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## Regional fishing site preferences of subgroups of Finnish recreational fishers

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### ABSTRACT



Understanding relevant subgroupings, among local and traveling recreational fishers, is critical for the tourism sector and fisheries managers. Subgroups may notably differ in fishing activity styles, commitment, traveling across provinces and demand for fishing activities. We analyzed survey data originally collected from registered Finnish recreational fishers in 2018. The reported number of fishing days and methods were used to construct profiles. Separate travel cost models were then fitted to explain factors associating with recreational fishing activities in the main fishing provinces, using the variety of cost, demographics, and profile as explanatory variables. The recreational use value of a fishing day and the total recreational use value of fishing in Finland were estimated. The most attractive province, Lapland, received the highest number of visiting fishers, and highest use value per fishing day. Active anglers spent more days fishing in Finland in general and in Lapland than other profiles. Active generalists were more frequent fishers in Southern Savonia and in marine areas than other profiles. The most common fishing destination for Finnish recreational fishers was their own residential province. These findings help fishery managers identify the most potential areas for improving fishing opportunities and to predict changes in visitation behavior.

### KEYWORDS

Recreational fishing; fishing tourism; revealed preferences; travel cost

## Introduction

Recreational fishing is a popular, and socially and culturally important leisure activity for a large number of Finnish citizens in terms of participation, time, and money spent (Pohja-Mykrä et al., 2018). There were approximately 1.5 million recreational fishers in Finland in 2018, with an annual catch of 22.3 million kg (OSF, 2019). Most of the catch, 18.1 million kg, was made in inland waters, and the main species in catch numbers were perch, pike, and pike perch. Fishers have annually made on average 25–32 fishing trips during the last decades (Sievänen & Neuvonen, 2011), but the activity and the money spent vary considerably from person to person (Markuksela, 2009; Pellikka & Eskelinen, 2019). Registered

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recreational fishers alone spend approximately 250 million euros on their fishing hobby (Pohja-Mykrä et al., 2018).

Fishing is an important activity for local economies (Pohja-Mykrä et al., 2018), while the popularity of the activity and the mobility of the fishers increase the demand for fishing opportunities beyond that of the local populations. The mobility and activity styles of the local and visiting fishers are also factors that need to be considered when assessing fishing pressures on social, ecological, and economic sustainability. Efficient fishery management requires information on the magnitude of fishing tourism and its various impacts, and particularly regarding the economic value of recreational fishing in Finland. Fishing tourism suffers from a lack of basic information on the sub-regional and local economic impacts of the phenomenon and this impedes, among other things, the development of the industry (Kauppila & Karjalainen, 2012).

Nationwide studies on the economic value of recreational fishing in Finland are rare and only some of them consider the spatial distribution of the nature-related recreational value of fishing. Vesterinen et al. (2010) used the Finnish National Outdoor Recreation Demand Inventory data to value water recreation days in Finland using a travel cost method, including recreational fishing. Toivonen et al. (2004) estimated the economic value of recreational fisheries in Finland using a contingent valuation method. Several site-specific studies on recreational fishing have been conducted in the Tenojoki, Tornionjoki, Simojoki, and Iijoki salmon rivers (Anon, 2009; Parkkila, 2005; Parkkila et al., 2011; Pokki et al., 2018; Pokki et al., 2020).

Understanding of the spatial distribution of the economic value of fishing in different provinces and marine areas in Finland is indeed needed. Finnish fishers differ in their behavioral patterns and fishing activity styles: e.g. how often they fish, how far they travel for fishing, what their target species are, and which gear they use. Recognizing differing behavioral and mobility patterns in distinct profiles is important supporting information to help develop arrangements that better meet the variety of fisher needs and to improve the acceptability of the recreational fishery management. Relevant differences in angler types identified in earlier research relate to e.g. the importance of the catch (catch or consumptive orientation, e.g. Kyle et al., 2007), distance traveled to the fishing sites, fishing equipment used, target species, and the response to different stock management options (Arlinghaus et al., 2014; Beardmore et al., 2011; Bonnicksen et al., 2016). Frameworks for fisher typologies have been developed to understand fisher preferences, their changes, to predict fisher behavior (Beardmore et al., 2011, 2013; Bryan, 1977; Cooke et al., 2016; Ditton et al., 1992), and for specific committed hobbyists, such as Finnish troll fishers (Markuksela, 2009). Less is known about other types of fishers (e.g. ones using nets, fish traps), and their behavior, and relatively little research has been carried out using representative national samples from the population of fishers (however, see Ditton et al., 2002).

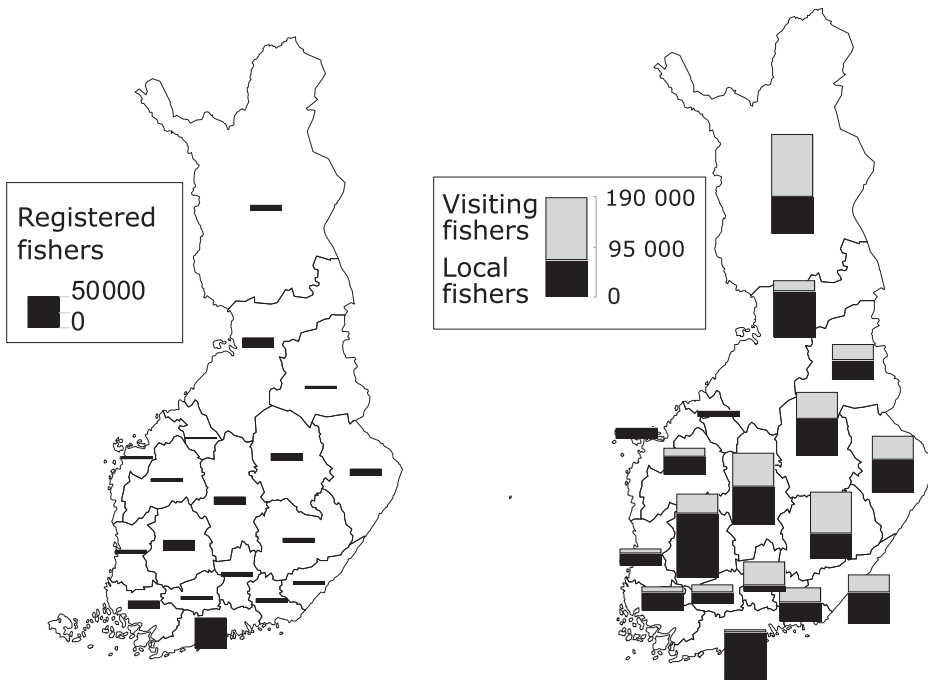
In this study, we take advantage of the typology of Finnish fishers' profiles created by Pellikka and Eskelinen (2019) and based on a random sample of registered fishers in Finland. Our study question is, which factors determine the demand of fishers and their different profiles for fishing days in the most visited provinces, in marine areas and in Finland as a whole. We also ask, what the consumer surplus per fishing day in these areas is and what the total use value of recreational fishing in Finland is beyond the profiles. The Finnish fishing profiles were originally identified based on the activity styles (i.e. the reported number of fishing days for each of the seven main fishing techniques in Finland: hook

and line fishing (angling rod), trolling, fishing rod with reel (casting rod), ice fishing rod, nets, fish trap, or fly fishing rod). The movements of Finnish fishers are mapped in this article to indicate the most significant fishing areas in Finland. Then the recreational use values of a fishing day for the significant areas are estimated using travel cost modeling (TCM). Finally, we estimate the total economic use value of recreational fishing in Finland.

## Material and methods

### Population

The residences of Finnish fishers are distributed throughout the provinces in Finland, but they are concentrated similarly to the rest of the Finnish population in Southern Finland. Approximately 200,000 fishers are registered when they pay the fisheries management fee, which is €45 for an annual fee, €15 for a week fee, and €6 for a day fee (Figure 1). Without registering it is only legal to engage in angling or ice fishing, or to fish for Baltic herring with a rod and vertically moved hooks attached to a line. Everyone under 18 or at least 65 years of age has the right to engage in any fishing without registering, unless they fish in the rapids and currents in waters containing migratory fish or water areas where fishing is prohibited based on other specific reasons. In the study our target population consisted of registered fishers who have the legal right to fish by any means and gear allowed by the Fishing Act, thus covering a large range of existing activity styles. Focusing on the registered segment of fishers also enabled us to focus on the most active segment of fishers, to collect regionally representative survey data based on a stratified random sample



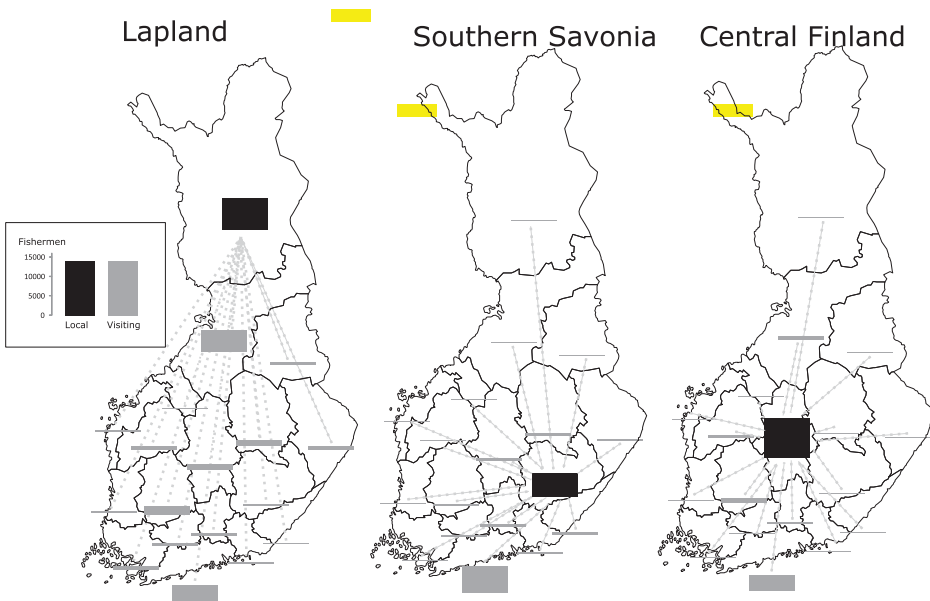
**Figure 1.** The number of registered fishers by region of residence in 2018 (on the left) and the number of registered and unregistered fishers by regions of their fishing activity (on the right).

of the target population, and to use survey weights (strata: region of fisher's residences) to adjust the collected data to the number of registered fishers in the regions (Figure 1).

The pattern changed, when we mapped the registered fishers according to the provinces where the fishing takes place. We identified the three most popular inland fishing regions (destinations of fishing trips) in terms of the number of registered or unregistered visiting fishers. The regions were Lapland, Southern Savonia, and Central Finland (Figures 1 and 2). While the pattern of popular destination provinces was the same for registered and unregistered visiting fishers, some differences were observed in the residential provinces of the visiting fishers.

### Survey data

We analyzed the survey data collected and described by Pellikka and Eskelinen (2019). They drew a regionally stratified sample of fisherman from the national registry ( $n = 19,567$  for email invitations;  $n = 998$  for mail invitations) with a similar quota size per stratum. After three weeks and two email reminders they had received 5,694 responses (response rate 28%). According to (i) a comparison of the respondents age structure to the corresponding structure of the known target population, (ii) a comparison of the permit type frequencies of the respondents and that of target populations, and (iii) a comparison of the responses given by first-wave-respondents and other respondents indicated that the representativeness of the collected data was mainly good (for details, see Pellikka & Eskelinen, 2019). However, there was some over-representation of the most active fishermen in respondents who had bought



**Figure 2.** The number of local registered fishers (black bars) and the number of visiting registered fishers by origin (residential province; gray bars) in three inland regions (Lapland, Southern Savonia, Central Finland) which had highest number of visiting fishers in 2018.

annual permits, compared to those fishing more infrequently (with day- or week permits).

### Questionnaire form

A questionnaire form was prepared by the project team in collaboration with a group of five experts from recreational fishery NGOs and Metsähallitus (state-owned forestry enterprise). Questions relevant to profiling fishermen included preliminary questions inquiring about the number of days during the last 12 months which included fishing with each of the following gear/techniques: hook and line fishing (angling rod); trolling; fishing rod with reel (casting rod); ice fishing rod; nets; fish trap; or fly fishing rod. The responses were used as manifest variables that together defined the (latent) profiles of fishers originally described in Pellikka and Eskelinen (2019). Questions for the analyses of this article concerned the fisher's demographic factors (age, sex, educational level, income level, residential province), number of fishing days in Finland by province/marine area (destinations), centrality of fishing to lifestyle (i.e. the extent to which one's lifestyle is connected with the pursuit of fishing, see e.g. Beardmore et al., 2013), and the costs associated with travel, accommodation, fishing permits, and services in the area. These data were used in the travel cost analysis of this article (Table 1) and to broaden the descriptions of the five profiles (Table 2) defined by Pellikka and Eskelinen (2019).

### Data for TCM

The aggregate number of fishing days over the season was determined from the survey, but there was no information on the number of trips taken. All 5,608 respondents included in the dataset used for TCM had been fishing in one of the Finnish provinces or marine areas at least one day during the season and 72 responses with zero fishing days were excluded from the sample. The maximum number of fishing days in the

**Table 1.** Definitions of the variables used in the travel cost models.

Variable	Variable definition
<b>Dependent variables</b>	
<b>Fishing days</b>	Total number of days spent fishing during the 2018 fishing season
<b>Explanatory variables</b>	
<b>Combined travel costs*)</b>	Travel cost per day in euros, combined travel costs including cost of travel time
<b>Male, dummy</b>	1 if the respondent was male, 0 otherwise
<b>Age</b>	Age of the respondent
<b>Income</b>	Respondent's average hourly wage in euros
<b>Active angler prob</b>	Estimated probability for the respondent of having active angler profile
<b>Active angler, dummy</b>	1 if the respondent has active angler profile, 0 otherwise
<b>Active generalist prob</b>	Estimated probability for the respondent of having active generalist profile
<b>Local resident, dummy</b>	1 if the respondent had been fishing in his/her residential province in 2018, 0 otherwise
<b>Target salmon, dummy</b>	1 if the main target species of the respondent was salmon, 0 otherwise
<b>Target whitefish, dummy</b>	1 if the main target species of the respondent was whitefish, 0 otherwise
<b>Target vendace, dummy</b>	1 if the main target species of the respondent was vendace, 0 otherwise
<b>Target pike, dummy</b>	1 if the main target species of the respondent was pike, 0 otherwise
<b>Multiple destinations, dummy</b>	1 if the respondent had been fishing in multiple provinces/regions in 2018, 0 otherwise

\*) Cost of travel time: 0.3333\*round-trip travel time (hours)\*the respondent's average hourly wage.

**Table 2.** The centrality of fishing within a lifestyle by profile and probabilities for having annual costs of fishing activities (other than the fisheries management fee) for five profiles of registered fishermen in Finland in 2018 (modified from Pellikka & Eskelinen, 2019).

Characteristics / Annual costs (purchases)	Active anglers % (s.e.)	Casual anglers % (s.e.)	Active generalist % (s.e.)	Gill net enthusiasts % (s.e.)	Casual generalists % (s.e.)
<b>Centrality of fishing</b>					
<b>High importance (%)</b>	32	<1	32	12	9
<b>Moderate importance (%)</b>	51	34	50	62	31
<b>Minor importance (or cannot say, %)</b>	17	65	18	26	60
<b>Incl. new equipment (&gt;0 €, dummy)</b>	52(2)	43(2)	60(2)	56(3)	34(4)
<b>≥ 250 € (dummy)</b>	33(2)	10(2)	34(2)	20 (3)	14(3)
<b>Incl. direct costs (&gt;0 €, dummy)</b>	77(2)	44(2)	64(2)	55(3)	32(4)
<b>Fuel (&gt;0 €, dummy)</b>	75(2)	39(2)	62(2)	48(3)	24(4)
<b>Public transport (&gt;0 €, dummy)</b>	9(1)	5(1)	7(1)	4(1)	5(2)
<b>Accommodation (&gt;0 €, dummy)</b>	40(2)	16(2)	26(2)	14(2)	9(3)
<b>Daily groceries (&gt;0 €, dummy)</b>	65(2)	32(2)	50(2)	34(3)	16(3)
<b>Cafe/restaurant (&gt;0 €, dummy)</b>	55(2)	26(2)	40(2)	25(3)	11(3)
<b>Licenses (&gt;0 €, dummy)</b>	73(2)	39(2)	58(2)	50(3)	29(4)
<b>Membership fee (&gt;0 €, dummy)</b>	17(1)	7(1)	19(2)	11(2)	12(3)
<b>Program services (&gt;0 €, dummy)</b>	6(2)	3(1)	5(2)	1(1)	5(2)
<b>Other direct costs (&gt;0 €, dummy)</b>	17 (1)	10(2)	15(2)	9 (2)	6 (2)

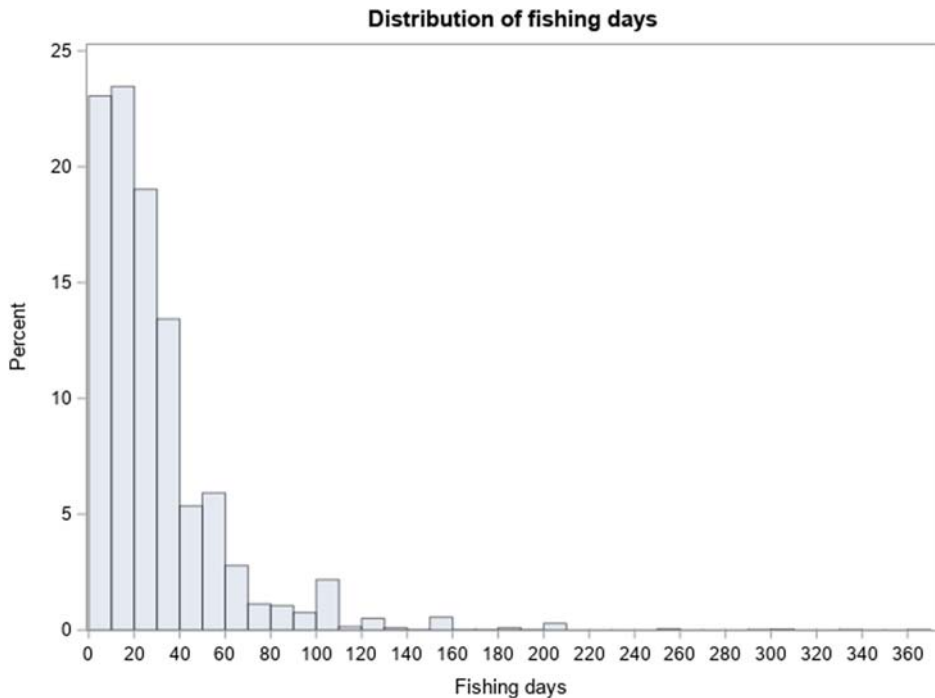
complete data was 360 days, fishers spent on average 26.51 days fishing in Finland, and 23% of fishers had 1–9 fishing days during the year (Figure 3). As the sample included only visitors with at least one fishing day, the demand functions were estimated using a zero-truncated negative binomial distribution.

The majority (89%) of the respondents included in the analyses were male and locals (69%) fishing in their own residential province. On average the respondents had an hourly income of 15.18 euros, and the average age of the respondent was 47 years. Almost half (47%) the respondents fished in multiple provinces in Finland. The definitions and the descriptive statistics of the variables used in the demand models for fishing days are presented in Tables 1 and 3, respectively.

## Methods

The respondents were classified by Pellikka and Eskelinen (2019) into fisher profiles based on a latent class analysis (LCA; Lazarsfeld, 1959). LCA is a statistical method used to empirically determine discrete latent constructs (here profiles), based on discrete observed manifest variables. In this case, the variables were related to the number of fishing days per fishing method (see introduction for detailed list of methods). They fitted 2-class-, 3-class, ... 10-class-models to the data, and evaluated alternative models with various metrics (log likelihood LL, G2), information criteria (AIC, BIC, aBIC) and entropy. Based on the metrics, indices, and the interpretability, they used a 5-class model in the consequent analyses, and named the classes (profiles) in order of prevalence in the target population as “Active anglers” (34% of the target population), “Casual anglers”





**Figure 3.** Distribution of total fishing days spent in the Finnish fishing destinations per individual during the 2018 fishing season.

(25%), “Active generalists” (22%), “Gill net enthusiasts” (10%), and “Casual generalists” (9%). We have used the classifications in the following analyses by including the posterior probabilities for each respondent belonging to the profiles in the explanatory variables.

**Table 3.** Descriptive statistics of the variables used in the travel cost models.

Variable	Data including multiple destinations (n=5608)		Data including only one destination per respondent (n=2944)	
	Mean	Std. Dev.	Mean	Std. Dev.
<b>Dependent variables</b>				
<b>Fishing days</b>	26.5112	28.6254	24.2412	29.4674
<b>Explanatory variables</b>				
<b>Combined travel costs*)</b>	23.8940	33.6671	26.0898	41.3762
<b>Male, dummy</b>	0.9092	0.2873	0.8866	0.3172
<b>Age</b>	46.5581	12.2894	48.6732	11.8708
<b>Income</b>	15.2575	9.1788	15.1830	9.1511
<b>Active angler prob</b>	0.3426	0.3562	0.2739	0.3295
<b>Active angler, dummy</b>	0.3461	0.4758		
<b>Active generalist prob</b>	0.2336	0.3326	0.2042	0.3227
<b>Local resident, dummy</b>	0.3618	0.4806	0.6872	0.4637
<b>Target salmon, dummy</b>	0.0344	0.1822		
<b>Target whitefish, dummy</b>			0.0547	0.2274
<b>Target vendace, dummy</b>			0.0241	0.1533
<b>Target pike, dummy</b>			0.1630	0.3694
<b>Multiple destinations, dummy</b>			0.4740	0.4994

\*) Cost of travel time:  $0.3333 \times \text{round-trip travel time (hours)} \times \text{the respondent's average hourly wage}$ .

### Travel cost method

Travel cost modeling (TCM) has been widely used for determining the value of a recreational activity such as recreational fishing (e.g. Ezzy et al., 2012; Fleming & Cook, 2008; Pokki et al., 2018; Pokki et al., 2020). One of TCM's strengths is that the data are based on real decisions by individuals and thus can be regarded as reliable indicators of preferences (Bateman et al., 2002). The basic idea is that using the costs of reaching a recreational site, it is possible to construct a demand curve for visits and calculate the consumer surplus of a recreational trip (Hotelling, 1949). The demand is conventionally defined by the number of trips to the recreational site over a season. In some cases, when recreational trips are taken to close destinations and consist mainly of short one-day trips, the demand is defined by the number of recreational days over a season (e.g. Vesterinen et al., 2010). With on-site sampling, only the participants are queried and all respondents in the sample have made at least one trip to the site. In this case, there are no zero visits in the sample and the distribution needs to be truncated at zero. Truncated poisson or truncated negative binomial probability distributions are suitable distributions when data include non-negative integer values and truncation (Cameron & Trivedi, 1998; Creel & Loomis, 1990; Grogger & Carson, 1991; Hellerstein, 1991; Hellerstein & Mendelsohn, 1993; Shaw, 1988). A truncated negative binomial model generates consistent and unbiased estimates also in the cases of over-dispersion in the data when the variance is greater than the mean (Grogger & Carson, 1991).

In a single-site travel cost model, the demand for recreation trips (or days) is assumed to be explained by the travel costs to the site, travel cost to a substitute site, income and demographic factors (Parsons, 2003):

$$r = f(tc_r, tc_s, y, z), \quad (1)$$

where  $r$  is the number of trips per season,  $tc_r$  is the recreation trip cost,  $tc_s$  is a vector of trip costs to substitute recreation sites,  $y$  is the income and  $z$  is a vector of demographic variables affecting the number of trips taken. Defining substitute sites can be troublesome in real life and there is no general agreement on how substitute sites should be treated in the travel cost model (Garrod & Willis, 1999). The substitutes are often ignored in empirical single-site applications, which results in overestimation of the consumer surplus and the recreational use value of the site.

The cost of travel time is an important component in the travel cost variable in TCM for obtaining unbiased estimates (Cesario & Knetsch, 1970). While there is no agreement on how to treat the cost of travel time, a variety of approaches have been taken. The most common approach was introduced by Cesario (1976) where the fraction-of-wage-rate is used. Often, the opportunity cost of time is defined as one-third of the wage rate (Englin & Cameron, 1996; Englin & Shonkwiler, 1995; Hellerstein & Mendelsohn, 1993).

### Calculating welfare measures

Once the demand function for recreational trips has been estimated, the consumer surplus (average recreational value) of a trip can be calculated with the following formula:

$$CS = -1/\beta_{TC} \quad (2)$$

where  $\beta_{TC}$  is the parameter estimate for the travel cost variable (Creel & Loomis, 1990). The following second-order Taylor series approximation for the variance of consumer surplus is used for calculating the approximate standard error for the consumer surplus (Englin & Shonkwiler, 1995):

$$\text{Var}\left(\frac{1}{\beta_{TC}}\right) = \frac{S^2}{\beta_{TC}^4} + 2\left(\frac{S^4}{\beta_{TC}^6}\right) \quad (3)$$

where  $S$  denotes the standard error of  $\beta_{TC}$ .

### Model specification

The dependent variable in the demand models was the total number of fishing days in the Finnish provinces and marine regions during the 2018 fishing season. The average number of fishing days, including all respondents (including multiple fishing destinations), was 26.51 with a standard deviation of 28.63 (Table 3). In the data including only one main fishing region, the average number of fishing days per season was 24.24 with a standard deviation of 29.47. The variance or square of standard deviation being considerably larger than the mean in both cases suggests that the data are over-dispersed. Accordingly, the demand models for fishing days were estimated using the NLOGIT software package (Greene, 2007) applying a truncated negative binomial distribution.

The demand for fishing days for Finland, marine areas, and the Southern Savonia and Lapland provinces was estimated with the following formula, using a truncated negative binomial model specification:

$$x_i = f(Z); \quad x_i > 0; \quad (4)$$

where  $Z$  is a vector of the round-trip travel cost per fishing day, and other explanatory variables vary depending on the model.

Explanatory variables selected for the demand model for fishing days in Finland were reported round-trip travel costs per fishing day (including travel time costs), age, and dummy variables for active anglers, salmon as target species, and multiple destinations. In the demand model for marine areas the explanatory variables were the round-trip reported travel cost per fishing day (including travel time costs), age, active generalist probability, and a target pike dummy. Explanatory variables included in the demand model for Lapland were the round-trip reported travel costs per fishing day (including travel time costs), male, income, active angler probability, and a target whitefish dummy. The demand model for Southern Savonia included the following explanatory variables: round-trip reported travel costs per fishing day (including travel time costs), active generalist probability, a local resident dummy, and target vendace dummy.

The travel costs in the demand models were defined as the combined costs of driving and travel time. The driving costs were the average amount of money spent per fishing day for travel to recreational fishing sites during 2018. The cost of the travel time was equally defined for all respondents; the travel time per fishing day, multiplied by one-third of the average hourly wage. The respondents did not report the amount of time spent traveling in the survey, and it was, therefore, estimated separately for different cases: (1) locals and fishers in marine areas, or those with multiple destinations; and (2)

traveling fishers with only one destination province. For respondents fishing outside their residential province (and only one destination area/region), the travel time was calculated using the number of round-trip travel kilometers divided by the most commonly allowed driving speed outside agglomerations in Finland, 80 kilometers per hour. The distance traveled to the main fishing province was estimated based on the distance between the central point of the respondent's home postal code and the nearest point of the border of the destination province. The kilometers per fishing day for respondents fishing inside their residential province, in marine areas, or in multiple destinations were calculated by dividing the reported travel costs per day by the average driving cost estimate, €0.24/km. Moreover, the travel time was calculated by dividing the estimated travel distance in kilometers by 80 kilometers per hour.

Majority of the fishers visiting Finland's Northern salmon rivers are men, and there is some evidence that a higher income implies more frequent visits to the most important Finnish Salmon River, the Teno (Pokki et al., 2018, 2020). To show the effects of sex and income level on the demand of fishing days, they were included as explanatory variables in the demand model for Lapland. In the questionnaire the income was reported as the monthly gross income for the household. In case there were several people in one household, the average hourly wage for a person was calculated by dividing the household monthly income by 150 (average working hours per month) and the number of habitants in the household. The data showed that almost 70% of the respondents are 40–65 years old. To understand if age has an impact on the demand of the number of fishing days and whether it is region-specific, age was tested to be included in the demand models. The profiles were included in the demand models for fishing days in two ways: as the estimated probability of the respondent having one of the profiles and as a dummy variable. Other costs per fishing day were included as explanatory variable in the models, because other costs for accommodation, services (restaurants, rentals), and fishing permits would likely be relevant for the demand, but they proved not to be statistically significant.

## Results

### *Demand models for fishing days*

The demand for fishing days was estimated separately for Finland as a whole, marine areas and the Southern Savonia and Lapland provinces. The estimation results are presented in Table 4. The over-dispersion test statistics suggest that the fishing day data are over-dispersed for all regions. Moreover, the variance of the number of fishing days per season (the square of the standard deviation in Table 3) is multiple compared to the mean. Thus, a truncated negative binomial model was estimated for all regions.

The pseudo- $R^2$  indicates that the models fit the data well in all four cases. The pseudo- $R^2$  was 0.57 in the demand model for Southern Savonia, 0.61 for Lapland, 0.69 for marine areas, and 0.62 for Finland. The travel cost coefficient was statistically significant and had the expected negative sign in all models. The male dummy was statistically significant only in the model for Lapland, indicating that men tend to spend more days fishing in Lapland than women. Age was statistically significant in models for marine areas and Finland; younger fishers spent more fishing days in marine areas, while a higher age denoted more fishing days in general in Finland.

**Table 4.** Estimated demand functions for recreational fishing days per season for different regions in Finland.

	Southern Savonia	Lapland	Marine areas	Finland
<b>Constant</b>	2.8747***	2.2073***	4.4364***	3.2877***
<b>Combined travel costs</b>	-0.0241***	-0.0129***	-0.0072***	-0.0096***
<b>Male, dummy</b>		0.3494**		
<b>Age</b>			-0.0195***	0.0026**
<b>Income</b>		0.3494***		
<b>Active angler prob</b>		0.8871***		
<b>Active angler, dummy</b>				0.1879***
<b>Active generalist prob</b>	1.1081***		0.6604**	
<b>Local resident, dummy</b>	0.5940***			
<b>Target salmon, dummy</b>				-0.1062*
<b>Target whitefish, dummy</b>		0.4671*		
<b>Target vendace, dummy</b>	0.6233***			
<b>Target pike, dummy</b>			-0.3473*	
<b>Multiple destinations, dummy</b>				0.1299***
<b>n</b>	84	183	134	2778
<b>Pseudo-R2</b>	0.5662	0.6057	0.6880	0.6233
<b>Log L</b>	-352.59	-708.89	-578.98	-11882.29
<b>Restricted Log L</b>	-812.81	-1797.80	-1855.96	-31540.05
<b>Dispersion parameter (alpha)</b>	0.4454***	0.6201***	0.7504***	0.6007***
<b>Point estimate (CS), € per day</b>	41.58	77.52	139.86	104.28
<b>Standard error (CS), € per day</b>	13.63	7.33	28.42	3.05
<b>Standard error (CS), %</b>	32.77	9.46	20.32	2.92

The income level was a statistically significant factor only in the Lapland model. The positive coefficient implies that fishers with a higher income spent more fishing days in Lapland than fishers with a lower income.

The active angler profile was statistically significant in the model for Lapland and Finland, while the same was applied for the active generalist profile in the models for Southern Savonia and marine areas. A higher probability of having active angler profile increased the estimated demand for the number of fishing days per season in Lapland, while a higher probability of having an active generalist profile increased the number of fishing days in Southern Savonia and marine areas. Considering the profile as a dummy variable, the positive coefficient of the active angler profile indicated that active anglers spent more days fishing in Finland on average in general than other fishers.

The local residency dummy for fishing only inside the residential province had a positive coefficient in the Southern Savonia model; locals had more fishing days in Southern Savonia, which mainly refers to locals fishing vendace with nets. Fishers aim for different main target species in different regions in Finland. Looking at the model for Finland as a whole, fishers mainly targeting salmon tended to spend fewer days fishing than fishers targeting other species. Moreover, in Lapland fishers mainly targeting whitefish spent more days fishing than their counterparts targeting other species. In Southern Savonia vendace as the main target species meant a higher number of fishing days on average. Pike as the main target species on the other hand implied a lower number of fishing days in marine areas. In general, salmon, trout, pike, and grayling as main target species associated with a lower number of fishing days spent in the Finnish fishing destinations, while fishers targeting species, such as white fish, vendace, pike perch, and perch, spent more days fishing. Evidently, the results relate to the gear type used; the previous species are mainly harvested by committed anglers, and the latter species mainly by fishers using nets or ice fishing rod (OSF, 2019).

The estimated consumer surplus per fishing day for Southern Savonia was EUR 42, for Lapland EUR 78, for marine areas EUR140, and for Finland EUR 104 (Table 4). The model for Finland has the best precision indicated by the relative standard error. Acknowledging that the results may be sensitive to the wage rate coefficient used when defining the travel time cost component in the travel cost variable, three different wage rate coefficients were tested in the model for Finland. Using a 0.2 or 0.4 wage rate coefficient instead of 0.33 results in a change of between €9 and €14 in the consumer surplus estimate and does not affect the statistical significance of any other variable than the target salmon dummy. An approximation of the total recreational value of fishing days in Finland can be calculated using the estimate for a fishing day value. The average fishing days and total number of visitors were available from the survey. Assuming that the sample properly represents the total population of registered fishers in Finland, the total recreational value can be estimated by multiplying the consumer surplus per fishing day ( $-1/\beta_{TC}$ ) by the average number of fishing days per fisher (26.51 days) and the total number of fishers visiting local and other fishing sites. If estimated to contain only the registered Finnish fishers (190,985 fishers), the estimated total recreational value of fishing in Finland was EUR 527.97 million in 2018.<sup>1</sup>

## Discussion and conclusions

Finnish entrepreneurs in the recreational fisheries sector have reported increasing numbers of customers during the last decades (e.g. Pohja-Mykrä et al., 2018; Toivonen, 2008). The sector is gradually growing in many countries, and the sector has nowadays some 21 million euros turnover in Finland (Pohja-Mykrä et al., 2018). Development measures for the sector require basic information on the recreational fishers to evaluate the economic impacts (Kauppila & Karjalainen, 2012). Theoretical concepts, such as tourist mobility and multi-locality, have been associated with research questions, such as “why” and “how” (Haldrup, 2004), but for many applications there is still a need for also asking a third question, “where”. In the context of fishing and fishing tourism, little is known about the fishers as potential tourists, or their fishing tourism trips and tourism experience (Turunen et al., 2020), and the dynamics of fisher flow between regions and places.

Our analysis revealed that the traveling patterns of unregistered and registered fishers in Finland show surprisingly similar revealed preferences for their fishing destinations, regardless that registering allows fishing with a much larger variety of styles/equipment and sites and enables specialization. Our analysis also demonstrates the important role of easy access to the fishing sites near the home. Most Finnish fishers still tend to go fishing only within their residential province.

The profiles of the registered fishers showed differences in preferred destinations and the money spent, emphasizing the need for understanding the heterogeneity of the fisher population and recreational fishing tourists (see also Markuksela, 2009). Personal needs for support services also vary greatly – only a minority (37%) of registered Finnish fishers in 2017 used any services of the 500 fishing entrepreneurs in the sector (Pohja-Mykrä et al., 2018).

Members of the “active anglers” profile were a highly mobile or multi-local segment among the registered fishers – 64% go fishing in at least two regions, and 19% make fishing trips abroad (Pellikka & Eskelinen, 2019). They are committed fishers, and focus

mostly on fishing with a rod, while the majority also participate in troll fishing or ice fishing, and some 20% go fly fishing. It is not surprising that they target salmonids more often than others. They spent more days fishing in Lapland on average than fishers with other profiles. However, salmon as the main target species indicated fewer fishing days in Finland in general. Intuitively salmon fishing mainly requires traveling long distances beyond many fishers' home residential province. Thus, only a few trips are made during one fishing season, but they last for several days, and the longer duration of the trip requires spending more money on traveling and local services.

Members of the "active generalist" profile were very active users of many types of gear (including also nets and fish traps), and were more eager fishers in Southern Savonia, and in marine areas than other profiles. Those using nets with vendace as their main target species spent more fishing days in Southern Savonia.

Our estimated value of a fishing day in Finland (EUR 104) indicates that recreationists are willing to pay more for fishing than other water recreation activities. The estimated value of a fishing day was considerably higher than the value of a daily water recreation trip (EUR 8.18 to EUR 24.64) estimated in a Finnish study using the LVVI database on outdoor recreation (Vesterinen et al., 2010).<sup>2</sup> Our estimated total recreational use value for fishing, EUR 528 million, fits the range of the total recreational value of a water recreation day of EUR 353 million to 1063 million by Vesterinen et al. (2010). Although the LVVI data did not allow an assessment of the value of fishing separately from other water recreation activities, Vesterinen et al. (2010) noted that travel costs per person were higher for fishing than for other activities, i.e. swimming or boating. The difference is clearly worth further exploration with data that cover a multitude of activities.

The value of a fishing day estimated in the demand model for fishing days in Lapland was EUR 78. In earlier studies on the river Teno and river Tornionjoki (Pokki et al., 2018; Pokki et al., 2020) the value of a fishing trip was EUR 235-338 for the river Teno in 2011 and EUR 121 for short trips (less than 3 days) to the river Tornionjoki in 2016. Considering inflation and the average fishing days per trip (6.79 for Teno and 1.49 for Tornionjoki), the value of a fishing day is approximately EUR 37-54 for Teno and EUR 83 for Tornionjoki at the 2018 price level. Our result seems to be in line with the Tornionjoki study, and less so with the study on the river Teno. However, the river Teno is a remote and highly unique salmon fishing destination for most of Finns. On average, fishers tend to spend more time per fishing trip in Teno than in other northern salmon rivers in Finland which makes the welfare estimation with the travel cost method more difficult (Pokki et al., 2018).

Several limitations and uncertainties related to the estimated models resulted from the dataset used for the study. One of the most important limitations was that there were no data available on the number of fishing trips during the season. In addition, the money spent on travel and fishing activity was reported as a total for the whole season, not for an average trip. We were, therefore, able to use only the average travel costs per fishing day of the season in the demand model. The travel cost variable included the cost of travel time estimated using several assumptions. To demonstrate the effect of the cost of travel time, all four models were also estimated, including only the reported travel costs per fishing day, and excluding the cost of the travel time from the travel cost variable. The sign of the explanatory variables remained the same, as well as the statistical significance of the travel cost variable. When the cost of the travel time was excluded, the coefficient of the travel cost variable was higher and the consumer

surplus per fishing day was lower than with a combined travel cost variable, giving a €15–30 lower consumer surplus per day, depending on the model. These models also have a better fit (higher pseudo- $R^2$  values). Considering the importance of including the cost of the travel time in the travel cost models for unbiased estimates (Cesario & Knetsch, 1970), the demand models with combined travel costs were selected for presentation in this paper.

In cases with multiple destinations, it is impossible to identify which of the costs relate to fishing in certain provinces or marine areas. Respondents fishing in multiple provinces and marine areas can, therefore, be included only in the model for Finland as a whole. Moreover, only the provinces and marine areas visited, not the exact fishing sites, were identified in the study. The travel costs to substitute sites were not included in the models as explanatory variables, and the consumer surplus estimates are, therefore, probably overestimations.

Data collected for this study did not allow an analysis of the importance of catch or quality differences (e.g. water quality, supply of fishing services, and accommodation) of fishing sites on the demand for fishing days. Future research could incorporate the catch levels/catch expectations and site quality aspects in the model determining the demand for fishing in the Finnish provinces and marine areas by applying hedonic travel cost models. Moreover, the data were collected from registered fishers aged between 18 and 65 only, and this limits our analysis to the most active fishers using fishing techniques which require the payment of a fisheries management fee. To study the value of all recreational fishing in Finland, including unregistered participants, wider data collection would be needed.

## Notes

1. This value includes fishing by registered fishers aged 18–65 and excludes fishing by foreign tourists.
2. Results from Vesterinen et al. (2010) are presented in 2018 prices.

## Disclosure statement

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