Lake Saimaa recreational fishers' attitudes and behavioral response towards and preferences for Saimaa ringed seal conservation

Our Saimaa Seal-LIFE: Deliverable in D4 Report of costs for recreational fishermen

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Contents

The project has received funding from the LIFE Programme of the European Union. The material reflects the views by the authors, and the European Commission or the CINEA is not responsible for any use that may be made of the information it contains.

Summary

The Saimaa ringed seal is a critically endangered species living only in the Saimaa waterways in Eastern Finland. The basis in the Saimaa ringed seal conservation work is to reconcile the needs of the Saimaa ringed seal protection and human activities in the Lake Saimaa in a sustainable way. Therefore, the residents of the Saimaa region and key stakeholders play a pivotal role in achieving the conservation goals. Since preventing seal mortality due to fishing is of utmost importance for achievement of these goals, understanding the attitudes and behavioral responses of Saimaa recreational fishers toward Saimaa ringed seal conservation is essential in assessing the social costs and benefits of Saimaa ringed seal conservation measures. The objective of this study is to examine how recreational fishers at Lake Saimaa perceive the Saimaa ringed seal and the measures for its conservation.

According to a survey collected, majority of Lake Saimaa recreational fishers has a positive attitude towards the Saimaa ringed seal and its protection, as fewer than 10 percent have had negative experiences with the species. While recreational fishers, in general, express support towards the various protection measures aimed at preserving the species, approximately a quarter of them do not support extending the fishing restriction to a larger area beyond the current restrictions. Around a quarter of the Saimaa recreational fishers reported that they would fish less often than they currently do, catch fewer fish, and use different fishing gear if the duration of the net fishing ban were extended. Based on a travel cost model, the recreational benefits associated with Lake Saimaa recreational fishing would decrease by 7-10 percent per fisher per year if duration of the net fishing restriction were extended from its current duration. Analysis of the choice experiment data further demonstrated the decreases in utility for fishers from the enhanced protection measures. Fishers' and other respondents' preferences for conservation scenarios clearly differed as other respondents' WTP ranged between €46-124 whereas fishers' WTP was negative, ranging from -€298 to -€164, highlighting the perceived disutility for fishers from increased seal population size and extended conservation measures.

1. Introduction

The Saimaa ringed seal is a critically endangered seal species living only in the Saimaa waterways in Eastern Finland. Currently, its population is around 430–440 individuals. A century ago, the population exceeded 1 000 individuals and based on the understanding of its habitat requirements, at least 4 000 individuals could live in Saimaa. However, hunting and bounty practices destroyed the populations completely in certain areas in the early 20th century. In 1955, the species was conserved, but the size of the 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, the species is reclaiming its habitat and its population is recovering in previously deserted parts of Saimaa, such as Puruvesi and Haapaselkä (Metsähallitus, 2023). Its key habitats are concentrated in Haukivesi and Pihlajavesi, where over half of the population lives and approximately 60% of pups are born. Since the 2000s, the population has been increasing by about 3% per year, although seal populations could potentially grow up to 10% per year. High pup mortality, particularly due to nest mortality and fishing bycatch, seems to be limiting population growth. Metsähallitus observed pup mortality at around 14% in 2020s. The main threats to conservation include fishing, climate change, disturbance of nesting caused by human activities due to construction on shorelines, and the small size and fragmentation of the population (Metsähallitus, 2023; Saimaannorpan suojelutyöryhmä 2022).

In accordance with the European Union Habitats Directive, Finland is committed to protecting the Saimaa ringed seal. The cornerstone of Saimaa ringed seal conservation efforts is to balance the needs of Saimaa ringed seal protection and human activities in the Lake Saimaa in a sustainable way. While authorities bear primary responsibility for implementation, residents of the Saimaa region and key stakeholders are in a key role in achieving the conservation goals (Saimaannorpan suojelutyöryhmä 2022).

Through the implementation of the coastal protection program and the Natura 2000 network, nesting areas are acquired by Metsähallitus, and nature reserves are established on private lands. Landing bans are enforced in breeding areas during winter, and snowmobiling during the breeding season is restricted in the central areas. Piling up snow drifts to support nesting ensures breeding in winters with limited snow. Piling up snow drifts is an effective measure as long as there is sufficient snow and ice. For ice-free winters, artificial nests are under development.

Effective prevention of seal mortality due to fishing is crucial, as other protective 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 is also prohibited year around, such as fish-tipped hooks and strong wire nets. Fishing restriction areas have expanded significantly in 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.

In nature conservation, efforts to implement conservation often face opposition from stakeholders who contend that certain conservation actions conflict with their basic interests, thus being perceived as unfair (Vucetich et al. 2018). Previous studies suggest that the protection of the Saimaa ringed seal enjoys strong support from Finns. For instance, in 2018, 96 percent of the inhabitants of the Saimaa watershed considered Saimaa ringed seal protection very or rather important (Turja, 2018). Mitigating threats to the seal was also

deemed important and protection measures were considered justified. Nevertheless, while local newspapers have predominantly supported conservation measures, there has also been opinion pieces opposing fishing restrictions (Jaakkola et al. 2019).

According to Kolari et al. (2018) a third of all recreational fishers in Saimaa had reduced their net fishing. However, 17% of the estate owners estimated that their winter net fishing has increased. Of those who fished 70% expressed their opinion about the need to change the fishing restrictions, only about half of those who did not fish. Of those who fished 20% were in favor of reducing the restrictions, while the corresponding share of non-fishers was 6%. Slightly more than every tenth fisher supported increasing the restrictions.

Since conservation attitudes change rapidly, it is important to update our understanding of the attitudes of fishers and other citizens. Previous studies do not provide detailed information on how the conservation measures affect the behavior of recreational fishers, particularly in terms of changes in the number of fishing visits and the use of different fishing gear. These studies also fail to quantify the negative impact of conservation options on recreational fishing, information essential for societal benefit-cost comparisons of conservation measures. Additionally, statistically representative information regarding the perceptions and preferences of fishers regarding conservation measures is missing.

In the following sections, we present the characteristics of Lake Saimaa recreational fishers and describe their fishing activity based on a survey sample of Finnish citizens, residents of the Saimaa regions, and visitors of the region. Our aim is to explore the perceptions of Saimaa recreational fishers regarding the Saimaa ringed seal and its conservation measures. From the conservation measures, the restrictions on the use of fishing gears that are dangerous for the seal are among the most significant ones. We analyze how fishers perceive the net fishing restrictions and how they anticipate adjusting their fishing activity under new restrictions. Moreover, we aim to provide a monetary value estimate for the change in fishing activity due to these restrictions. We also compare fishers' perceptions and preferences for seal conservation with those of the general population.

2. Data and methods

2.1. Survey data collection

The study is based on a survey data collected in spring 2022.

The survey was developed between 2021-2022 by experts in environmental valuation in collaboration with natural scientists specialized in Saimaa ringed seal research. Before conducting a pilot study, several experts from academia, nature conservation organizations, and state-owned organizations involved in Saimaa ringed seal conservation provided feedback on the survey. A pilot survey was conducted in March 2022 (N=210). Pre-testing evaluated the entire survey instrument, with a particular focus on descriptions of the current state of the Saimaa ringed seal population, conservation measures, and valuation scenarios. Following the pilot survey, the survey was refined, and the final design for the valuation questions was established.

The final survey was administered in April - May 2022 and collected from three separate samples. The first sample included Finnish citizens over 18-year-old. Stratified random sampling was employed, with stratification based on factors such as age, gender, and location, to obtain a representative sample of the

general population. The second sample consisted of residents of municipalities located around Lake Saimaa. The third sample comprised visitors to Linnansaari National Park. The survey was conducted by the private survey company IROResearch. For Samples 1 and 2, the data was collected using an internet panel by IROResearch, while for sample 3, the contact details were obtained from the Linnansaari National Park visitor survey by Metsähallitus.

In total, 1487 respondents participated in the survey, resulting in a response rate of 10.3%. The number of observations in each sample is provided in Table 1. On average, respondents took approximately 15 minutes to complete the survey. Table 2 presents the socio-demographic background of the respondents.

Table 1. Number of respondents in each sample

Sample	**Number of observations**
Finland	913
Lake Saimaa region	522
Linnansaari National Park visitors	52
Total N	1487

Table 2. Socio-demographic background of the respondents

	Sample			All samples together	Finnish population[a]
	Finland	Lake Saimaa region	Linnansaari National Park visitors		
Gender, male %	52.5	62.5	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

[a] Source: Tilastokeskus, www.stat.fi

* Population median includes people under 18 years

2.2. Survey content

The survey comprised a total of 44 questions, with some questions not being posed to all respondents. The questions were categorized into 7 sections:

1) Introduction to the survey
2) Respondent's connection and visits to the Saimaa region, along with experiences related to the Saimaa ringed seal
3) Most recent recreational visit to Lake Saimaa
4) Recreational fishing on Lake Saimaa (asked only if the respondent engages in fishing on Lake Saimaa)
5) Preferences for conservation measures
6) Recreational visits to Lake Saimaa in the future
7) Background questions.

Descriptive statistics from the survey can be found in the deliverable of Our Saimaa seal-project Lankia et al. 2022.

The methods employed in this study are presented in the following section.

3. Methods

3.1 Recreational fishers' attitudes to the Saimaa ringed seal conservation measures

We assessed both attitudes to Saimaa ringed seal itself, and to the conservation measures. Attitudes toward the Saimaa ringed seal were measured with three statements "I like Saimaa ringed seal", "I support the protection of Saimaa ringed seal", and "I have had negative experiences from Saimaa ringed seal". Respondents were asked to evaluate these statements on 5-point Likert scales (1 = Strongly disagree, 5 = Strongly agree).

Attitudes toward conservation measures were elicited for 13 distinct conservation measures and were also measured on 5-point Likert scale (1=Do not support at all, 5=Support strongly).

3.2. Impacts of Saimaa ringed seal conservation on the recreational use of the Lake Saimaa

The effect of conservation measures on the fishing choices of recreational fishers was examined in two ways. First, their behavioral intentions in the event of an extension to the ban on net fishing was elicited. This was measured with 7 statements, including, among others, "I would catch fewer fish than I currently do" and "I would fish less often than I currently" rated on a 5-point Likert scale (1 = Completely agree, 5 = Completely disagree).

Next, the study explored the potential impacts of a hypothetical future increase in the Saimaa ringed seal population and the hypothetical extensions of gill net fishing restrictions on the number of visits to Lake Saimaa by both recreational fishers and other visitors to the lake. To achieve this, we applied the combined travel cost - contingent behavior method (TC-CB). The TC-CB method is a widely-used technique in environmental economics (e.g. Lankia et al. 2019, Bertram et al. 2019, Egan et al. 2022) for assessing

expected changes in recreational benefits resulting from hypothetical changes in environmental quality or the recreational facilities in a specified area used for nature based recreation.

The TC-CB method combines travel cost method (e.g. Zhang et al. 2015, Hanauer et al. 2017., Czajkowski et al. 2019), a revealed preferences method for estimating the monetary value of specified area's recreational value, with contingent behavior data. The travel cost method utilizes data on the number of recreational visits people make to a specific recreational destination over a certain period and the associated travel costs to determine the demand and monetary value of these visits.

The contingent behavior method, on the other hand, is a stated preference method that asks people how their behavior, such as visit frequency to a specific recreational site, would change if a specified change in site quality occurred. By combining data on actual past recreational behavior (travel cost method) and expected future behavior under different scenarios (contingent behavior method), it becomes possible to estimate changes in the recreational value while anchoring the results in real past behavior. Here, TC-CB method is employed to evaluate how an increase in the Saimaa ringed seal population or changes in the duration of the net fishing ban would affect the volume and economic value of recreational visits to Lake Saimaa.

To assess the current extent of recreational use of Saimaa, the survey collected information on the total number of annual recreational visits to Saimaa from respondents who had visited the area for recreation in the last 12 months. Respondents were first asked about the frequency of their recreational visits to Saimaa or its shorelines in the past year, with response options including daily, weekly, monthly, and less frequent visits. Subsequently, more detailed questions were posed to ascertain the number of visits during the indicated period. For instance, respondents who reported visiting Saimaa weekly were asked how many times per week. The total number of visits by a visitor was then calculated by multiplying the weekly frequency by 52, the number of weeks in a year.

Following the questions about the current volume of the recreational visits to Lake Saimaa, respondents were presented with three future scenarios and asked how these scenarios would affect the number of future visits. The scenarios were:

1. The Saimaa ringed seal population would increase by 2.5-fold: "The current size of the Saima ringed seal population is around 430 individuals. How often would you visit Saimaa in the next 12 months if the population increased 2.5-fold?"

2. The ban for gill net fishing would be extended to the end of July: "Gill net fishing is currently prohibited in Saimaa from 15 April to 30 June. How often would you visit Saimaa in the next 12 months if the ban was extended until the end of July?"

3. The ban for gill net fishing would be extended year-round: "Gill net fishing is currently prohibited in Saimaa from 15 April to 30 June. How often would you visit Saimaa in the next 12 months if the ban was extended year-round?"

To reduce the response burden, half of the sample was presented with the gill net fishing ban July -scenario and the other half the gill net fishing ban around the year -scenario. The scenario of an increased Saimaa ringed seal population was presented to all respondents.

3.3 Preferences for Saimaa ringed seal conservation scenarios

Citizens' preferences for different conservation scenarios for Saimaa ringed Seal were derived using choice experiment (CE) method. 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 that are 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 is indirectly revealed based on the choices they make (e.g., Hanley, Mourato and White, 2001). Each respondent answers several choice tasks. The number of choice tasks typically ranges between 4 and 8 in environmental studies.

Alternative conservation scenarios were presented to the respondents. The scenarios contained the varying levels of Saimaa ringed seal population and the conservation measures aimed at increasing the seal population, i.e. restrictions for fishing, snowmobiles and shoreline construction. Table 3 presents the attributes and their levels in more detail. An example of the choice task is presented in Figure 1. Each choice task contained current state (status quo) and two alternatives with increased conservation levels.

Table 3. 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 subspecies of the seal 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 to 600 • The population will increase to 800 • The population will increase 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 will be 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 reproduction and fledging 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	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	• Stays as it is (7200) • Decreases by a quarter from the current (5600) • Decreases to half of the current (3600)

	seal´s potential nesting area has been lost as a result of shoreline construction.	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.	
Additional cost as tax for 10-year period, €	Additional conservation measures incur costs.		• 0 (current) • 10 • 20 • 50 • 100 • 200 • 500

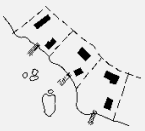
	Current state	Scenario A	Scenario B
Size of the Saimaa ringed seal population 	Currently approximately 430 individuals	The population will increase 2-fold	The population will increase 1.5-fold
Duration of net fishing ban 	15.4.–30.6.	Stays as it is	Extends until the end of October
Motor vehicle ban on ice, km^2 	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

Figure 1. Example of the choice task.

4. Results

4.1 Descriptive statistics of Lake Saimaa recreational fishers

To identify recreational fishers within the sample, respondents were first asked if they had visited Lake Saimaa for recreational purposes. Subsequently, those who had visited the lake in the past 12 months were asked about their fishing activities at Lake Saimaa. Among all respondents, 41.0% (610 respondents) reported

having visited the Lake Saimaa for recreation in the past 12 months. Among these visitors, 30.2% (184 respondents) stated that they engage in fishing at Lake Saimaa. Among visitors residing in the region, 33.3% reported fishing by Lake Saimaa, while among visitors with a leisure home in the region, the percentage was 42.3%.

The average age of the Lake Saimaa recreational fishers in the sample was 61 years, with 59% being male and 85.3% residing in the Saimaa region. In terms of fishing frequency in 2021 at Lake Saimaa, respondents reported an average 15.2 times (median 10 times) during the summer and 3.9 times (median 0 times) during the winter. The most commonly used fishing gear among the respondents was a hook and line (used by 63% of Lake Saimaa recreational fishers), followed by a spinning rod (57.1%), a fish trap (42.4%) and a gill net (37.0%) (Table 4).

Table 4. Fishing gear used by the respondents fishing by Lake Saimaa

Fishing gear (kalastusväline)	**Share of Saimaa recreational fishers using that fishing gear (%)**
Gill net (Kalaverkko)	37.0
Seine (Nuotta)	2.7
Trap net (Rysä)	0.5
Fish trap (Katiska)	42.4
Hook and line (Onki)	63.0
Jig/Ice fishing (Pilkki)	34.2
Spinning rod (Heittouistin)	57.1
Trolling gear (Vetouistin)	32.1
Other	1.1
n	184

To assess the significance of Lake Saimaa fish in respondents' diet, they were asked how frequently they consume fish caught by themselves or their family members from Lake Saimaa. Only, 4% responded "never", indicating that that nearly all fishers in the sample eat fish caught by themselves from Lake Saimaa at least occasionally. Furthermore, 17 percent reported that they eat self-caught fish on a weekly basis, and 28 percent reported doing so a few times a month.

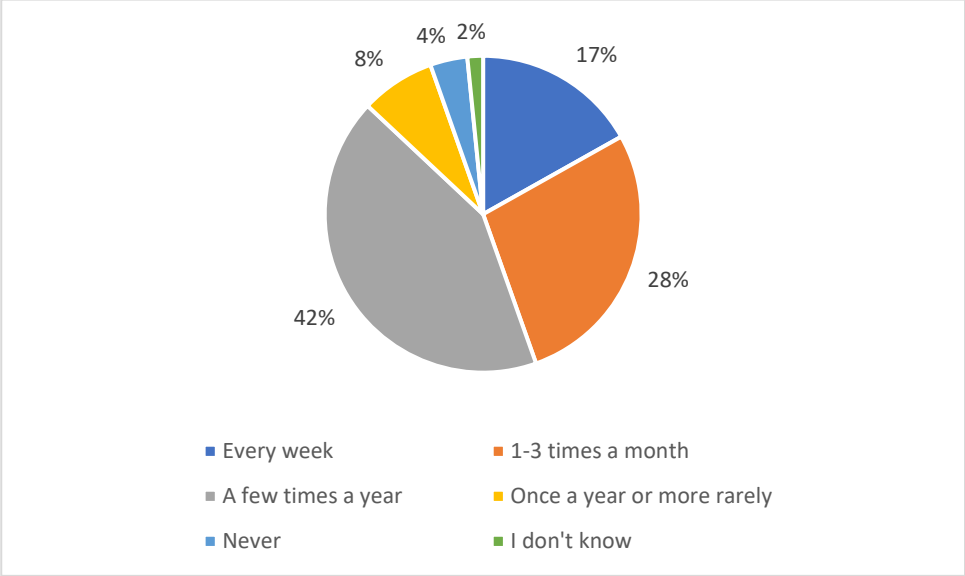


Figure 2. Recreational fishers (n=184) answers to question "How often do you eat fish that you or your family member caught from the Lake Saimaa?"

4.2. Lake Saimaa recreational fishers' attitudes towards Saimaa ringed seal and its protection measures

Attitudes toward Saimaa ringed seal

Fishers' attitudes toward Saimaa ringed seal were generally very positive: 90.8 percent completely or somewhat agreed that they like Saimaa ringed seal, 90.2 percent supported protection of the species, and 8.7 percent reported having had negative experiences with the species (Table 5).

These attitudes closely align with those of respondents who do not fish at Lake Saimaa. From the entire sample, 86.9 percent completely or somewhat agreed that they like Saimaa ringed seals and 92.1 percent supported protection of the species. Only the percentage of respondents who reported having had negative experiences with the species was statistically significantly smaller in the entire sample (2.0%) than among the fishers in the sample (8.7%) (chi squared test, p-value < 0.05).

Table 5. Attitudes toward Saimaa ringed seal among fishers, non-fishers and entire sample

	Completely agree, %	Somewhat agree, %	Does not agree nor disagree, %	Somewhat disagree, %	Completely disagree, %
			Fishers		
I like Saimaa ringed seal	69.0	21.7	6.5	1.1	1.6
I support protection of Saimaa ringed seal	70.1	20.1	6.5	1.6	1.6
I have negative experiences from Saimaa ringed seal	4.4	4.4	14.1	9.2	67.9
			Non-fishers		
I like Saimaa ringed seal	64.8	21.6	10.9	0.92	1.84
I support protection of Saimaa ringed seal	77.3	15.1	5.0	1.5	1.1
I have negative experiences from Saimaa ringed seal*	0.5	0.5	7.4	5.5	86.0
			Entire sample		
I like Saimaa ringed seal	65.3	21.59	10.36	0.94	1.82
I support protection of Saimaa ringed seal	76.4	15.74	5.18	1.55	1.14
I have negative experiences from Saimaa ringed seal*	1.01	1.01	8.2	5.99	83.79

*Distribution of responses differs statistically significantly from the fishers' sample (chi squared test, p-value <0.01)

Attitudes toward Saimaa ringed seal protection measures

Fishers were generally supportive of various protection measures for the species (Table 6). For example, only 15.2% did not find the prohibition of gill net fishing during months when Saimaa ringed seals are at high risk of dying due the gill nets supportable. A slightly larger share, but still only a fourth (25.6%), did not find the extension of the fishing restriction to a larger area in the lake to be supportable.

Regarding other measures listed in the questionnaire, restricting water traffic (21% found it not supportable or not at all supportable), protecting Saimaa ringed seal habitats by establishing nature conservation areas (16.9% found it not supportable or not at all supportable), protecting shorelines from construction near Saimaa ringed seal nesting areas (14.7% found it not supportable or not at all supportable), and restricting snowmobile driving on ice (12% found it not supportable or not at all supportable) gathered the most resistance. For the remaining measures, fewer than ten percent of fishers found them not supportable.

Table 6 also shows how the recreational fishers' attitudes compare with the non-fishing respondents. There are no statistically significant differences in attitudes between the groups regarding reducing environmental toxins, developing and deploying seal safe fishing gear, limiting water level fluctuations to prevent Saimaa ringed seal nests from collapsing, and combating climate change. However, for all other protection measures, there are statistically significant differences in attitudes between fishers and non-fishers in Lake Saimaa. In general, non-fishers tend to find these protection measures more supportable than fishers.

Table 6. Saimaa recreational fishers' attitudes towards different protection measures of Saimaa ringed seal compared to attitudes of the non-fishers in the sample.

	Strongly supportable, %	**Somewhat supportable, %**	**Neither, %**	**Not supportable, %**	**Not at all supportable, %**
			Fishers/non-fishers		
Reducing environmental toxins	73.4/75.7	20.7/18.5	5.4/4.2	0.6/0.5	0/1.1
Development and deployment of seal safe fishing gear	65.2/70.5	22.8/22.3	8.2/5.5	2.2/0.8	1.6/1.0
Extending fishing restrictions to a larger area in the Lake Saimaa*	26.6/37.4	26.6/35.9	21.2/16.4	14.7/7.0	10.9/3.3
Limiting the fluctuation of the water level to prevent the Saimaa ringed seal nests from collapsing	37.5/41.7	45.1/39.6	10.3/14.0	6.00/3.4	1.1/1.3
Protecting shorelines from construction in the vicinity of Saimaa ringed seal nesting areas*	42.9/48.6	27.7/33.8	14.7/11.9	8.7/4.5	6.0/2.2
Restricing water traffic*	23.4/35.5	39.7/39.4	15.8/15.9	13.0/6.6	8.2/2.7
Protecting Saimaa ringed seal habitats by establishing nature conservation areas*	31.5/49.5	35.9/34.5	15.8/9.8	10.9/4.5	6.0/1.7
Combating climate change	46.7/52.4	32.6/27.3	10.3/12.8	4.9/3.5	5.4/3.9
Piling up snow drifts to support nesting in winters with little snow*	59.8/65.7	24.5/26.2	10.9/5.0	1.6/1.8	3.3/1.4
Development of artifical nests for ice free winters*	52.7/60.6	29.9/29.8	9.8/6.1	3.8/1.9	3.8/1.7
Restricting snowmobile driving on ice*	35.9/50.3	39.7/32.7	12.5/11.0	8.7/4.1	3.3/2.0
A prohibition of net fishing in the months when Saimaa ringed seals are at high risk of dying for fishing nets*	45.1/60.4	27.7/26.4	12.0/8.1	9.2/3.1	6.0/2.0
Prohibition of other fishing gear dangerous to the Saimaa ringed seal*	39.7/57.0	36.4/28.9	17.9/9.7	3.8/2.3	2.2/2.1

*The response distribution of fishers differs statistically significantly from the response distribution of non-fishers (chi squared test, p-value <0.05)

4.3. Expected impacts of hypothetical extension in fishing restrictions on recreational fishing

To explore how extending the duration of the gill net fishing ban (currently 15th of April - 30th of June) would impact recreational fishing at Lake Saimaa, fishers were asked how extending the duration would impact their fishing activities. The majority of all Lake Saimaa recreational fishers in the sample did not see an extension affecting their fishing activities significantly, or they did not take a stand on the claims (Table 7). Approximately one fourth of fishers completely or somewhat agreed with statements "I would fish less often than I currently do", "I would catch fewer fish" and "I would use other fishing gear than currently". A little less than a fifth of fishers (18%) completely agreed or somewhat agreed with the statement "I would fish other fish species than I currently do". A slightly smaller share of the fishers (13-14%) completely agreed or somewhat agreed with the statements "I would change my fishing location", "I would fish more often than I currently do", and "I would fish other fish species than I currently do".

Table 7. Responses on how extending the duration of gill net fishing ban in Lake Saimaa would impact fishing activity (all Saimaa recreational fishers in the sample).

Statement	Completely agree (%)	Completely agree (%)	Does not agree nor disagree (%)	Somewhat disagree (%)	Completely disagree (%)
I would fish other fish species	4.9	8.1	33.7	12.0	41.0
I would catch more fish	8.2	9.8	41.2	11.4	28.8
I would catch fewer fish	12.5	13.0	40.8	10.9	22.8
I would fish more often	5.4	8.7	44.6	15.2	26.1
I would fish less often	13.6	11.4	34.8	11.4	28.8
I would use other fishing gear	11.4	13.6	31.0	11.4	32.6
I would change my fishing location	7.1	7.1	26.3	12.0	47.3

If compared to all fishers among the fishers who use a gill net to catch fish (n=68), a significantly larger share foresees changes in their fishing activity if the duration of the gill net fishing ban was extended (Table 8). Over half of them (52.3%) completely or somewhat agreed that they would catch fewer fish than they currently do, and just under half (47.1%) agreed that they would fish less often than they currently do. Nearly forty percent (38%) completely or somewhat agreed that they would use other fishing gear than they currently do. Still, no more than 14 percent completely or somewhat agreed that they would change their fishing location.

Table 8. Responses on how extending the duration of gill net fishing ban would impact fishers fishing activity (recreational fishers in the sample, who use gill nets)

Statement	Completely agree (%)	Somewhat agree (%)	Does not agree nor disagree (%)	Somewhat disagree (%)	Compeletely disagree (%)
I would fish other fish species	5.88	11.76	33.82	14.71	33.82
I would catch more fish	4.41	7.35	36.76	16.18	35.29
I would catch fewer fish	29.41	23.53	33.82	7.35	5.88
I would fish more often than	1.47	7.35	39.71	23.53	27.94
I would fish less often	26.47	20.59	25	16.18	11.76
I would use other fishing gear	14.71	23.53	30.88	14.71	16.18
I would change my fishing location	7.35	8.82	25	19.12	39.71

4.4. Impacts of growing Saimaa ringed seal population and extending gill net fishing ban on the recreational benefits of Lake Saimaa recreational fishing

To study, how on one hand, extending the duration of the ban on gill net fishing to protect Saimaa ringed seals and, on the other hand, increased population of the Saimaa ringed seal would impact the recreational value of Lake Saimaa, respondents were first asked how many times they currently visit Lake Saimaa for recreational purposes during 12 months and how many visits they would make under hypothetical future scenarios.

Currently, 21% of fishers in the sample visit the Lake for recreational purposes daily, 38% weekly. 24% monthly and 17% less frequently (Table 9). The average number of recreational visits in the past 12 months for fishers was 172, while in the entire sample the average was 121 (Table 10).

Table 9. Frequency of recreational visits by Saimaa recreational fishers (not limited to fishing occasions)

Frequency of recreational visits	Share of fishers (n=184) (%)
Daily	21%
Weekly	38%
Monthly	24%
Less frequently	17%

Table 10. Number of visits to Lake Saimaa in the past 12 months

	All (n=579)	Fishers (n=168)
Mean (S.d.)	121 (221)	172 (290)
Median	36	52

The majority of the fishers in the sample reported that they would visit the Lake for recreation as often as they currently do even if the Saima ringed seal population were to grow 2.5-fold or if the ban on gill net fishing were extended until the end of July or year-round (Table 11).[1] Around 10 percent of fishers (8-14%) reported that they would visit the lake less frequently if the duration of the gill net fishing ban were extended.

Table 11. Impacts of the hypothetical future scenarios on the visit frequency

Scenario		All	Fishers
Saimaa ringed seal population grows 2.5-fold	N	610	184
	As often as now	83%	83%
	More often	14%	11%
	Less often	2%	6%
Extending the ban on gill net fishing until the end of July	N	295	84
	As often as now	92%	81%
	More often	3%	5%
	Less often	5%	14%
Extending the band on gill net fishing year-round	N	315	100
	As often as now	90%	87%
	More often	5%	5%
	Less often	4%	8%

Respondents also reported the number of expected recreational visits to the lake per year under the three scenarios (Table 12). The average number of recreational visits would stay almost the same if the Saimaa ringed seal population increased 2.5-fold (current average 172, under the increased population scenario 173). The median number of visits, 52, would remain at its current level. However, extending the gill net fishing ban until the end of July or year-round would lead to slight decrease in the average number of visits (to 157), but the median would remain at its current level 52.

Table 12 Number of expected recreational visits to Lake Saimaa under hypothetical future scenarios

Scenario		All	Fishers
If the Saimaa ringed seal population increases 2.5-fold	N	577	168
	Mean	123	173
	SD	226	303
	Median	36	52
If the ban on net fishing is extended until the end of July	N	276	76
	Mean	115	157
	SD	221	283
	Median	36	52
If the ban on net fishing is extended year-round	N	300	92
	Mean	115	157
	SD	209	276
	Median	36	52

[1] To reduce response burden, half of the sample was presented with the net fishing ban July -scenario and the other half the net fishing ban around the year -scenario. The increased Saimaa ringed seal population scenario was presented to all the respondents.

A statistical travel cost model (random effects Poisson model) was developed based on the reported number of visits both at present and in the future, as well as travel expenses associated with travelling to Lake Saimaa. This model was used to assess the impact of the three scenarios on the number of recreational visits and their monetary value (Table 13). To specifically analyze, how these scenarios would affect the visitation patterns and monetary value for recreational fishers, the modelling sample was narrowed down to include only respondents who engage in fishing activities at Lake Saimaa.

As anticipated, travel costs exhibited a statistically significant negative impact on the number of visits, indicating that individual residing farther away from Lake Saimaa tend to make fewer visits. Furthermore, the hypothetical scenarios yielded expected effects: an increase in the Saimaa ringed seal population led to an increase in visits, while the extensions of the gill net fishing ban resulted in fewer visits. The extension of the net fishing ban year-round had a larger impact on reducing visits compared to the extension until the end of July. The coefficients of these variables were statistically significant across all hypothetical scenarios.

Table 13. Travel cost model for the number of recreational visits to Lake Saimaa for fishers.

Random effects Poisson model Independent variables	Coefficient
Travel costs (EUR per person)	-0.0107***
Seal population grows 2.5-fold	0.0239***
Net fishing ban: July	-0.0681***
Net fishing ban: Year-round	-0.0994***
Constant	5.2806***
Alpha	1.5078
Log likelihood	-3869.64
Number of observations	485
Number of individuals	163

***p-value<0.01, **p-value<0.05

The model allows for calculation of the monetary value of recreational visits using the formula CS/visit=-$1/\beta_{\text{Travel costs.}}$ Based on the modelling results and this formula, the monetary value of a single recreational visit to Lake Saimaa for fishers is approximately EUR 93 per person per visit (Table 14).

Table 14. Economic value of a recreational visit to Lake Saimaa, EUR/visit/person

Group of respondents	Economic value/visit, EUR/person
Recreational fishers	93.20

Additionally, the model enables the calculation of the predicted number of visits under each scenario, as presented in Table 15.

Table 15. Predicted number of visits in the past 12 months and under the hypothetical future scenarios

Scenario	Predicted number of visits
Past 12 months	146
Seal population 2.5x	149
Net fishing ban: July	136
Net fishing ban: Year-round	132

By multiplying the economic value of the recreational visits per visit with the predicted number of visits for each scenario, we can estimate the economic value of recreational visits for fishers. Table 16 illustrates that the economic value of recreational visits to Lake Saimaa for Saimaa recreational fishers is approximately EUR 13 600 per year under the current Saimaa ringed seal population and existing fishing restrictions. The value would increase to EUR 13 900 per year if the Saimaa ringed seal population were to grow 2.5-fold. If the ban on gill net fishing were extended until the end of July, the value would decrease to EUR 12 700 per year. Extending the ban year-round would further reduce the value to EUR 12 290 per year.

Table 16. Economic value of recreational visits to Lake Saimaa for fishers.

Scenario	Economic value of the visits per year per person, €/fisher/year	Change in the value compared to the value in the past 12 month, €/fisher/year (%)
Past 12 months	13 574	-
Seal population 2.5x	13 903	329 (2%)
Net fishing ban: July	12 681	-893 (-7%)
Net fishing ban: Year-round	12 290	-1284 (-9%)

4.5 Preferences for Saimaa ringed seal conservation scenarios

Respondents' preferences for Saimaa ringed seal population size and conservation measures were examined using choice experiment method and analyzed with mixed logit model. The model results are reported in Table 17. Including interactions between conservation scenario attributes and those who have been fishing in Lake Saimaa allowed comparison of fishers' preferences to the rest of the sample.

The results show that even though Finnish citizens in general prefer increases in the size of the seal population, fishers have an opposite opinion. The interaction terms between fishers and seal population attribute were significant and had considerably large negative coefficients for all attribute levels. Hence, the increases in the seal population from the current state were perceived as negative by fishers.

Regarding the extension of the duration of net fishing bans, fishers' preferences were clear. All elongations to the current ban were not preferred. Again, this differed from the preferences of other citizens who especially supported extending the net fishing ban until the end of July and somewhat supported the extension until the end of October. Changing the ban to cover whole year was perceived negatively by both fishers and other citizens, however, fishers' negative preferences were stronger.

Expanding the area of motor vehicle ban on ice from the current 100 km^2 to 200 km^2 did not affect the choices of other citizens, but for the fishers' the effect was negative. The preferences for the change from 100 km^2 to 400 km^2 did not differ between fishers and others, all perceived this change negative.

The last attributes describing the conservation scenarios, i.e. the decreases in the number of available building sites along the shoreline of Lake Saimaa, were supported by other citizens, whereas the interaction for fishers showed that they perceived the decreases negatively. The interactions, however, were only weakly significant.

Table 17. Mixed logit model with interactions for fishers

Attribute	Level	Mean	S.E	Standard deviation	S.E
ASC(SQ)		-0.373*	0.176		
Cost, €		-0.014***	0.001		
Saimaa ringed seal population	600	0.555***	0.156	2.439***	0.193
	800	1.064***	0.161	2.633***	0.193
	1000	1.349***	0.170	2.998***	0.217
Duration of the net fishing ban	Until end of July	0.603***	0.115	2.886***	0.213
	Until end of October	0.252*	0.120	3.019***	0.236
	All year	-0.850***	0.135	3.180***	0.245
Motor vehicle ban on ice	Area doubles to 200 km^2	0.177	0.102	2.621***	0.205
	Area quadruples to 400 km^2	-0.259**	0.104	2.122***	0.179
Building sites available for construction along the shoreline	Decrease by one quarter (5400)	0.344***	0.104	2.845***	0.203
	Decrease to half (3600)	0.386**	0.103	2.448***	0.188
Interactions for fishers					
Cost, €		0.003*	0.001		
Saimaa ringed seal population	600	-1.105**	0.345		
	800	-1.094**	0.347		
	1000	-1.814***	0.379		
Duration of the net fishing ban	Until end of July	-0.824**	0.308		
	Until end of October	-1.969***	0.358		
	All year	-1.814**	0.352		
Motor vehicle ban on ice	Area doubles to 200 km^2	-0.824**	0.301		
	Area quadruples to 400 km^2	-0.249	0.279		
Building sites available for construction along the shoreline	Decrease by one quarter (5400)	-0.600*	0.283		
	Decrease to half (3600)	-0.585*	0.277		

***, ** and * refer to 0.001, 0.01 and 0.05 significance levels, respectively.

Based on the mixed logit model, respondents' willingness to pay (WTP) for two different conservation scenarios was estimated (Table 18). The first conservation scenario, named as High, contained the highest levels for all attributes. For fishers, the WTP was EUR -298.42, whereas for other citizens it was EUR 46.15. The second scenario, named as moderate, contained smaller changes to the current state compared to the

high scenario. WTP for this scenario was EUR -164.21 for fishers and EUR 123.90 for others. These results highlight the perceived disutility for fishers from the conservation scenarios with increased seal population size and conservation measures. For non-fishers there seems to be a preference for moderate level of conservation measures over high levels.

Table 18. Willingness to pay for different conservation scenarios, EUR.

Scenario	Fishers	Others
High - Seal population 1000 seals - Net fishing ban all year - Motor vehicle ban on ice 400km^2 - Number of available building sites decreased to half	-298.42	46.15
Moderate - Seal population 600 seals - Net fishing ban until end of July - Motor vehicle ban on ice 200km^2 - Number of available building sites decreased by one quarter	-164.21	123.90

5. Discussion and conclusions

According to survey data, approximately one third of those who visited Lake Saimaa in their free time within the past 12 months also engage in fishing by the lake during their free time. The majority of these individuals hold positive attitudes toward Saimaa ringed seal and its protection, with fewer than 10 percent reporting negative experiences with the species. While most fishers expressed support for various protection measures related to the species, around a quarter of them did not endorse extending fishing restriction to cover a larger area compared to the current regulations.

Roughly one of fourth of Saimaa recreational fishers either completely or somewhat agreed that they would fish less frequently than they currently do, catch fewer fish, and use different fishing gear than they currently do if the duration of the gill net fishing ban were extended. Approximately one fifth completely or somewhat agreed that they would target different fish species than currently, and 14 percent expressed agreement that they would change their fishing locations. Among fishers who use gill nets to catch fish, a higher percentage anticipated changes in their fishing activity in the event of an extended gill net fishing ban.

According to a travel cost model, the recreational value of Lake Saimaa would decrease by EUR 893-1284/person/year (equivalent to a 7-10 percent reduction in value per fisher per year) if the duration of the gill net fishing ban were extended beyond its current level.

Respondents' preferences for the size of the seal population and different conservation measures were measured using choice experiment method. The choice experiment method differs from one dimensional attitude measures as a respondent faces the costs of conservation in comparing possible future conservation scenarios with the current state. While fishers may support conservation in general or the current conservation measures CE shows their objection for increased conservation. Fisher interactions for all attributes were significant so the preferences of fishers and other respondents differed. Fishers had considerably large negative coefficients for all attributes implying disutility from the increased level of

conservation measures. For example, while non-fishing respondents' WTP for different conservation scenarios ranged between €46 and €124, fishers' WTP was negative (-€298–-€164). Hence, fishers perceived disutility from the increased levels of conservation. It should, however, be noted that these results represent the mean across all fishers. As can be seen from the other results of the survey, as a group, fishers are not completely unanimous. Overall, based on the survey, fishers seem to accept and support the conservation measures but do not favor expanding them from their current level.

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