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Seal of approval: Public preferences for the conservation of endangered Saimaa ringed seal

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ABSTRACT

In species conservation, various options for conservation measures typically exist, yet their implementation may lead to conflicts among different population groups. Heterogenous preferences toward conservation measures often stem from the utilization of natural resources, whether for livelihood or recreational purposes. This study, focusing on the Saimaa ringed seal, a symbol of nature conservation in Finland, examines both population size and conservation measures. We distinguish the stated preferences between recreational visitors to Lake Saimaa, fishers at the lake, and individuals residing in other parts of Finland without direct use of the lake. To measure preferences, we utilize a choice experiment that incorporates both population size and the most promising conservation measures as attributes. The findings reveal significant variations in willingness-to-pay estimates between visitors and non-visitors, as well as between fishers and non-fishers. Interestingly, all population groups expressed a preference for a moderate increase in the seal population and a small extension of conservation measures, rather than opting for a substantial extension of measures. This insight emphasizes the importance of considering diverse stakeholder perspectives when designing and implementing species conservation strategies.

1. Introduction

Humankind has had a devastating impact on biodiversity. According to the estimates by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019), over a million plant and animal species are under immediate threat of extinction. The main drivers of this biodiversity loss and ecosystem degradation—changes in land and sea use, overexploitation of natural resources, climate change, pollution, and the introduction of invasive species—have all accelerated in recent decades. Despite scientific information regarding the loss of biodiversity, the conservation efforts have largely failed to reverse this trend. A number of researchers recommend focusing on understanding human attitudes towards conservation to improve the social acceptability and further effectiveness of conservation strategies (Carmen et al., 2015; Lévesque, Gagné, & Dupras, 2022; Martín-López, Montes, & Benayas, 2007). Recognizing human values, attitudes, perceptions, and preferences is essential in planning accepted conservation measures (Bennett et al., 2017). This is particularly relevant in the conservation of individual species, such as the Saimaa ringed seal (*Pusa hispida saimensis*), one of the few freshwater seal species in the world, which we are focusing on in this study.

To be able to achieve conservation objectives, conservation measures must be acceptable to the affected people and gain their commitment (Mangel et al., 1996; Reed, 2008). Preference studies can help to understand the social impacts and acceptability of conservation, as well as evaluate whether the ecological outcomes of conservation are beneficial to individuals (Bennett et al., 2017). Measuring individual preferences for the size of a species population or for conservation measures allows for consideration of the perceived benefits of conservation, such as existence, option, bequest, or spiritual values.

The results of prior preference studies on endangered species have been compiled in meta-analysis by Loomis and White (1996), Richardson and Loomis (2009), and Subroy, Gunawardena, Polyakov, Pandit, and Pannell (2019). Since these meta-analyses, recent studies have successfully applied the choice experiment method to estimate in economic terms the preferences and perceived values for conservation of individual endangered species. CE is a survey-based stated preference method widely used to estimate the value of non-market environmental goods and services (Bliemer & Rose, 2014). In previous studies, CE has been used to measure both local and visitor preferences for species conservation. For example, Zander, Pang, Jinam, Tuen, and Garnett (2014) investigated the attitudes and choices of locals and international

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tourists to ensure the survival of the wild Bornean orangutan (*Pongo pygmaeus*) population. Lee and Du Preez (2016) measured visitors' preferences for white rhinoceros (*Ceratotherium simum simum*) and black rhinoceros (*Diceros bicornis*) conservation using CE in the Eastern South Africa. Subroy, Rogers, and Kragt (2018) evaluated the non-market values of the threatened endemic species, numbats (*Myrmecobius fasciatus*) and woylies (*Bettongia penicillata ogilbyi*), in Western Australia. Estifanos, Polyakov, Pandit, Hailu, and Burton (2020) investigated rural residents' preferences in designing the Ethiopian wolf (*Canis simensis*) conservation programme to mitigate human–carnivore conflicts. Mzek, Samdin, and Mohamad (2022) applied CE to measure visitors' preferences and to estimate their willingness-to-pay (WTP) for Malayan tiger (*Panthera tigris jacksoni*) conservation attributes in Malaysia. Notaro and Grilli (2022) found that tourists preferred modest increase in the population of large carnivores at Alps.

Some previous valuation studies using various valuation methods have assessed the value of seal conservation in marine environments (Subroy et al., 2019). Total WTP per household values have varied by geographical location and the extent of population change. For instance, a 96 % loss of the elephant seal population in USA was valued at US\$ 42 (in 2016 US dollars) (Hageman, 1985). Maintaining the population of spotted seal in South Korea was valued at US\$ 39–47 (Kim, Mjelde, Kim, Lee, & Ahn, 2012). A 100 % loss for Mediterranean monk seal population in Greece was valued at US\$ 139 (Kontogianni, Tourkoulas, Machleras, & Skourtos, 2012) and US\$ 27 in another study (Langford et al., 1998, 2001), whereas maintaining the monk seal population in Greece ranged from US\$ 23 to US\$ 40 (Stithou & Scarpa, 2012).

The conservation of the Saimaa ringed seal has been valued using contingent valuation method by Moisseinen (1997). However, as far as we know, this is the only valuation study for freshwater seals. In species conservation, there are usually several options for conservation measures that can increase a species' population. While effective conservation measures may be known, their implementation can cause conflicts between population groups or stakeholders. Even if people have positive attitudes for increasing population, they may hold negative attitudes toward some conservation measures that impact their livelihoods or leisure activities. Some CE studies have focused solely on conservation measures (Grilli & Curtis, 2020), while others have analyzed preferences for various measures to achieve different population sizes (Estifanos et al., 2020; Gong, Bi, & Wu, 2020; Mzek et al., 2022; Subroy et al., 2018).

Heterogeneity in preferences towards conservation outcomes and measures have been observed. Mzek et al. (2022) allowed heterogeneity in their choice model and found that socio-demographic characteristics, such as gender and education, associated with peoples' conservation preferences. Subroy et al. (2018) identified several background variables, particularly prior knowledge, as significant factors explaining the heterogeneity in preferences for population size. Notaro and Grilli (2022) indicated that the place of residence along the urban–rural continuum influences preferences. Several valuation studies of species conservation preferences have either focused on the samples of tourists (e.g. Notaro & Grilli, 2022; Estifanos et al., 2021; Lee & Du Preez, 2016) or on the preferences of locals (Bhatta, Garnett, & Zander, 2022; Estifanos et al., 2020), but comparative analysis are rare (Estifanos, 2019).

Previous studies of conservation preferences have observed that maintaining large populations can be perceived both as a service and a disservice, particularly for large carnivores. This variation in preferences is often connected to the use of natural resources for either livelihood or leisure activities (Estifanos et al., 2020). Estifanos et al. (2020) found that respondents living inside or near protection areas, and who depend on park resources or use alternative stored livestock feed, tend to prefer increasing wolf population and receiving financial incentives from wolf-related tourism. Negative WTP estimates have been observed for the conservation of some carnivores due to the costs imposed on local communities (Jacobsen et al., 2022). Often the perceived harm is strongly associated with the size of population.

In some cases, people may prefer increasing the population size of a species only to a level where it is no longer in danger of extinction, showing indifference towards larger population sizes. For example, Jacobsen, Lundhede, and Thorsen (2012) identified respondent groups that either express preferences for saving species from acute danger of extinction but not for higher population levels, prefer both moderate and high increases in population equally, or generally show positive preferences for population increases but favor moderate increases over high for at least one wildlife attribute.

In this study on the Saimaa ringed seal, a symbol of nature conservation in Finland, we examine citizens' preferences for both population size and conservation measures. This study contributes to the existing literature by providing novel insights into preferences for various conservation measures aimed at seals. We also provide an updated valuation of the Saimaa ringed seal, which enhances the relevance of our findings for contemporary conservation efforts. Furthermore, our research methodology is designed to capture and analyze heterogeneous conservation preferences across different user groups, revealing how various population segments perceive the Saimaa ringed seal population and associated conservation measures. By presenting these new perspectives, our study advances the understanding of public attitudes towards the species and supplies valuable data that enriches the field of conservation research.

Our aim in this study is to examine the views of Finns on seal conservation, focusing on their preferences for different conservation measures, their scope, and the size of the seal population. Since it is expected that people living in different parts of Finland will have varying preferences towards conservation (Robinson, van Beukering, & Brander, 2023), the first specific objective of the study is to separately consider those who visit and recreate at the Lake Saimaa —often living in municipalities in the Saimaa region — and those who do not visit the lake and typically live in other parts of Finland. The preferences of people living outside the Saimaa region may emphasize the existence values associated with the seal population. In contrast, those who live and spend time in the Saimaa region also enjoy the opportunity to see seals in the wild, but on the other hand, must adapt their activities to the requirements of conservation measures. Given that part of the conservation measures address on fishing methods, the second specific objective is to focus on fishers and model conservation preferences by considering the heterogeneity in preferences due to fishing activity. To measure preferences, we apply CE and focus on these different groups of Finnish citizens, producing estimates for their willingness to pay for different Saimaa ringed seal conservation programs. This information can be valuable in decision-making, especially when allocating resources for different conservation measures.

2. Case: conservation of Saimaa ringed seal

The Saimaa ringed seal is a critically endangered seal sub-species living only in the Saimaa waterways in Eastern Finland. Currently, its population is around 480 individuals.¹ A century ago, the population exceeded 1,000 individuals and based on the understanding on its habitat requirements, at least 4,000 individuals could live in Saimaa. However, hunting and bounty practices completely destroyed the populations in certain areas in the early 20th century. Although the species was protected in 1955, its population continued to decline until the 1980s due to environmental toxins, habitat loss and fishing bycatch mortality. At its lowest point, the population was around 100–160 individuals (Metsähallitus, 2022).

Today, Finland is committed to protecting the seal in accordance

¹ At the time of planning and implementing the survey, the population estimate was approximately 430 individuals. Since then, the population has slightly increased. However, it should be noted that the population size is only an estimate as it is not possible to determine the exact number of seals.

with the European Union Habitats Directive ([Saimaannorpan suojelutyöryhmä, 2022](#)). The species is reclaiming its habitat, and its population is recovering in previously deserted parts of Saimaa ([Metsähallitus, 2023c](#)). However, there remains uncertainty regarding the conservation target. After achieving the mid-term goal of 400 individuals in 2019 ([Metsähallitus, 2023b](#)), the target shifted to attaining a favorable conservation status. The target comes from EU's Habitats Directive ([European Council, 1992](#)) which defines conservation status as favorable if the species is viable in its natural habitats and remains so in the long term. Achieving a favorable conservation status requires that the distribution area is sufficient and does not diminish, the population's condition is such that the species remains viable in the long term, and that there are enough suitable habitats. However, the new target for Saimaa ringed seal does not specify a number of individuals or a timeline for achieving the conservation goal. This lack of clarity generates uncertainty among stakeholders and leads to disagreements about future conservation efforts: some believe efforts can be reduced, while others think they should be intensified ([Peltonen & Sivonen, 2022](#)).

The main threats to Saimaa ringed seal conservation include fishing by-catch mortality, climate change, disturbance of nesting caused by human activities and shoreline construction, and the small size and fragmentation of the population ([Kunnasranta et al., 2021](#); [Metsähallitus, 2023c](#); [Saimaannorpan suojelutyöryhmä, 2022](#)). Various conservation measures are in place to protect the population from these threats.

While Saimaa ringed seal has become the symbol of nature conservation in Finland ([Peltonen & Sivonen, 2022](#)) and enjoys wide public support ([Turja, 2018](#)), its conservation measures have been a source of a conflict ([Peltonen & Sivonen, 2022](#)). In particular, fishing restrictions to avoid by-catch mortality have created friction between fishers and conservation community ([Peltonen & Sivonen, 2022](#)). Approximately 49 000 recreational and 190 commercial fishers operate in Lake Saimaa ([Ministry of Agriculture and Forestry of Finland, 2021](#)). The Saimaa area accounts for 34 % of the value of commercial catches in Finland's inland waters and more than half of the value of the vendace catch. The economic value of recreational fishing in the Saimaa region has been estimated at €11.4 million per year. At the same time, by-catch mortality from fishing is a major cause of death for the Saimaa ringed seal, particularly among the young ([Saimaannorpan suojelutyöryhmä, 2022](#)). Preventing seal mortality due to fishing is crucial, as other conservation measures would be insufficient otherwise.

Therefore, efforts to reduce the fishing mortality of young seals have been significantly enhanced. Gill net fishing is prohibited entirely from April 15th to June 30th, except for gill nets with a knot spacing of less than 22 mm. Certain fishing gear, such as fish-tipped hooks and strong wire nets, is prohibited year-round. Fishing restriction areas have expanded significantly over the last decade. However, with the expansion of spring and early summer fishing restrictions, mortality has shifted to July and early winter. Between 2017 and 2021, half of the observed fishing mortality occurred in July. There has been debate about extending the ban on gill net fishing should be extended until the end of July. Some support the extension to further reduce the by-catch mortality of young seals, while others oppose it due to its adverse impact on fisheries ([Ministry of Agriculture and Forestry of Finland, 2021](#)).

The conflict particularly intensifies every five years when the act restricting fishing in Lake Saimaa for the protection of Saimaa ringed seal is renegotiated ([Peltonen & Sivonen, 2022](#)). For example, the enactment of the latest act on fishing restrictions was delayed due to disagreements, particularly over the extension of the restrictions into July. There are decision-makers advocating for stricter fishing restriction to protect the species from increasing threats, while others push for maintaining or loosening the existing restrictions to allow some level of gill net fishing. Proponents of stricter fishing restrictions argue that the risk of extinction is so severe that heavy restrictions are necessary. Conversely, others believe that there is no need for new restrictions since

the population is already growing and a small number of by-catch deaths is acceptable ([Peltonen & Sivonen, 2022](#)).

Beyond fishing restrictions, there are also other measures in place to protect the seal. Saimaa ringed seals are remarkably sensitive to human disturbance during the breeding season. Therefore, landing bans are enforced in breeding areas during winter, and snowmobiling on ice is prohibited in certain areas during the breeding season. As the seal's habitat expands, there is a need to extend motorized traffic restrictions on ice to new areas to ensure the seal's nesting peace.

The construction of vacation homes and related activities on the shores of Lake Saimaa causes disturbances for the seal, as the constructed shores are not suitable for nesting areas. Of the seals potential nesting area, 30 % has been lost due to shoreline construction. Currently, construction along the shoreline is restricted if a seal nests within 800 m of the site. Expanding these construction restrictions would reduce the number of lots available in Saimaa but would require landowners to be compensated for the resulting losses.

Nature reserves have been established through the implementation of the coastal protection program and the Natura 2000 network. Piling up snow drifts supports nesting in winters with limited snow by providing seals with drifts to build their nests. This measure is effective if there is sufficient snow and ice. For ice-free winters, artificial nests are under development.

3. Data and methods

3.1. Choice experiment

We use a choice experiment (CE) to derive the preferences of citizens for different conservation scenarios for the Saimaa ringed seal. CE belongs to stated preference methods, and it uses a survey to ask respondents to choose their preferred alternative between two or more discrete alternatives described with attributes. By varying attribute levels and including a price variable as one of the attributes, respondents' perceived benefits in monetary terms i.e. willingness to pay (WTP) for a different scenarios or attribute levels, are indirectly revealed based on the choices they make (e.g., [Hanley, Mourato, & Wright, 2001](#)). Each respondent answers several choice tasks. The number of choice tasks typically ranges between 4 and 8 in environmental studies.

In our case, the attributes ([Table 1](#)) were chosen to reflect the conservation efforts of the Saimaa ringed seal as realistically as possible. A list of all existing conservation measures was used as a basis for attribute selection. The aim was to select such measures that require policy level decisions and are thus not based on volunteer work. The attributes and their levels were determined in cooperation with experts from Natural Resources Institute Finland, Metsähallitus, and the North Savo ELY Centre, who are working in the field of Saimaa ringed seal conservation. The three conservation measures selected as attributes were: prohibition of gill net fishing, prohibition of snowmobiling in areas important for the breeding of the seal, and restrictions on construction on the shores of the Lake Saimaa near breeding areas. In addition, the future size of the Saimaa ringed seal population and monetary cost of conservation measures were included as attributes. An example of the choice task is presented in [Fig. 1](#).

The choice experiment design for the survey was developed using specialized software N-Gene 1.2.1. We applied a Bayesian D-efficient design which helps to maximize the information extracted from each respondent, improves statistical efficiency, accounts for prior information about the parameters and minimizes the variability of parameter estimates ([Rose & Bliemer, 2009](#)). Priors from the pilot study facilitated this design process. We restricted the cost attribute of the alternative scenarios to be positive; hence, there would be additional cost for respondents from the additional conservation measures. For other attributes, also the status quo (SQ) level, i.e. the current state, could appear in alternative scenarios. However, the SQ level for the size of the Saimaa ringed seal population was restricted to appear less often than other

Table 1
Attributes in the choice experiment.

Attribute	Description	Current state	Levels
Size of the Saimaa ringed seal population	The Saimaa ringed seal is a highly endangered seal subspecies that lives only in Finland, in the waters of Saimaa. At its lowest point, the population was less than 200 individuals in the 1980s.	Currently, the population is around 430 individuals.	The population will stay at 430 The population will increase 1.5-fold (to 600) The population will increase 2-fold (to 800) The population will increase 2.5-fold (to 1000)
Duration of the net fishing ban	By banning net fishing in the most important habitats for Saimaa ringed seal cubs, the number of deaths due to fishing nets is reduced.	Currently, net fishing is prohibited in nesting areas from 15 April to 30 June. As for vendace nets, the fishing ban ends on June 20. In addition, during open water season, the nets must be anchored and it is forbidden to lower the nets to the vertical wires. The use of gears dangerous for Saimaa Ringed Seal is prohibited all year round. The scope and duration of the net fishing ban can be changed by regulation.	Stays as it is (15.4–30.6) Extends until the end of July Extends until the end of October Lasts all year round
Motor vehicle ban on ice	Saimaa ringed seals are particularly sensitive to disturbances during the breeding and pup-rearing phase, especially motor vehicles are harmful to nesting.	Currently, motorized vehicles on ice are restricted in Saimaa national parks, in Lietvesi near Puumala and in Jänisselkä near Rääkkylä. The ban can also be extended elsewhere.	Stays as it is (100 km ²) Area doubles to 200 km ² Area quadruples to 400 km ²
Building sites available for construction along the shoreline	The construction of the shores of Lake Saimaa causes disturbances for the Saimaa ringed seal, and the constructed shores are not suitable for nesting areas. So far, approx. 30% of the seal's potential nesting area has been lost as a result of shoreline construction.	The construction along the shoreline can be restricted on zoned construction sites if they are located in nesting areas. Nowadays, construction is restricted if the seal nests closer than 800 meters from the construction site. It is possible to expand the construction restriction, which would reduce the number of beach construction sites available in Saimaa. Landowners will be compensated for the resulting losses.	Stays as it is (7200) Decreases by a quarter from the current (5600) Decreases to half of the current (3600)
Cost, €	Additional conservation		0 (current) 10

Table 1 (continued)

Attribute	Description	Current state	Levels
	measures incur costs.		20 50 100 200 500

levels. In total, the design consisted of 108 choice tasks, organized into 18 blocks with six choice tasks in each. Respondents were randomly assigned to different blocks while aiming for even distribution across all blocks. Blocking the design divides the full set of choice tasks into smaller subsets, so that each respondent completes only one block. This approach reduces the cognitive burden on respondents and enhances data quality by allowing to cover large set of possible attribute combinations.

3.2. Survey

The online survey, including the CE, was implemented in spring 2022, which gathered information on the attitudes and preferences of Finns towards the conservation of the Saimaa ringed seal. The survey was designed in cooperation with researchers from the Natural Resources Institute Finland who specialize in the economic valuation of the environment and the conservation of the Saimaa ringed seal. In addition, eight experts with wide knowledge from Saimaa ringed seal and its conservation from universities, environmental organizations, and Metsähallitus, a stated-owned enterprise managing state-owned land and water areas in Finland, gave feedback on the survey. Before the actual data collection in April-May 2022, the survey was tested in a pilot survey with 210 respondents. The design of the bid range in CE was supported by open ended contingent valuation results from the pilot. The effects of attribute levels on choice probabilities were analyzed to evaluate the attribute levels for the final survey. The survey was finalized based on the results and feedback from the pilot.

The final questionnaire consisted of seven sections: 1) introduction to the survey, 2) respondents' connections to the Saimaa region, visits to the Saimaa and experiences with the Saimaa ringed seal, 3) most recent leisure visit to Saimaa (asked only of respondents who had visited Saimaa during their leisure time in the last year), 4) recreational fishing in Saimaa (only asked of respondents who reported recreational fishing in Saimaa), 5) preferences towards conservation measures for the Saimaa ringed seal measured with choice experiment, 6) future recreational visits to Saimaa, and 7) background information. There were 44 questions in total, however, questions regarding details on recreation visits to Lake Saimaa or on fishing activities were only asked from those respondents reporting they had visited or fished on Lake Saimaa during the past year. The questionnaire was conducted as a web-based survey and the practical implementation was carried out by Iro Research agency.

3.3. Sample

The questionnaire was addressed to three separate samples: 1) Finnish citizens aged 18 and over, aiming for a representative sample by age, gender, and place of residence; 2) residents of the municipalities around Lake Saimaa; and 3) visitors to Linnansaari National Park, located on an island in the middle of Lake Saimaa, in 2021. Samples 1 and 2 were retrieved from the respondent panel of the private survey company IROResearch, while the contact details of respondents in sample 3 were obtained from the Metsähallitus Linnansaari Visitor Survey. A total of 1,487 respondents answered the survey, with a response rate of 10.3 %. The number of respondents in the subsamples, as well as socio-demographic background of the respondents, are presented in Table 2.






		Current state	Scenario A	Scenario B
Size of the Saimaa ringed seal population		Currently approximately 430 individuals	The population will increase 2-fold	The population will increase 1.5-fold
Duration of net fishing ban		15.4.–30.6.	Stays as it is	Extends until the end of October
Motor vehicle ban on ice, km²		100 km ²	Area doubles to 200 km ²	Stays as it is
The number of building sites available for construction along the shoreline		7200	Decreases by a quarter from the current	Decreases by half of the current
Additional cost as tax for a 10-year period, €/year		€0	€50	€20

Fig. 1. Example of the choice task.

Table 2
Socio-demographic background of the respondents.

	Sample			All samples together	Finnish population ^a
	Finland	Lake Saimaa region	Linnansaari National Park visitors		
N	913	522	52	1487	
Gender, male %	52.5	36.6	42.3	47	49
Age, median	54	63	52	57	43.6*
High education, %	50.5	46.6	75	52.4	32.6
Median income, €	2000–2999	2000–2999	3000–3999	2000–2999	2994
Has visited Lake Saimaa during last 12 months, %	16.8%	77.8%	98.1%	41.0%	
Has fished in Lake Saimaa, %	3.2%	27.0%	26.9%	12.4%	

^a Source: Tilastokeskus, www.stat.fi.

* Population median includes people under 18 years.

3.4. Econometric model

A mixed logit (MXL) model was used to analyze respondents' preferences for Saimaa ringed seal population size and different conservation measures based on their choices in the CE. MXL accounts for respondent heterogeneity by allowing coefficients to differ across the respondents according to a pre-specified distribution. MXL is applicable especially when the source of heterogeneity can be assumed and built in the model as interaction of relevant background variable and attributes. MXL can estimate any discrete choice model and relaxes the assumption of the independence of irrelevant alternatives (IIA) related to multinomial and conditional logit models (Train, 2003). In the MXL model, the probability of choosing alternative *i* is the expected value of the logit probability integrated over all different values of β , weighted by the mixing distribution $f(\beta)$ (Hensher, Rose, & Greene, 2005):

$$P_{ni} = \int \left(\frac{e^{\beta'x_{ni}}}{\sum_{j=1}^J e^{\beta'x_{nj}}} \right) f(\beta) d\beta$$

Typically, $f(\beta)$ is specified as continuous, and it can follow any distribution, for example normal, log-normal or uniform distribution.

In the MXL models, all attributes were treated as random variables with a normal distribution, except for cost, which was treated as a fixed variable. We estimated two models to test the effect of visitation and fishing activities. These variables were interacted with conservation scenario attributes to reveal the heterogeneity between visitors and non-visitors (Model 1) and between fishers and non-fishers (Model 2). All models were estimated using the mlogit package (Croissant, 2020) for R Statistical Software (R Core Team, 2022).

4. Results

Initially, we assessed support for conservation by comparing the proportion of respondents who chose alternative scenarios (scenario A or B) with increased level of conservation in at least one of the six choice tasks and those who consistently opted for the SQ alternative, which represents the current state without additional conservation measures. As shown in Table 3, non-visitors expressed the strongest support for conservation, followed closely by visitors. However, nearly 30 % of respondents who fish in Lake Saimaa always chose the SQ alternative, indicating lower support for the conservation among fishers.

Table 3
Support for conservation scenarios in different respondent groups.

	Non-visitors	Visitors	Non-fishers	Fishers	All
Proportion of respondents choosing increased conservation (scenario A or B) in at least one of the choice tasks, %	84.3	81.8	86.4	71.2	83.3
Proportion of respondents choosing SQ alternative in all choice tasks, %	15.7	18.2	13.6	28.8	16.7

To explore respondents' preferences for Saimaa ringed seal conservation in greater detail, we employed MXL models (Table 4) that included interactions between conservation scenario attributes and two specific groups: those who had visited Lake Saimaa within the last 12 months (Model 1) and those who had been fishing in Lake Saimaa (Model 2). This approach allowed us to compare preferences among visitors, fishers, and the remaining sample.

The alternative specific constant for status quo level (ASC SQ) in Model 1 indicates that respondents generally preferred alternative conservation scenarios over the status quo. Notably, there was no significant difference between visitors and non-visitors in their likelihood of choosing the SQ alternative. As expected, the cost of conservation program affected respondents' choices, with higher costs decreasing the likelihood of selecting an alternative scenario. The cost interaction variable for respondents who had recently visited Lake Saimaa for recreation (recreational users) showed a small positive coefficient. This suggests that the conservation program cost had a slightly less negative impact on recreational users' choices, and they were willing to pay more for the conservation programs compared to non-users.

All levels of increases for Saimaa ringed seal population were significant and positive, reflecting a strong preference for larger seal population. However, for visitors, the largest population level (1,000 seals) had a negative interaction effect, indicating that the benefit they derived from a population of 1,000 seals was actually smaller than that from a population of 800 seals.

Regarding net fishing bans, extending the ban from the end of June until the end of July was favored by all respondents. However, preferences for longer bans varied between visitors and non-visitors. While extending the ban until the end of October increased utility for non-visitors, it had a negative effect for visitors. Moreover, extending the ban throughout the entire year had a negative effect for all respondents, with visitors experiencing twice the disutility compared to non-visitors.

When it comes to expanding the motor vehicle ban on ice from the current 100 km² to 200 km², had non-visitors' responded positively. In contrast, respondents who had visited Lake Saimaa for recreation in the past year found this conservation measure to be a source of disutility. Further expanding the ban from 100 km² to 400 km² had a negative effect on the choices of all respondents, with no significant difference between visitors and non-visitors.

Finally, while decreasing the number of available building sites along the shoreline was generally perceived positively, the coefficient associated with this change was quite small for visitors. Non-visitors preferred reducing the number of sites by a quarter, whereas visitors had a stronger preference for decreasing the number of possible building sites by half.

The results from Model 2 reveal an intriguing contrast in preferences Finnish citizens and fishers in Lake Saimaa. While Finnish citizens generally prefer an increase in the seal population, fishers in Saimaa hold an opposing view. The interaction terms between fishers and the seal population attribute showed significant negative coefficients across all levels, indicating that any increase from the current seal population were perceived negatively by fishers compared to non-fishers.

Regarding the extension of net fishing bans, preferences were

distinctly divided. Fishers found any extension beyond the current ban duration unfavorable. Conversely, other citizens supported extending the ban until the end of July and showed some favorability towards extending it until the end of October. However, both groups perceived a year-round ban negatively, with fishers' expressing stronger aversion.

When examining the expansion of the motor vehicle ban on ice, increasing the restricted area from 100 km² to 200 km² had a slight positive effect on the choices of other citizens but a negative effect for fishers. Expanding the ban to further 400 km² was viewed negatively by both groups, with no significant difference in their preferences.

In terms of reducing available building sites along the Lake Saimaa shoreline, other citizens were supportive of the decrease, while fishers perceived it negatively. Notably, the interaction effects were only weakly significant. Additionally, beyond the effect of specific attributes, the non-significant coefficient for alternative-specific constant associated with the status quo level (ASC SQ) suggests no clear overall preference between choosing a conservation program or maintaining the current state. This is evident from.

Table 5 presents the willingness-to-pay (WTP) estimates for all attribute levels, derived using the mixed logit model and can be calculated as the negative ratio between attribute coefficient and cost coefficient. The results indicate diminishing marginal WTP for increases in the seal population among visitors, non-visitors, and non-fishers. In contrast, fishers exhibited negative WTP values for population increases, except at the 800-seal level, where the WTP was close to zero. For the duration of the net fishing ban, a moderate extension resulted in positive WTPs of similar magnitude to population increases among visitors, non-visitors, and non-fishers. However, a year-round ban elicited the highest absolute negative WTP, indicating significant compensation requests. WTP for expanding the area for the motor vehicle ban on ice varied across respondent groups. Similarly, regarding the reduction of available building sites along the shoreline, visitors, non-visitors and non-fishers demonstrated positive WTP, whereas fishers showed negative values, suggesting a need for compensation. These findings underscore the distinct preferences and WTP among different respondent groups, influenced by their specific characteristics and interactions with conservation scenario attributes.

Additionally, WTP estimates were calculated for two different conservation scenarios (Table 6). The first scenario included the highest levels for all attributes, resulting in a WTP of EUR 73.86 for non-visitors, whereas visitors exhibited a negative WTP of EUR -34.00. In a second, more moderate scenario with smaller attribute changes, WTP estimates were EUR 147.50 for non-visitors and EUR 105.17 for visitors.

For fishers, the first scenario yielded a WTP of EUR -249.09, indicating significant disutility. In contrast, other citizens had a positive WTP of EUR 43.79 for the same scenario. In the moderate scenario, fishers' WTP was EUR -144.36, while non-fishers showed a WTP of EUR 119.00. These results highlight the perceived disutility among fishers regarding conservation scenarios involving a larger seal population and additional conservation measures. Interestingly, non-fishers appear to favor a moderate level of conservation measures over more extreme ones.

It is important to note that the dataset used for modeling combined three distinct samples—representative of the Finnish population, residents of the Lake Saimaa region, and visitors to Linnansaari National Park. Therefore, the results cannot be directly generalized to the entire Finnish population. To address this limitation, we estimated an MXL model specifically for Sample 1. The results of this model, included in the Appendix, closely resemble the preferences observed among non-visitors and non-fishers in Models 1 and 2.

5. Discussion and conclusions

In our study, we used a choice experiment method to investigate preferences for the Saimaa ringed seal population and various conservation measures among different respondent groups. Non-visitors and

Table 4
MXL models.

Attribute	Level	Model 1 Non-visitors vs visitors				Model 2 Non-fishers vs fishers			
		Mean	S.E	Interactions for visitors	S.E	Mean	S.E	Interactions for fishers	S.E
ASC(SQ)		-0.489 *	0.260	0.368	0.349	-0.302	0.454	-0.081	0.489
Cost, €	-0.014 ***	0.001	0.002*	0.001	-0.014***	0.001	0.003**	0.001	
Saimaa ringed seal population	1.5-fold (600 seals)	0.655 ***	0.202	-0.488	0.300	0.549***	0.162	-1.062**	0.441
	2-fold (800 seals)	1.000 ***	0.205	0.032	0.300	1.058***	0.166	-1.047**	0.440
	2.5-fold (1000 seals)	1.476 ***	0.218	-0.725**	0.315	1.343***	0.175	-1.766***	0.473
Duration of the net fishing ban	Until end of July	0.671 ***	0.142	-0.331	0.211	0.600***	0.116	-0.801**	0.328
	Until end of October	0.353 **	0.148	-0.768***	0.229	0.230**	0.121	-1.946***	0.378
	All year	-0.626 ***	0.161	-0.717***	0.233	-0.852***	0.136	-1.020**	0.362
Motor vehicle ban on ice	Area doubles to 200 km ²	0.261 **	0.127	-0.347*	0.195	0.175*	0.103	-0.810***	0.313
	Area quadruples to 400 km ²	-0.237 *	0.128	-0.097	0.191	-0.261**	0.105	-0.235	0.290
Building sites available for construction along the shoreline	Decrease by one quarter (to 5400)	0.478 ***	0.126	-0.456**	0.192	0.342***	0.105	-0.581*	0.297
	Decrease to half (to 3600)	0.421 ***	0.126	-0.215	0.190	0.383***	0.103	-0.567*	0.296
		Standard deviations	S.E.			Standard deviations	S.E.		
Saimaa ringed seal population	1.5-fold (600 seals)	2.532***	0.196			2.439***	0.193		
	2-fold (800 seals)	2.642***	0.194			2.632***	0.193		
	2.5-fold (1000 seals)	3.017***	0.218			2.997***	0.217		
Duration of the net fishing ban	Until end of July	2.922***	0.216			2.884***	0.213		
	Until end of October	3.056***	0.241			3.017***	0.236		
	All year	3.176***	0.249			3.179***	0.245		
Motor vehicle ban on ice	Area doubles to 200 km ²	2.631***	0.206			2.620***	0.205		
	Area quadruples to 400 km ²	2.176***	0.181			2.121***	0.179		
Building sites available for construction along the shoreline	Decrease by one quarter (5400)	2.826***	0.204			2.844***	0.203		
	Decrease to half (3600)	2.452***	0.190			2.447***	0.188		

*, ** and *** Significance at 10%, 5% and 1% levels, respectively.

Table 5
Willingness-to-pay (WTP) estimates for seal population and conservation measures.

Attribute	Level	Model 1		Model 2	
		Visitors	Non-visitors	Fishers	Non-fishers
Saimaa ringed seal population	1.5-fold (600 seals)	54.58	46.79	-46.64	39.21
	2-fold (800 seals)	83.33	71.43	1.00	75.57
	2.5-fold (1000 seals)	62.58	105.43	-38.45	95.93
Duration of the net fishing ban	Until end of July	55.92	47.93	-18.27	42.86
	Until end of October	-34.58	25.21	-154.00	18.00
	All year	-111.92	-44.71	-170.18	-60.86
Motor vehicle ban on ice	Area doubles to 200 km ²	-7.17	18.64	-57.73	12.50
	Area quadruples to 400 km ²	-19.75	-16.93	-23.73	-18.64
Building sites available for construction along the shoreline	Decrease by one quarter (5400)	1.83	34.14	-21.73	24.43
	Decrease to half (3600)	35.08	30.07	-16.73	27.36

Table 6
WTP for different conservation scenarios, EUR.

Scenario	Model 1		Model 2	
	Visitors	Non-visitors	Fishers	Non-fishers
High	-34.00	73.86	-249.09	43.79
- Seal population 1000 seals				
- Net fishing ban all year				
- Motor vehicle ban on ice 400 km ²				
- Building sites decreased to half				
Moderate	105.17	147.50	-144.36	119.00
- Seal population 600 seals				
- Net fishing ban until end of July				
- Motor vehicle ban on ice 200km ²				
- Building sites decreased by one quarter				

non-fishers preferred increasing the Saimaa ringed seal population to the highest level presented in the CE. However, recreational visitors exhibited a turning point in their perceived benefits when the population more than doubled from its current size. This shift may reflect concerns about the potential impacts of a significant population increase on local communities and the heightened likelihood of conflicts

associated with seal conservation efforts. Fishers, on the other hand, viewed population increases negatively, likely for two main reasons: seals may be perceived as competitors that affect fish catch, and higher population levels could be expected to be a result from more stringent restrictions for fishing activities. From the policy perspective, it is essential to engage stakeholders in discussions about population targets and potential conflicts.

Our findings on preferences for population levels align with the heterogeneous groups identified by (Jacobsen et al., 2012). Fishers in our sample resembled those who favored saving species from acute danger of extinction but were not supportive of higher population levels and opposed any restrictions on recreational access. In contrast, non-fishers and non-visitors in our study resembled respondents who supported both moderate and high population increases opposing only the strictest restrictions on recreational access. Similarly, the visitors in our sample were comparable to the third group identified by (Jacobsen et al., 2012), who exhibited positive preferences for increasing population levels but favored moderate over high increases and resisted recreational access restrictions.

This variation in preferences among fishers, recreational visitors, and other respondents is consistent with previous studies that compare the preferences of those who utilize natural resources with those who value their existence and recreational aspects (Notaro & Grilli, 2022; Estafinos et al., 2021; Lee & Du Preez, 2016; Estifanos et al., 2020; Bhatta et al., 2022).

Our results indicate that a moderate extension of the net fishing ban by one month, until the end of July, was acceptable to all groups except fishers. However, longer bans encountered resistance from both fishers and recreational visitors, likely due to the significant impact these restrictions would have on their fishing activities during the vacation period. Interestingly, even non-visitors and non-fishers, who do not personally engage in fishing, did not support a year-round net fishing ban. This reluctance to endorse stringent conservation measures likely stems from a desire to avoid local conflicts, favoring policies that balance conservation with community needs.

Regarding motor vehicle bans on ice, fishers and visitors objected any extension—likely because snowmobiles are essential for net fishing during the winter. Doubling the current ban area did not significantly affect the utility of other respondents. However, expanding the ban to four times its current size was viewed negatively, suggesting that implementing motor vehicle bans in nesting areas outside of national parks could be a viable conservation strategy, provided the total banned area remains within reasonable limits. It is important to note that those supporting this conservation measure are not directly impacted by it, underscoring the need for inclusive policies that consider diverse stakeholder perspectives.

The final conservation measure—limiting the number of available building sites along the shoreline—yielded contrasting results for visitors and non-visitors. Visitors preferred stricter limitations, favoring a reduction in the number of sites by half, while non-visitors preferred reduction by a quarter. Visitors' preference for stronger limitations may be due to the fact that many of them are locals who already own property along Saimaa's shorelines.² Their aversion to further construction could be driven by a desire to maintain a peaceful environment or preserve high property values. Overall, limiting the number of building sites was seen as a positive conservation measure by all respondents except fishers.

When comparing the WTP estimates for two conservation scenarios—moderate and high—it is evident that the moderate program is preferred, yielding the greatest benefits for Finnish citizens. The difference in benefits between these scenarios was slightly more

pronounced for visitors than for fishers, with the latter experiencing negative utility from the more restrictive scenario. Since the moderate scenario also provides higher benefits for non-users, the overall preference for it remains strong, regardless of the proportion of recreational users and non-users.

Our WTP estimates are consistent with previous valuation studies on seal populations in other regions and under different scenarios. While previous studies have typically focused on the significant decline or potential extinction of seal populations (Kontogianni et al., 2012; Langford et al., 1998, 2001; Stithou & Scarpa, 2012), our study considered an increase in the population. Consequently, we applied a WTP form of CE, which generally yields lower values than compensation requests related to a declining population. Despite this, our average WTP levels were relatively high compared to previous studies, likely reflecting the flagship status of Saimaa ringed seal in Finland.

Compared to simply examining fishers' attitudes towards Saimaa ringed seal conservation, the CE provides a more comprehensive analysis by highlighting the conservation costs associated with different conservation measures and comparing potential future scenarios with the current policy. The CE results reveal distinct preferences for varying levels of conservation. While fishers may generally support conservation at current levels, they tend to oppose more stringent measures, as reflected in the CE findings.

Interactions between fisher status and most conservation attributes were significant, indicating clear differences in preferences between fishers and other respondents. Fishers exhibited substantially large negative coefficients for attributes, suggesting a strong sense of disutility from increased conservation efforts. For instance, while non-fishing respondents' WTP for different conservation scenarios ranged between €44 and €119, fishers' WTP was consistently negative, ranging from -€249 to -€144. This indicates that fishers perceive significant disutility from heightened conservation measures. However, it is important to note that these results represent the average across all fishers. As previous studies (Salmi et al., 2013) have shown, Lake Saimaa fishers are not a homogeneous group in terms of their attitudes towards Saimaa ringed seal conservation.

Contrary to several previous studies that focus on a single population group, our analysis examined the key groups with differing preferences for seal conservation measures. This approach clearly identifies which groups benefit and which perceive disutility from various conservation actions.

It is important to note that the combined data do not represent Finnish population, as residents of the Saimaa region were over-represented. However, given that Saimaa ringed seal conservation measures primarily impact those living in the region, it is crucial to understand the local population's preferences towards conservation measures. By simultaneously studying the preferences of people living outside of Saimaa, we obtained comparative, policy-relevant insights into the preferences of different groups of people across the country. Additionally, the results from the MXL model for sample 1 (Appendix), which represents the Finnish population, closely align with the preferences of non-visitors and non-fishers in the combined dataset.

Our findings suggest that implementing conservation policies with moderate increases across all measures would maximize benefits while balancing conservation with societal needs. Specifically, a moderate extension of net fishing bans is preferable based on our analysis. While higher levels of conservation are generally seen as beneficial by the majority of the population, it is crucial to strengthen compensation mechanisms for recreational fishers to mitigate potential local conflicts. Acknowledging fishers' concerns, involving them in conservation planning, and exploring alternative fishing gear or areas could help reduce perceived disutility and gain wider support for conservation measures. Moreover, transitioning directly to stringent conservation measures could heighten the risk of local conflicts.

² From the respondents that have visited Lake Saimaa during the last year, 58.2% have property on its shoreline, where as 74.5% of fishers had property on the shoreline.

CRedit authorship contribution statement

Annika Tienhaara: Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **Tuija Lankia:** Writing – original draft, Conceptualization. **Eija Pouta:** Writing – original draft, Supervision, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors 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. MXL for sample 1

Attribute	Level	Mean	S.E	WTP, €
ASC(SQ)		-0.115	0.212	
Cost, €		-0.013 ***	0.001	
Saimaa ringed seal population	600	0.684 ***	0.186	50.8
	800	1.078 ***	0.190	80.1
	1000	1.489 ***	0.203	110.5
Duration of the net fishing ban	Until end of July	0.613 ***	0.133	45.5
	Until end of October	0.418 **	0.138	31.0
	All year	-0.694 ***	0.160	-51.5
Motor vehicle ban on ice	Area doubles to 200 km ²	0.211 *	0.118	15.7
	Area quadruples to 400 km ²	-0.159	0.117	n.a.
Building sites available for construction along the shoreline	Decrease by one quarter (to 5400)	0.560 ***	0.120	34.6
	Decrease to half (to 3600)	0.466 ***	0.118	41.5
Standard deviations				
Saimaa ringed seal population	600	2.375***	0.232	
	800	2.614 ***	0.245	
	1000	3.240 ***	0.274	
Duration of the net fishing ban	Until end of July	2.630 ***	0.250	
	Until end of October	2.538 ***	0.278	
	All year	3.186 ***	0.300	
Motor vehicle ban on ice	Area doubles to 200 km ²	2.307 ***	0.234	
	Area quadruples to 400 km ²	2.018 ***	0.209	
Building sites available for construction along the shoreline	Decrease by one quarter (5400)	2.545 ***	0.230	
	Decrease to half (3600)	1.931 ***	0.208	

Data availability

Data will be made available on request.

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