the location of the measures and the target river attributes indicate that, on average, respondents would like restoration measures to be carried out throughout the country and in rivers with both high and low hydropower production.

Appendix G. A 5-class latent class model in which no restrictions are placed on the attribute coefficients

Table G1

A 5-class latent class model for the choice experiment data in which no restrictions are placed on the attribute coefficients.

	Class1	Class2	Class3	Class4	Class5	Wald, p-value	Wald(=), p-value
Class size	0.257	0.248	0.2207	0.1563	0.118		
Attributes	Coefficients and signiracnce levels						
ASC SQ							
ASC Alternative 1	1.011	-1.997	3.057 ^a	0.985 ^c	6.151	0.000	0.000
ASC Alternative 2	0.978	-1.565	3.400 ^a	0.343	5.301		
Cost	-0.017 ^a	-0.007 ^a	0.000	-0.003 ^a	-0.004 ^a	0.000	0.000
Geographical location of the measures							
Southern Finland only	0.122	-1.216 ^a	-0.472 ^a	-1.314 ^a	-1.068 ^a	0.000	0.001
Northern Finland only	-0.714 ^a	-1.296 ^a	-0.860 ^a	-0.701 ^a	0.570 ^c	0.000	0.001
Target rivers							
Rivers with a low volume of hydropower production only	0.326	-0.893	-0.335 ^b	-0.279	0.009	0.080	0.270
Rivers with a high volume of hydropower production only	0.455	-0.708	-0.280	-0.138	-0.263	0.210	0.310
Kilometers of free-flowing river achieved	0.001 ^a	-0.0004	0.001 ^a	-0.0001	0.0002	0.000	0.000
Waterbodies with wild reproductive migratory fish population achieved							
New water bodies with wild reproductive trout populations	1.545 ^a	0.499	1.329 ^a	0.576 ^b	1.028 ^a	0.000	0.130
New water bodies with wild reproductive trout and salmon populations	1.640 ^a	0.458	1.920 ^a	0.569 ^b	1.033 ^b	0.000	0.008

^a p-value <0.01.

^b p-value <0.05.

^c p-value <0.1.

In this model, all classes except Class 2 valued the increase of trout and salmon habitats. The number of free-flowing river kilometers had a statistically significant effect on choices in Classes 1 and 3.

Respondents in Classes 2, 3, and 4 preferred that restoration measures be implemented across the whole of Finland. For Class 1, it was important that measures were not implemented only in Northern Finland, while for Class 5 it was important that they were not implemented only in Southern Finland. Class 5 also found it acceptable that measures be carried out exclusively in Northern Finland.

Hydropower production intensity mattered only for Class 3, which preferred that measures not be limited to rivers with low hydropower production.

Costs had a negative and statistically significant impact in all classes except Class 3, which preferred more restoration measures regardless of the cost.

Overall, Classes 1 and 3 emerge as the most environmentally oriented groups. For them, the increase of fish habitats had the greatest influence across classes, and they were also willing to pay for increasing the number of free-flowing rivers. Classes 4 and 5 also favored the increase of fish habitats but were somewhat more moderate in their preferences compared to Classes 1 and 3. For Class 3, the magnitude of costs did not affect choices.

Class 2 was relatively indifferent to most attributes; for them, the only statistically significant factors were cost and the requirement that measures be implemented nationwide.

Table G2 presents the willingness-to-pay estimates for the classes.

Table G2

Willingness to pay estimates for the attributes of the choice experiment in the latent classes.

Attribute	WTP, €/person/year in ten years				
	Class 1	Class 2	Class 3	Class 4	Class 5
Geographical location of the measures					
Southern Finland only		-164.3	-	-424.0	-274.0
Northern Finland only	-42.5	-175.2	-	-226.0	0.04
Target rivers					
Rivers with a high volume of hydropower production only	-	-	-	-	-
Rivers with a low volume of hydropower production only	-	-	-	-	-
Kilometers of free-flowing river achieved, EUR/km	0.08	-	-	-	-
Waterbodies with wild reproductive migratory fish population achieved					
New trout waters	92.0	-	-	185.6	263.5
New trout and salmon waters	97.6	-	-	183.7	264.9

Appendix H. Questionnaire

The survey was conducted only in Finnish, and it has been translated into English for inclusion in the article. The layout of the questionnaire presented here differs from the layout of the implemented survey, which was conducted as an online questionnaire by the private survey company Taloustutkimus.

Dear respondent,

Thank you for taking the time to participate in this study on citizens' views about hydropower production in Finland and its environmental

management.

Every response is important, whether you feel very familiar or not at all familiar with hydropower production and its impacts, or whether it affects your daily life a little or a lot.

The information you provide will help guide the development of hydropower management approaches that balance society's energy needs, climate change considerations, the condition of our waterways, and citizens' values. This survey is part of the SusHydro project, funded by the Academy of Finland and carried out by the University of Eastern Finland, the Natural Resources Institute Finland (Luke), and the Finnish Environment Institute (SYKE). The survey is administered by the Natural Resources Institute Finland (Luke).

Thank you again for your time and contribution!

All responses are anonymous, and participants cannot be identified from their answers. Information on data protection for the collected material can be found at: [link].

For more information about the study, please contact:

Tuija Lankia – Research Scientist, Natural Resources Institute Finland (Luke)

Email: [e-mail address].– Tel. [phone number].

Janne Artell – Senior Scientist, Natural Resources Institute Finland (Luke)

Email: [e-mail address].– Tel. [phone number].

Your connection to river environments

1. How far is the nearest river environment from your permanent residence or your recreational property?

By “river environment,” we mean areas of rivers or streams where the water depth allows navigation by at least a small boat. Reservoirs formed by dammed river areas are also considered river environments

 - Less than 1 km away
 - 1–5 km away
 - 6–20 km away
 - More than 20 km away
2. Do the following factors affect the river environments near your permanent residence or recreational property in any way? Please select all that apply.
 - Hydropower production
 - Water level regulation in nearby water bodies
 - Other water constructions (dams, culverts)
 - None of the above
3. How many days have you spent leisure time in a river environment during the past 12 months? An estimate is sufficient. If not at all, mark 0. Please consider all visits for leisure to river environments in Finland, whether for walking, swimming, fishing, or spending time at a recreational property.

__ days
4. What do you usually do when spending leisure time in a river environment? Please select your main activities.
 - I do not spend leisure time in river environments
 - Jogging or walking
 - Swimming, diving, or snorkeling
 - Fishing
 - Nature observation or photography
 - Boating or paddling
 - Hiking
 - Spending time on the shore, picnic
 - Ice sports (skating or skiing)
 - Other, what: _____
5. Which of the following describe your fishing in river environments? Please select all that apply.
 - I fish especially in a river environment near my home or recreational property
 - I fish only in a few familiar river environments
 - I make overnight fishing trips to a river or rivers
 - I fish stocked fish
 - I fish especially migratory fish
 - I prefer rivers with good fish stocks
 - Migration barriers in rivers hinder my fishing

The significance of rivers to you

6. How important are the following aspects related to Finnish river environments to you?

(Scale: 1 = Very important, 2 = Fairly important, 3 = Neither important nor unimportant, 4 = Fairly unimportant, 5 = Completely unimportant)

 - a) Opportunity to experience the river environment and its plants and animals
 - b) Inspiration and new ideas, artistic experiences
 - c) The existence of natural river environments
 - d) Preservation of natural river environments for future generations
 - e) River-related livelihoods (other than hydropower)
 - f) Opportunity to visit cultural sites
 - g) Fishing opportunities
 - h) Fish caught from the river as food

- i) Other outdoor and recreational opportunities in the river environment (excluding fishing)
- j) Hydropower production
- k) Flood management and water level regulation in nearby water bodies
- l) Built river landscape (e.g., stone embankments, ironworks, dams, bridges, power plants)

The role and impacts of hydropower in society

In 2019, hydropower accounted for 14% of the electricity consumed in Finland. Hydropower is currently the technically and economically best way to provide balancing power, i.e., to smooth out peaks in electricity production and consumption. As weather-dependent wind and solar power production increases, the need for balancing power will grow.

Hydropower is produced in 29 watercourses in Finland. Of these, six (Kemijoki, Oulujoki, Vuoksi, Kokemäenjoki, Kymijoki, and Iijoki) account for over 95% of domestic hydropower production. The other 23 regulated watercourses are of lesser importance for hydropower production due to smaller power plants and production potential.

7. How well do you feel you are familiar with hydropower production in Finland? (Scale: 1 = Very well ... 5 = Not at all)
8. Does your household currently use electricity produced by hydropower?
 - Yes
 - No
 - I don't know
9. Does your household currently use eco-labeled electricity?
 - Yes
 - No
 - I don't know

Hydropower impacts on river environments

Hydropower dams and flow regulation significantly affect river ecosystems. Dams make it difficult or impossible for migratory fish to reproduce naturally. By migratory fish we mean species that are born in rivers, spend their growth phase in the sea or a lake, and return to their birthplace to spawn. Most migratory fish species in Finland are endangered.

The construction of rivers also weakens the living conditions of other animal and plant species dependent on free-flowing rivers. For example, the freshwater pearl mussel has almost completely disappeared from southern Finland.

10. How well do you feel you are familiar with the ecological and environmental impacts of hydropower? (Scale: 1 = Very well ... 5 = Not at all)

Managing the ecological impacts of hydropower

Hydropower producers have been required to compensate for damage to fish stocks and fishing through fish stocking, habitat restoration, fisheries fees, and technical bypass solutions for dams. In some cases, especially for small power plants, there are no such requirements, or they only concern water level regulation.

These obligations have not been sufficient to maintain viable populations of migratory fish and other riverine species. For example, stocked fish do not survive like wild fish.

Restoring fish populations requires technical solutions or the removal of migration barriers. Fishways or bypass channels resembling natural streams enable fish to migrate past dams upstream to spawning areas. In addition, habitat restoration measures and safe downstream guidance of juveniles are needed.

These measures entail construction and maintenance costs for hydropower producers, as well as losses in electricity production when water bypasses the power plant. Fish stocking also involves costs.

11. To what extent do you agree or disagree with the following statements about domestic hydropower production? (Scale: 1 = Strongly agree ... 5 = Strongly disagree)

I think that hydropower production in Finland...

- a) ... is an environmentally friendly way to produce energy
- b) ... does not hinder recreation in river environments
- c) ... is very important for mitigating climate change
- d) ... can be replaced as balancing power in the future
- e) ... is more important than free-flowing rivers as habitats for migratory fish
- f) ... is more important than free-flowing rivers as recreation areas for people
- g) ... as cultural-historical sites are more important than free-flowing rivers
- h) ... is a significant factor in Finland's energy self-sufficiency

12. To what extent do you agree or disagree with the following statements related to mitigating the environmental impacts of hydropower? There are no right or wrong answers.

(Scale: 1 = Strongly agree, 2 = Somewhat agree, 3 = Neither agree nor disagree, 4 = Somewhat disagree, 5 = Strongly disagree)

- a) In my opinion, all regulated rivers in Finland should be restored as close to their natural state as possible
- b) Only the rivers most significant for hydropower production should be maintained in hydropower use

- c) Hydropower companies are already doing enough to reduce environmental impacts
- d) Hydropower companies can compensate for the environmental harm they cause with financial payments
- e) Hydropower companies can compensate for the harm caused to fish stocks by stocking fish
- f) Fish migration routes should be restored primarily with fishways, not by dismantling hydropower dams
- g) River environments should be protected significantly more than at present
- h) Protecting migratory fish populations is very important
- i) Mitigation of environmental impacts must not affect water level regulation in nearby water bodies
- j) Mitigating climate change through hydropower is more important than its negative impacts on biodiversity

Could the environmental impacts of hydropower production be reduced through ecological compensation?

Reducing environmental impacts is most cost-effective for both the economy and biodiversity in locations where improvements to the state of river environments are achieved with the smallest possible input.

One way to improve cost-effectiveness is ecological compensation, in which the party causing the environmental harm improves the condition of a similar environment elsewhere rather than at the location where the harm occurred. Yet, compensation should only be applied to the extent that mitigation measures are not technically or economically feasible at the original site of the damage.

The goal of ecological compensation is to fully offset the environmental damage caused, while also taking into account the risks of restoration measures failing. Ecological compensation, however, does not primarily take into account the impacts of environmental harm or restoration measures on people.

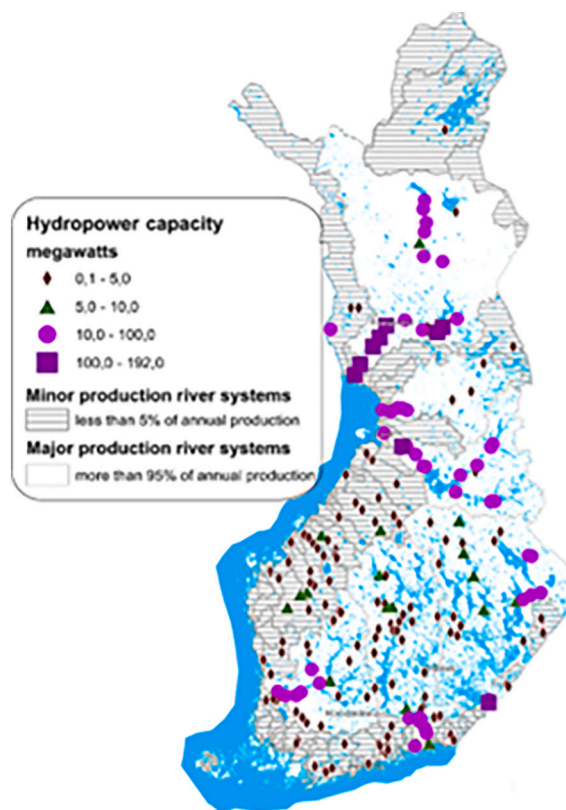
Ecological compensation is not currently in use in Finland, but its adoption has been proposed as a way to reduce environmental impacts and to help resolve conflicting situations. Next, we will ask for your views on the acceptability of ecological compensation in relation to hydropower and river environments.

13. To what extent do you find ecological compensation of hydropower's environmental impacts an acceptable practice?
 1 = Very acceptable practice, 2 = Fairly acceptable practice, 3 = Not very acceptable practice, 4 = Not at all acceptable practice, 5 = Don't know/Cannot say.
14. In your opinion, would ecological compensation of hydropower's environmental impacts be acceptable if the given statement were to apply?
 There are no right or wrong answers. (Scale Acceptable, Not acceptable)

Compensation measures

- a) ... would not fully cover the harm caused to biodiversity
- b) ... would impose costs on society
- c) ... would significantly reduce domestic electricity production
- d) ... would produce a greater improvement in environmental conditions than the original harm (overcompensation)
- e) ... could be implemented far from the river environment that suffered the harm
- f) ... would be implemented if restoration in the affected river environment were not economically viable
- g) ... would be implemented only if restoration in the affected river environment were not technically feasible
- h) ... would be implemented without consulting local residents in the affected area
- i) ... would not benefit people but only nature
- j) ... could also be implemented in other natural environments (forests, mires, etc.)
- k) ... would be implemented only in small rivers producing hydropower, leaving the impacts of large hydropower plants unchanged

Where and how should river environments be restored?



The choice situations involve the following impacts, which we ask you to review carefully.

	Description
Geographical location of restoration measures	The geographical location of the restoration measures indicates whether new restoration efforts would be targeted in Northern Finland, Southern Finland, or across the whole country.
Targeting of restoration measures across water bodies	The targeting of restoration measures indicates whether new efforts would be implemented in rivers with low hydropower production, in rivers with high hydropower production, or in both.
Free-flowing river kilometers	Diverse river ecosystems require free-flowing water. At present, less than 30% of Finland's river kilometers are free-flowing. Free-flowing river segments can be increased through restoration measures such as dam removal.
Natural migratory fish waters	Natural populations of migratory fish require free-flowing rivers as their habitat. Restoration measures can enable the return of brown trout alone, or both brown trout and Atlantic salmon, to rivers that are suitable habitats for them.

15. Before presenting the choice situations, we would like to know how much you would at most be willing to pay for the implementation of the proposed restoration program below compared to the current projected development path

	Current development	Restoration program
Location of restoration actions	All of Finland	All of Finland
Focus of restoration actions in different river systems	All hydropower producing river systems	All hydropower producing river systems
New free running river-kilometers	100 km	900 km
New naturally producing migratory fish river systems	No new trout or salmon producing river systems	Both new trout and salmon producing river systems created

I would be willing to pay at most ____€ per year in increased taxes for the proposed restoration program for ten years (2022–2031). Please remember that the amount you indicate would reduce your other consumption. The effects of the program would be visible in the water bodies starting from 2025.

16. Choice situation 1. Please select the option you prefer the most from the following. Please remember that the proposed cost would reduce your consumption every year for ten years (2022–2031). If you choose the current development, there will be no additional costs. The effects of the program would be visible in the water bodies starting from 2025.
Which option would you choose?

	Current development	Alternative 1	Alternative 2
Location of restoration actions	All of Finland	North-Finland	South-Finland
Focus of restoration actions in different river systems	All hydropower producing river systems	Major hydropower producing river systems	Minor hydropower producing river systems
New free running river-kilometers	100 km	450 km	900 km
New naturally producing migratory fish river systems	No new trout or salmon producing areas	New trout producing areas created	New trout or salmon producing areas created
Effect on your taxation between 2022 and 2031	0 € per year (in 10 years totalling 0 €)	10 € per year (in 10 years totalling 100 €)	400 € per year (in 10 years totalling 4000 €)
I choose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Respondents were presented with a total of six choice situations.

17. If you chose the first option (current development) in one or more of the choice situations, what was the main reason for your choice?
- The condition of river environments in Finland is good enough without additional measures
 - The other options were too expensive
 - The other options were not good enough
 - I cannot afford to pay for additional measures
 - Other problems are more important than the condition of river environments
 - I oppose additional taxes
 - I do not believe that the money would be used to improve the condition of river environments
 - The condition of river environments cannot be significantly improved from the current state
 - Other reason, what? _____
18. When making your choices, how important were the following factors to you? (Scale: Very important, Fairly important, Neither important nor unimportant, Somewhat unimportant, Completely unimportant)
- Geographical location of restoration measures
 - New free-flowing river kilometers
 - New natural migratory fish waters
 - Targeting of restoration measures across different water bodies
19. To what extent do you agree or disagree with the following statements related to the choice tasks? (Scale: Strongly agree, Somewhat agree, Neither agree nor disagree, Somewhat disagree, Strongly disagree)
- a) It was easy to answer the choice questions
 - b) I made my choices based only on one factor
 - c) I am confident in my choices
 - d) I believe that my answers matter for the survey results
 - e) I believe that the survey results will have an impact on planning the reduction of hydropower's environmental impacts
20. To what extent do you agree or disagree with the following statements related to the funding of river environment restoration? (Scale: Strongly agree, Somewhat agree, Neither agree nor disagree, Somewhat disagree, Strongly disagree)
- a) Money should preferably be used for other nature conservation rather than restoring river environments
 - b) I cannot currently afford to contribute to nature conservation
 - c) Too little money is spent on nature conservation
 - d) Funding for restoring river environments should be obtained from hydropower companies
 - e) The state must financially support hydropower owners in covering the costs of restoring river environments

Background questions

21. To what extent do you agree or disagree with the following statements? (Scale: Strongly agree, Somewhat agree, Neither agree nor disagree, Somewhat disagree, Strongly disagree)
- The delicate balance of nature is easily disturbed by human activity
 - The Earth has only limited space and resources
 - Plants and animals do not exist primarily for humans
 - Changing the environment for human use rarely causes serious problems
 - Economic growth has no limits
 - Humans have the right to control the rest of nature
22. How important are the following values to you?

Please select the option that best reflects your view. Use also the extremes of the scale. (Scale: Extremely important, Somewhat important, Neither, Somewhat unimportant, Not important at all).

- Power (e.g., control of others, prestige, social power, wealth)
- Achievement (e.g., success, ability, ambition, hard work, achieving goals, influencing people and events)
- Hedonism (e.g., satisfying cravings, self-indulgence, enjoying life)

- Stimulation (e.g., adventures, risk-taking, a diverse and exciting life)
- Self-direction (e.g., creativity, freedom, curiosity, independence, choosing your own goals)
- Universalism (e.g., broad-mindedness, beauty of nature and arts, social justice, peace of mind, equality, mature understanding of life, protection of nature)
- Benevolence (e.g., helpfulness, honesty, forgiveness, loyalty, trustworthiness, friendship)
- Tradition (e.g., respect for traditions, humility, acceptance of one's lot in life, adherence to faith, moderation, temperance)
- Conformism (e.g., obedience, respect for older people, self-discipline, politeness)
- Security (e.g. national security, family security, social order, cleanliness, reciprocity of services)

23. What are the first three digits of the postal code of your permanent residence?
24. What is your primary living environment?
- Rural area
 - City or urban-like environment
25. What is your gender?
- Male
 - Female
 - Other
26. Your age?
27. What is your highest level of vocational/educational attainment? (mark the highest level)
- Vocational school
 - Institute-level degree
 - Bachelor's degree
 - Master's degree
 - No degree or degree unfinished
28. Are you currently employed?
- Yes
 - No
29. Your annual income before taxes (gross income)?
- No income
 - Less than €23,000
 - €23,000 – €30,999
 - €31,000 – €46,999
 - More than €47,000
30. What is the type of your household?
- Single-person household
 - Couple
 - Household with children
 - Other adult household (all members over 18 years old)
 - Other
31. Which party would you be most likely to vote for in the next elections?
- The National Coalition Party
 - Finns Party
 - Centre Party
 - Christian Democrats
 - The Swedish People's party of Finland
 - The Social Democratic Party of Finland
 - Left Alliance
 - The Greens
 - Other
 - I would not vote for any party-
 - I do not wish to say/I don't know
32. If you wish, you may add to your responses or comment on the questionnaire or the study below

Appendix I. Average score of valuation debriefing questions by class

Variable	Average score on a 5-point Likert scale from completely unimportant (1) to very important (5).							
	Class 1	Class 2	Class 3	Class 4	Class 5	All	F-score	P-value
Importance of attributes in choices								
The geographical location of the restoration measures	3.3 ²⁴⁵	3.5 ¹³	3.2 ²⁴⁵	3.7 ¹³	3.6 ¹³	3.4	13.8	0.000
New free-flowing river kilometers	4.0 ²³⁵	4.3 ¹³⁴⁵	3.1 ¹²⁴⁵	4.0 ²³⁵	3.7 ¹²³⁴	3.9	126.0	0.000
New natural migratory fish waters	4.1 ²³⁵	4.5 ¹³⁴⁵	3.1 ¹²⁴⁵	4.1 ²³⁵	3.7 ¹²³⁴	3.9	139.5	0.000
Targeting of restoration measures to different water bodies	3.9 ²³	4.2 ¹³⁴⁵	3.3 ¹²⁴⁵	4.0 ²³⁵	3.7 ²³⁴	3.8	55.0	0.000
Tax cost	3.8 ²³⁴⁵	3.2 ¹³⁴⁵	4.1 ¹²⁴	3.5 ¹²³⁵	4.1 ¹²⁴	3.7	68.5	0.000

(continued on next page)

(continued)

Variable	Average score on a 5-point Likert scale from completely unimportant (1) to very important (5).							
	Class 1	Class 2	Class 3	Class 4	Class 5	All	F-score	P-value
Statements regarding choice tasks								
Average score on a 5-point Likert scale from completely disagree (1) to completely agree (5)								
It was easy to answer the choice questions.	3.1	3.2 ⁴	2.9	2.9 ²	2.9	3.0	2.9	0.020
I made my choices based on only one factor.	2.6 ³⁴	2.6 ³	3.1 ¹²⁴⁵	2.8 ³	2.8 ³	2.8	17.1	0.000
I am confident in my choices.	3.2 ²³	3.5 ¹⁴	3.6 ¹⁴⁵	3.3 ²³	3.3 ³	3.4	8.3	0.000
I believe that my answers matter for the survey results.	3.3 ³	3.4 ³⁵	2.8 ¹²⁴⁵	3.3 ³	3.0 ¹²³	3.2	24.1	0.000
I believe that the survey results will influence the planning of reducing the environmental impacts of hydropower.	3.3 ³⁵	3.3 ³⁵	2.7 ¹²⁴⁵	3.1 ³	3.0 ¹²³	3.1	28.3	0.000
Statements regarding restoration funding								
Money should preferably be spent on other nature conservation rather than restoring river environments.	2.6 ²³⁵	2.4 ¹³⁵	3.0 ¹²⁴⁵	2.5 ³⁵	2.8 ¹²³⁴	2.6	37.3	0.000
I cannot afford nature conservation right now.	2.6 ²³⁵	2.1 ¹³⁴⁵	3.7 ¹²⁴⁵	2.7 ²³⁵	3.3 ¹²³⁴	2.8	130.5	0.000
Too little money is spent on nature conservation.	3.8 ²³⁵	4.1 ¹³⁴⁵	2.7 ¹²⁴⁵	3.7 ²³⁵	3.2 ¹²³⁴	3.5	119.4	0.000
Money for restoring river environments should be obtained from hydropower companies.	4.0 ²³	4.2 ¹³	3.7 ¹²⁴⁵	4.0 ³	3.9 ²³	4.0	20.2	0.000
The state must financially support hydropower owners in the costs of restoring river environments.	3.1 ³	3.1 ³	2.8 ¹²⁴	3.2 ³	3.0	3.0	4.6	0.001

Numbers after figures denote classes with significant differences in Games-Howell test.

Data availability

Data will be made available on request.

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