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Participation rate and demographic profile in recreational angling in The Netherlands between 2009 and 2017

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ABSTRACT

Since 2009 the Netherlands has conducted extensive online screening surveys to establish the number, trends and demographic profile of recreational anglers, resulting in a large dataset of almost 500.000 data records between 2009 and 2017. Participation in both marine and fresh water recreational angling were analysed using general linear models (GLM). Results showed a steady decline in the participation rate in fresh water angling. The participation rate in marine angling was smaller, and declined from 2009 to 2011, but remained similar afterwards. Analysis of demographics (age, gender, education and region) showed that males were overall much more likely to participate in recreational angling than females. Additionally, the age distribution differed for marine and fresh water. In marine water young adult males (age group (25,45]) had the highest participation rate, whereas in fresh water the youngest age group, (5,15], had the highest participation rate, closely followed by young adult males (age group (25,45]). Additionally, lower educated persons were more likely to participate in recreational angling than higher educated persons. This study provides more insight in the culture of Dutch recreational angling. Furthermore, the participation model can be used to predict future angling participation.

1. Introduction

Recreational angling is a popular leisure activity. Knowledge of participation rates in recreational angling is valuable information for policymakers (Brownscombe et al., 2019). However, it is difficult to anticipate future participation, because participation rates are often difficult to assess or unknown (Dempson et al., 2012; Fedler and Ditton, 2001; Hartill et al., 2011; Jones and Pollock, 2013; Lyle et al., 2002).

Traditional survey methods to assess participation in recreational angling are based on telephone-, mail- or face to face surveys. Participation rates can also be determined by licence sales. However, telephone or mail surveys are increasingly vulnerable to non-response bias due to declining response rates and it can be costly to recruit large numbers of individuals by telephone or mail, often resulting in small sample sizes of fishers (Brownscombe et al., 2014; De Leeuw and De Heer, 2002; De Leeuw, 2013; Groves, 2006; Massey and Tourangeau, 2013). Studies based on licence sales do not accurately represent participation rate because they indicate the intention to go fishing and not if the activity indeed took place (Ashford et al., 2009). In addition, angler coverage is not always complete because there are often exemptions and because there might be non-compliance. In the Netherlands, for example, children under 14 only need a licence if they go fishing without an adult with a licence and purchasing a licence in marine water is not obligatory. Due to these rules and non-compliance, roughly only ~50–70 % of the anglers purchase a licence for freshwater recreational angling (Aarts, 2008 and unpublished data). More recently, internet surveys have become more common for data collection. Online data collection has the advantage that it is fast with relatively low costs and potentially answers can be more honest because of respondent anonymity (De Leeuw, 2012). Disadvantages are that online data collections often results in non-representative samples based on the group of people using the internet mostly, or based on panels which are a result of self-recruitment (De Leeuw, 2013). However, a good alternative would be a panel that is representative in the key demographic characteristics of the population and does not allow self-recruitment of its members.

Participation in recreational fishing can be influenced by culture, socio-economic status, availability of fishing grounds, age, gender, household composition, ethnicity, working status, weather conditions and urban residency (Aas, 1996; Arlinghaus, 2006; Arlinghaus et al., 2008, Arlinghaus2015; Floyd and Lee, 2002; Kuehn et al., 2013; Murdock et al., 1996; Walsh et al., 1989). Because these factors differ among countries, the participation rates are also highly variable among countries. For example in 2015, participation rates (marine and fresh water) in European countries were estimated to vary between 3.2 % (Czech Republic and Hungary) and 32.2 % (Norway), with of an overall

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average participation rate of almost 11 % (Arlinghaus et al., 2015). In marine water European participation rates were estimated to be between 0.22 % (Belgium) and 33 % (Norway) with an estimated 8.7 million European recreational sea fishers corresponding to an overall participation rate of 1.6 % (Hyder et al., 2018).

The objective of this study was to investigate how the trend in participation rate in recreational angling in marine and fresh water in the Netherlands is influenced by the following demographic factors: gender, age, education, region and household size. Data was obtained using an online survey, which was conducted by a commercial market company (Kantar), which maintains a large online survey panel comprising more than 50.000 households in which self- recruitment is not allowed. The survey was conducted biennially between 2009 and 2017, resulting in a dataset of almost 500.000 records. In this study, a generalized linear model (GLM) was developed to analyse the association of gender, age, education level, household size and region on the participation rate of recreational angling in the Netherlands.

2. Material and methods

2.1. Kantar panel

Data collection was conducted by a marketing company (Kantar), which sends online questionnaires to households in its panel (> 50.000 households). The panel contains samples randomly selected from each demographic defined group (i.e. sampling stratum) and the sample size in each group is aimed to be proportional to the actual population size in the same group (a so-called quasi-representative sample of the population). The demographic groups were defined by gender, age, education, income, region, urbanity, ethnicity and household size. Most households (~70 %) in the panel were recruited using random telephone recruitment surveys. Some groups were more difficult to recruit such as the elderly, low educated persons, immigrants and single person households. These groups were recruited through a purchased database (20 %) or by asking selected existing participants if they knew persons belonging to the groups that were difficult to target (10 %). Self-recruiting of panellists was not allowed. Members receive a small reward (gift cards) for each questionnaire. This is not expected to be a motivation for the majority of people to join the panel. Matthijsse et al. (2015) stated that incentives result in participation of individuals who are less interested or have lower topic involvement and therefore incentives reduce the non-response bias.

To reduce possible fraud in order to obtain the reward, respondents were checked for filling in the questionnaires very fast and answers were checked for unusual or conflicting responses. Respondents had at least two weeks to respond to each questionnaire and reminders were sent in case of non-response. As a result, the panel is ISO 9001 certificated (see also Van der Hammen et al., 2016).

2.2. Screening survey

The Kantar panel was used to conduct a biennial online screening survey to identify recreational anglers in the Netherlands (Van der Hammen et al., 2016). Data was collected for all types of recreational fishers, however because 95 % (marine) and 99 % (fresh water) of the recreational fishers are anglers, the analyses were restricted to anglers. In each survey, questions were embedded in an omnibus questionnaire that covered a variety of different topics. To reduce the potential for non-response bias based on the survey subject, participants did not know the topics before filling in the questionnaire and were not allowed to skip individual topics. Each member of the household could fill in the questionnaire individually, or one member could fill it in for several members of the household. Respondents were asked who in the household had fished recreationally in the Netherlands in marine and/or freshwater in the previous year, how often and what gear(s) they had used. If a member of the family filled in the questionnaire for other members of the family, it was assumed that the responding member had knowledge whether other members had fished in the survey year. In 2009, 93 % of the Dutch population had access to the internet, increasing to 97 % in 2013 (no information could be found after 2013) and thus potential coverage bias caused by limited internet access is expected to be small. Specific response rates based on individuals were available for 2015 (76 %) and 2017 (78 %). To correct for possible bias due to non-response, post-stratification weights were calculated by Kantar using census data. The strata that were used to calculate the weights were gender, region, age, household size and education.

Table 1
Categorization and definition of the demographic predictors in the GLM. Groups with * refer to the reference level of the predictor in the model.

Demographic predictors	Classes	Definition
Age	(5,16]*	child
	(16,25]	youth
	(25,45]	young adult
	(45,65]	middle age
	> 65	after retirement
Gender	Female*	
	Male	
Education	Low*	no education, elementary school or lowest secondary levels
	Medium	medium and higher secondary levels and post secondary levels other than university levels.
	High	applied and research university levels
Region	North*	See Fig. 1.
	South	
	East	
	West	
Year	2009*	
	2011	
	2013	
	2015	
	2017	

2.3. Demographic predictors

Information on gender, age, education level, region and household size were provided by Kantar and were hypothesized to be associated with participation rate (Table 1). Age was categorized into 5 groups representing roughly different life stages; (5,16] (child), (16,25] (youth), (25,45] (young adult), (45,65] (middle age) and > 65 (after retirement). Education was categorized into low (no education, elementary school or lowest secondary levels), medium (medium and higher secondary levels and post-secondary education other than university levels) and high (applied and research university levels). Household region was categorized into North, South, East and West (Fig. 1). Apart from the demographic factors, year was included as a predictor. The effect of year is likely to be caused by unknown and/or unavailable predictors, such as national social-economic conditions, weather conditions or fish stock sizes.

2.4. Statistical analysis

Because several anglers fished both in marine and fresh water, first the participation rate per year was calculated for each type of angler (marine, fresh water or both), after applying the post-stratification weights. Next, the analyses were split in fresh and marine water and the participation rate per year and per demographic group was calculated. A generalized linear model (GLM) was then applied to explore the association between predictors and the participation rate in recreational angling. The participation rate was modelled as a Bernoulli distribution with logit link function. Correlations between every two predictors were calculated to check for co-linearity. Because household size showed negative correlation with age (Spearman's correlation =

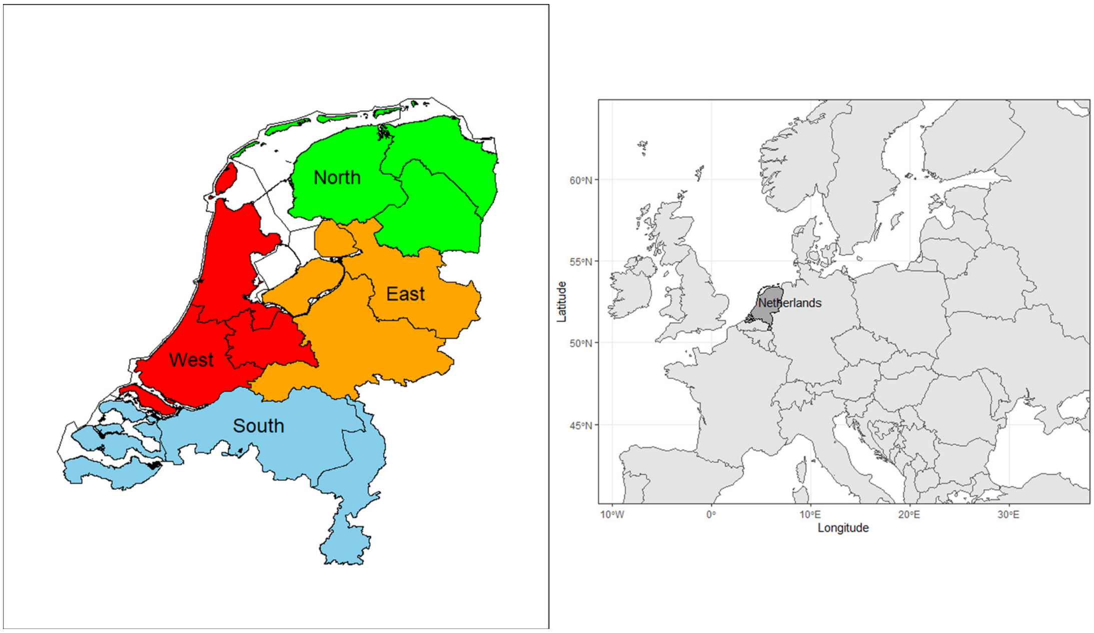

Fig. 1. Location of The Netherlands within Europe (right) and regions within the Netherlands as included in the model (resident location, left). North (green), South (blue), East (orange), West (red). Number of residents (1 jan 2017, x1000): North = 1623, South = 3791, East = 3388, West = 7242. For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.

−0.6), household size was not included in the models. The interactions between the predictors were also explored. Model coefficients were estimated through Maximum likelihood estimation. The best fitted models were then selected according to minimum AIC. Model goodness of fit was checked by plotting the observed vs. predicted participation rate. A very large sample size (N > 490,000) results in statistically significant effects even when the magnitude of the effects are very small. Because p-values do not provide a lot of information at such high statistical power, the estimated effect sizes were presented as odds ratios (OR). An OR larger than 1 indicates a positive effect while an OR smaller than 1 indicates a negative effect of a predictor. The further the OR deviates from 1, the stronger the effect is. Compared to the descriptive summary statistics, GLM gives a mathematical formulated relationship between predictors and participation rates. Such relationship can be used for forecasting future participation rate in The Netherlands. All data analyses were conducted using the open source programming language R (R Development Core Team, 2018).

3. Results

3.1. Marine

The annual participation rates estimated after weighting was applied were 3.8 %, 3.3 %, 3.2 %, 3.4 % and 3.5 % for 2009–2017 (Fig. 2). This is only a slight difference compared to the estimates without weighting (3.9, 3.4, 3.0, 3.3 and 3.3 for 2009–2017 respectively), suggesting that the responding sample was generally unbiased. The trend in participation rate was stable for anglers fishing in both water types (Fig. 2). For anglers fishing in marine water only, there was a decline in the participation rates between 2009 and 2011, but there was no negative trend afterwards. Overall, males had a much higher participation rate than females (5.8 % vs. 1.2 %). The observed participation rate after applying the weights per demographic subgroup and year are listed in Table S1 (Supplementary material). The highest participation rate in marine water were low educated young adult males (25,45] living in the northern region (13.5 % on average over the years, Table S1).

The best fitted participation model for marine water included the predictors age-gender (including interaction), year, education level and region (Table 2). The model fitted the data well (Fig. S1). Age and gender explained the majority of the variation (Fig. 3a). Participation per age group differed for males and females. The age group (25,45] showed a clear peak in participation rate for males and females. However, for females this peak is similar to the youngest age group (6,15] (reference line, Fig. 3a). Participation rate also differed by region: In the northern region (Fig. 1), participation rates were higher compared to the other regions.

3.2. Fresh water

The annual participation rates estimated after weighting was applied were 9.3 %, 8.0 %, 7.3 %, 6.8 % and 6.5 % for 2009–2017. The annual participation rates estimated from the quasi-representative sample were 9.6 %, 8.1 %, 7.3 %, 6.7 % and 6.2 % for 2009–2017, suggesting that the responding sample was generally unbiased. In contrast with marine angling, fresh water participation rates decreased in each survey year from 2009 to 2017. This negative trend in fresh water anglers was seen only for the group of anglers fishing only in fresh water. Anglers fishing in both water types did not show a decline (Fig. 2). Overall, males had a much higher participation rate than females (12.6 % vs. 3.0 %).

Similar to marine water, the best fitted participation model for fresh water included the predictors age-gender (including interaction), year, education level and region (Table 2). The model fitted the data well (Fig. S1). Age and gender explained the majority of the variation (Fig. 3b). Similar to marine angling, in fresh water residents of the northern region (Fig. 1) were more likely to participate in angling than residents of other regions. The youngest age group (5,16] were most likely an angler in both genders (Fig. 3b). The young adult groups (25,45] in both genders also had high participation rates. The highest participation rate in fresh water was for males in the youngest age group (5,16] living in the northern region (31.4 % on average over the years).

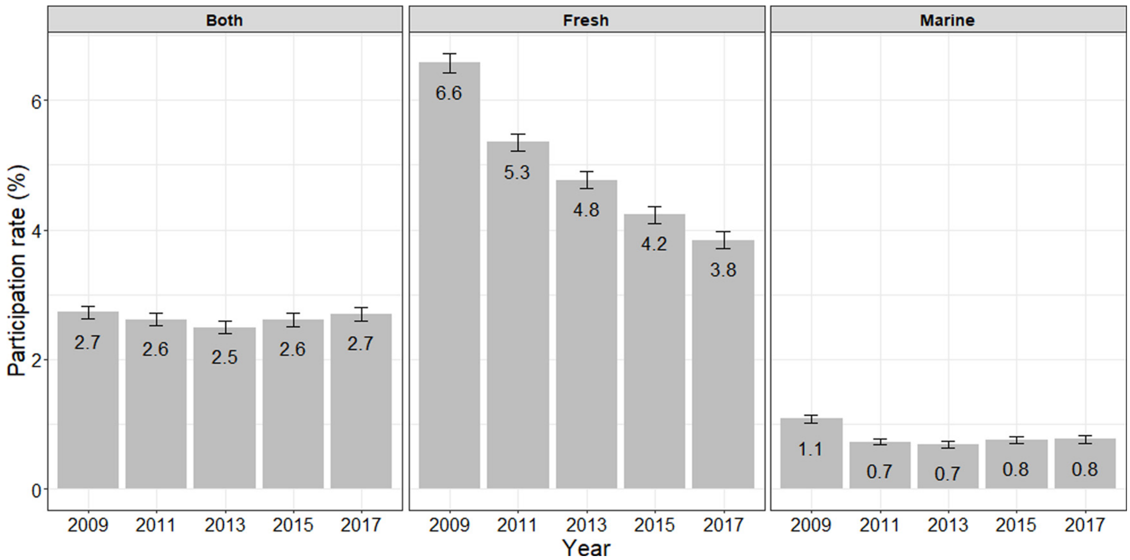

Fig. 2. Participation rate (%) of recreational anglers in the Netherlands for 2009:2017 and 95 % confidence intervals. Left) anglers who fish in marine and freshwater; middle) fresh water anglers; right) marine anglers.

Table 2
Estimated model coefficients and standard errors. The reference level of the predictor in the model is Year = 2009, EDU = low, Region = North, Gender = Female, Age = (5,16].

	Marine			Fresh water		
	coefficient	SE	p-value	coefficient	SE	p-value
Intercept	−3.576	0.049	< 0.001	−1.656	0.026	< 0.001
Year 2011	−0.171	0.024	< 0.001	−0.224	0.016	< 0.001
Year 2013	−0.240	0.025	< 0.001	−0.296	0.017	< 0.001
Year 2015	−0.143	0.025	< 0.001	−0.373	0.018	< 0.001
Year 2017	−0.112	0.025	< 0.001	−0.415	0.018	< 0.001
EDU medium	−0.233	0.021	< 0.001	−0.361	0.015	< 0.001
EDU high	−0.713	0.026	< 0.001	−0.955	0.019	< 0.001
Region South	−0.306	0.027	< 0.001	−0.862	0.019	< 0.001
Region East	−0.404	0.028	< 0.001	−0.460	0.018	< 0.001
Region West	−0.273	0.024	< 0.001	−0.544	0.016	< 0.001
Female, Age (16,25]	−0.333	0.076	< 0.001	−0.940	0.046	< 0.001
Female, Age (25,45]	0.122	0.056	0.029	−0.611	0.033	< 0.001
Female, Age (45,64]	−0.606	0.059	< 0.001	−1.299	0.035	< 0.001
Female, Age (64,100]	−1.412	0.093	< 0.001	−1.988	0.058	< 0.001
Male, Age(5,16]	1.236	0.049	< 0.001	1.244	0.025	< 0.001
Male, Age(16,25]	1.251	0.052	< 0.001	0.605	0.030	< 0.001
Male, Age(25,45]	1.848	0.048	< 0.001	1.087	0.027	< 0.001
Male, Age(45,64]	1.492	0.047	< 0.001	0.700	0.026	< 0.001
Male, Age (64,100]	1.022	0.051	< 0.001	0.387	0.029	< 0.001

4. Discussion

This study provides a detailed analysis of factors influencing participation rates in marine and fresh water angling in the Netherlands. Results show (i) that participation rate was much lower in marine angling than in fresh water, (ii) that children had high participation rates in fresh water angling, but less so in marine angling, (iii) that participation rates by males were much higher than females, (iv) that lower educated had higher participation rates, (v) that the participation rates were highest in the northern regions with high availability of fishing grounds and relatively few urban areas and (vi) that participation in fresh water angling has been declining.

Participation rates in fresh and marine water were analysed separately even though there was overlap with many anglers indicating that they fished both in marine and fresh water. Over all survey years, about 60 % of all anglers fished in fresh water only, whereas 30 % fished in marine and fresh water and 10 % fished in marine water only (Fig. 2). This means that most marine anglers (about three quarters) also fished in fresh water, whereas most freshwater fishers only fished in fresh water (about two third).

There are many similarities between marine and fresh water angling. As expected, in both water types, males participated much more than females. Traditionally, angling is biased to males, which is also found in other studies (Aas, 1996; Arlinghaus, 2006; Brownscombe et al., 2014; Fedler and Ditton, 2001; Floyd and Lee, 2002; Floyd et al., 2006; Freire et al., 2012; Henry and Lyle, 2003; Kuehn et al., 2013; Lyle et al., 2009; Murdock et al., 1996; Walsh et al., 1989). Higher participation in the North for both marine and fresh water can be explained by the abundant availability of marine and fresh water fishing grounds in this area and relatively small amounts of urban areas. In the west there is also abundant availability of fishing grounds, but participation rates may be lower in this area because the main large cities are located in the western part of the Netherlands and angling participation is usually lower in urban as compared to more rural areas (Aas, 1996; Arlinghaus et al., 2008; Arlinghaus and Mehner, 2004; Arlinghaus et al., 2015). Lower participation at higher education levels in the Netherlands is more difficult to explain and the relationship is not consistent in the literature. A positive relationship was found in the USA (Fedler and Ditton, 2001; Floyd et al., 2006; Walsh et al., 1989), whereas a negative relationship was found in Germany (Arlinghaus, 2006) and in this study. Likely, there are factors correlated with education which were not studied and may depend on region specific culture. For example, education may be inversely correlated to the availability of free time in different countries. Lack of free time was found to be an important factor explaining participation in recreational fishing in the USA (Fedler and Ditton, 2001).

Overall, Dutch participation rates were much higher in fresh water than in marine water. The trends in participation also differed: The participation rate in fresh water steadily decreased between 2009 and 2017, whereas in marine angling there is a drop between 2009 and 2013, but a slow increase after 2013. Declines in participation rate were also observed in the US, Canada, England Australia and New Zealand (Aprahamian et al., 2010; Brownscombe et al., 2014; Dedual and Pickford, 2018; Gray et al., 2003; Lyle et al., 2009; Parkinson et al., 2018; Sutton et al., 2009; USFWS, 2006; West et al., 2015). The decline

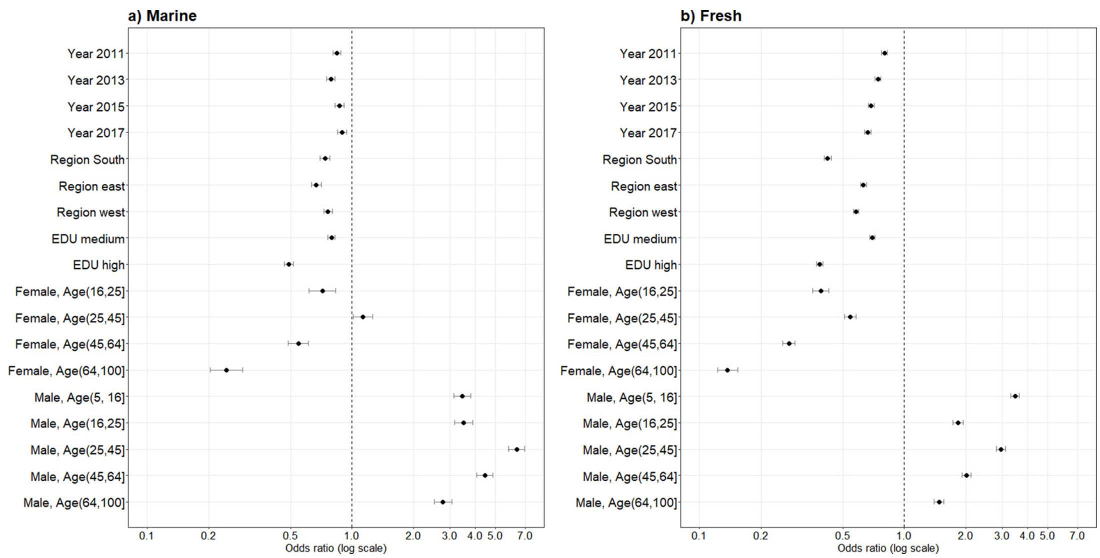

Fig. 3. Odds ratio (OR) and 95 % confidence intervals for the predictors in the two GLM's. (a) marine and (b) fresh water. The OR is calculated to each reference level of the predictor (OR = 1), i.e. year = 2009, region = north, EDU = low, gender:age = female, age (5,16].

in participation is often explained by the youth showing less interest in fishing activity (Brownscombe et al., 2014; West et al., 2012). In this study we also found that the mean age of anglers slowly increased due to the increasing mean age of the Dutch population and there are signals that memberships of children and youth of fresh water angling clubs are declining (Slot-Heijs and Roest, 2017). However, participation rate alone does not necessarily reflect the total effort in the population, which is a combination of the participation rate, the fishing activity per angler and the population size. In the Netherlands, most recreational anglers are low avid (Van der Hammen et al., 2016), which is also the group that more easily ceases the activity (unpublished data). Therefore, it is likely that the decrease in total effort was lower than the decrease in the number of participants. The Dutch population increased between 2009 (15.46 million) and 2017 (16.14 million), however despite the population growth, the number of fishers declined in fresh water or more or less stabilised in marine water. Another difference between marine and fresh water is the age distribution of the anglers. In fresh water the youngest age group (age group (5,16]) had the highest participation rate, whereas in marine waters the highest participation rate was in the young adult group (age group (25,45]). Likely, marine angling requires higher cost and commitment, e.g. marine anglers regularly go on charter boats and travelling to the fishing site may take a longer time, which might be a burden for children to go fishing in marine water compared to fresh water. The decrease of interest in age group (16,25] in fresh water angling is possibly due to that at these ages many changes take place, such as becoming independent of parents or move away from home. Indeed in our data we also found that families had higher participation rates compared to one-person households and Slot-Heijs and Roest (2017) also found that young anglers often go fishing with a member of the family. Possibly, when these previous anglers age, they may become active again after they settle down and have their own family (age (25–45]). The participation rate found in this study is similar to that found by Aarts (2008) who estimated the participation rate (marine and freshwater) to be 11 % in 2004. The combined marine and freshwater participation rate in this study in 2009 was 10.5 % (Fig. 2).

The participation model applied in this study only provides plausible associations between the selected demographic factors and participation, whereas the underlying causal factors remain unclear and require further investigation. Fishing behaviour is often influenced by a mixture of social-economical aspects. Information such as country's income, employment, available free time or weather condition were not available for this study. Also fish stock size or management rules are likely to influence fishing behaviour (Arlinghaus et al., 2019; Arlinghaus et al., 2008, Brownscombe2019; Lester et al., 2003). For example, the cod (*Gadus morhua*) stock has declined strongly in the North Sea (ICES, 2019a), which has reduced the number of charterboats in the North sea targetting cod. The European Seabass (*Dicentrarchus labrax*) stock has also declined strongly recently and is now at the lowest levels since the start of the timeseries (ICES, 2019b), causing several management measures to become in place for the recreational sector, such as a baglimit, a closed time period and a minimum landing size (Council Regulation (EU), 2020/123). Also the recreational eel (*Anguilla anguilla*) fishery in The Netherlands has been transformed to be a catch and release fishery only as a result of the eel regulation (Council Regulation (EC) No, 1100/, 2007). As discussed above, the dependence of participation on region or age were possibly caused by an underlying mechanism such as the availability of fishing ground or availability of free time.

The results from the participation model can be used to project future angler participation (Murdock et al., 1992). For example, expected changes in population size, in demography, region or education levels in combination with the model will lead to predictions that can be used by policymakers.

CRediT authorship contribution statement

Tessa van der Hammen: Conceptualization, Methodology, Formal analysis, Writing - original draft, Visualization. **Chun Chen:** Conceptualization, Methodology, Formal analysis, Writing - review & editing, Visualization.

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 A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.fishres.2020.105592.

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