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Explaining participation rates in recreational fishing across industrialised countries

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Abstract On average, 10.52% of the total population was found to fish for recreation across the industrialised world (N = 27 countries), amounting to an estimated 118 million (95% confidence interval 81–154 million) people in North America, Europe and Oceania. Participation rates declined with population density and gross domestic product, indicating a negative effect of urbanisation and post-modernisation on fishing interest. Participation rates also declined with increasing median age, average household size and unemployment rate, suggesting resource limitation to constrain participation in fishing. By contrast, two indicators of the cultural importance of fish (fish landings and per capita fish consumption) and an indicator of perceived need for leisure (weekly working hours) were positively correlated with fishing participation. Based on these findings, which explained 60% of the variance in fishing participation across the industrialised world, reduced fishing interest is to be expected with post-industrialisation. Dedicated management and marketing intervention is needed to reverse the track of diminishing fishing interest in industrialised countries.

KEYWORDS: angler, demographics, socio-economic drivers, urbanisation, values, videophilia.

Introduction

Recreational fishing is defined as fishing of aquatic animals that do not constitute the individual's primary resource to meet basic nutritional needs and are not generally sold or otherwise traded on markets (FAO 2012). Such fisheries constitute the dominant or sole use of most wild-living freshwater and many coastal fish populations in all industrialised countries and several economies in transition (e.g. Brazil) (Arlinghaus *et al.* 2002; Mora *et al.* 2009; FAO 2012). Global estimates of recreational fishers vary widely from 220 million (World Bank 2012) to 700 million (Cooke & Cowx 2004). To reduce this uncertainty, more work on the drivers of recreational fishing interest across the world is needed.

Projecting the future participation in fishing is of considerable importance to a range of stakeholders, businesses and agencies (Loomis & Ditton 1988; Murdock *et al.* 1992, 1996; Arlinghaus 2006; Kuehn *et al.* 2013). For example, by accurately predicting the number of recreational fishers over time, fishing tourism developments and investments by the fishing industry could be improved. Also, international fishing bodies would benefit from knowledge of drivers of fishing participation to improve the design of fisheries policies. Finally, many fisheries management agencies depend on fishing licence

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sales. Hence, knowledge about the predictors and trends of recreational fishing interest would be paramount to improve marketing and recruitment initiatives.

One way to understand fishing participation quantitatively is to relate individual-level variables (e.g. age, income or residency in urban areas) to observations of engagement in recreational fishing and thereby derive a probabilistic model of fishing interest (e.g. Walsh *et al.* 1989; Floyd & Lee 2002; Arlinghaus 2006; Kuehn *et al.* 2013). Often, demographic predictor variables have been used using this approach. This research has reported positive influences of income, male gender and proximity to, and quality of, fishing sites on the likelihood to fish recreationally and negative influences of age (but see Floyd & Lee 2002; Arlinghaus 2006 for exceptions), household size (but see Walsh *et al.* 1989) and urban residency (e.g. Walsh *et al.* 1989; Floyd & Lee 2002; Arlinghaus 2006; Thunberg & Fulcher 2006; Kuehn *et al.* 2013). By moving the sampling units from the individual person to countries, country-level (and by the same token state-level) participation rates in recreational fishing have also been found to be related to state-level demographic and geographical variables (Loomis & Ditton 1988; Edwards 1989; Murdock *et al.* 1992, 1996; Adams *et al.* 1993).

Any micro-level decision-making by individuals is nested in, and affected by, macro-level societal developments such as industrialisation and urbanisation (Inglehart 1990; Manfredo 2008; Manfredo *et al.* 2009). Many industrialisation-induced societal changes should initially foster public interest in recreational fishing because increasing wealth helps large fractions of society meet their basic nutritional needs and frees resources that can be invested in leisure activities to meet 'higher-order' psychological goals (for general sociological perspective, see Inglehart 1990; for a conceptual model in recreational fisheries, see Smith 1986; Arlinghaus *et al.* 2002; FAO 2012). Correspondingly, interest in recreational fishing rises sharply with initial economic development of a given society (Smith 1986; FAO 2012). However, there are limits to growth, and in many highly so-called post-industrialised countries (Inglehart 1990), recreational fishing interest has recently been declining (e.g. Canada Gray *et al.* 2003; USA USFWS 2006; UK and France, Aprahamian *et al.* 2010). Similar developments have been reported for recreational hunting (Heberlein *et al.* 2002; Robison & Ridenour 2012). Several mechanisms associated with post-industrialisation and urbanisation such as reduced cultural importance of fishing and hunting, and altered access to fish and wildlife, are likely contributing to the decline of interest in hunting and fishing in many post-industrialised societies (Adams *et al.* 1993; Aas 1996; Arlinghaus 2004; Arlinghaus *et al.* 2012).

As macro-level observations, such as a country's participation rate in fishing, are an emerging property of complex micro-level individual decision-making processes, taking a psychological perspective can help understand fishing interest. Accordingly, recreational fishing is a goal-oriented process that helps the individual angler to meet expected psychological outcomes (Driver & Knopf 1976; Driver & Cooksey 1977; Manfredo *et al.* 1996). However, even if a person has the motivation to go fishing, this can only be accomplished if fishing opportunities exist and are accessible (Edwards 1989; Adams *et al.* 1993). Moreover, one has to have the resources (time, money and physical abilities), interest and knowledge to engage in fishing (Walsh *et al.* 1989; Floyd & Lee 2002; Kuehn *et al.* 2013). Finally, any perceived personal constraints such as 'lack of time' (e.g. due to family commitments) have to be overcome (Crawford *et al.* 1991; Fedler & Ditton 2001; Sutton 2007). However, in many cases, social–structural variables related to resources and access have been found to be more important predictors of participation in leisure activities than self-reported intrapersonal or interpersonal constraints (Shaw *et al.* 1991; Aas 1996; Sutton *et al.* 2009; Freudenberg & Arlinghaus 2010; Kuehn *et al.* 2013). Therefore, one can expect that societies in which the average individual has sufficient resources available in terms of time and money should show higher recreational fishing participation rates. Along the same rationale, countries with higher water availability and greater cultural importance of fishing should reveal increased fishing participation rates compared with countries or states with a scarcity of fishing opportunities (Adams *et al.* 1993).

The objectives of this study were to describe and explain variance in recreational fishing participation rates across industrialised countries. The study focused on already industrialised and post-industrialised countries due to lack of data on recreational fishing rates from the developing world (Arlinghaus & Cooke 2009). Five hypotheses were tested.

- Recreational fishing participation is positively related to the cultural importance of fish in a given country (H_1);
- Recreational fishing participation is negatively related to urbanisation (H_2);
- Recreational fishing participation is positively related to availability of resources in terms of time and money (H_3);
- Recreational fishing participation is positively related to perceived leisure need (H_4); and
- Recreational fishing participation is positively related to availability of fishing opportunities (H_5).

Methods

A literature search targeting primary publications and grey literature was conducted to identify studies that

reported data on numbers of recreational fishers in a given country or state. Standard search engines were used (e.g. Web of Science, Google Scholar), supplemented by searching key international conferences and their proceedings (e.g. Hickley & Tompkins 1998). Moreover, known researchers in countries of North America, South America, Eurasia, Oceania and Asia were contacted by email to identify unpublished studies, governmental reports and similar references. Each identified study was judged for its scientific quality in relation to the estimated numbers of recreational fishers. Preference was given to studies that used probability-based sampling of the general population to identify active recreational fishers. Studies with reported weights to correct for biased sampling (highest quality) were preferred over studies without reported weights (lower quality). As a second and somewhat less reliable data source, licence number sales were used in cases where no random sampling-based study was available, although licence sales are known to underestimate the total fishing participation in some countries (e.g. Kohl 2000). In general, studies were preferred that followed a consistent survey mode across countries or states (e.g. Toivonen *et al.* 2000; Table 1). Many initially identified participation rate (or number) estimates were ultimately discarded due to concerns with study quality, and they are not reported here to avoid readers taking them as face value.

The approach of data collection yielded $N = 28$ recreational fisher estimates with a bias towards Western countries in North America and Europe (Table 1). Due to low sample size, it was decided to consider all US states and Canadian provinces as 'countries' similar to the approach taken by Heberlein *et al.* (2002) in recreational hunting. The large variance in demographics, socio-economic status and urbanisation among US states (Manfredo *et al.* 2009) warranted this decision. From each study, the most complete estimate of recreational fisher numbers was extracted, irrespective of environment or type of recreational fishing. Double counting of people engaging in freshwater or saltwater fishing was avoided. Estimates relating to the active fishing population within the last 1 or 2 years were preferred, where applicable. Studies differed in the age threshold used to count fishers (e.g. aged 14 and older or aged 18 and older), which was not further considered. To standardise the fisher-number metric and achieve a participation rate estimate used as dependent variable in the present work, the absolute number of recreational fishers was related to the total population size.

Predictor variables to test the five hypotheses were collected from a range of sources and publicly available country-specific or international (e.g. United Nations) statistical compilations (see Supporting Information for details) and matched to the study year of the recreational fishing participation rate similar to Heberlein *et al.* (2002). As indicators of urbanisation and post-industrialisation, population density was chosen as a measure of urbanisation and the per capita gross domestic product as a measure of the size of the economy. Population density was treated as a measure of urbanisation after realising definition issues with alternative metrics such as percentage of the population in cities of a given size. Per capita availability of resources for the average member of society was measured by the average age of a given society (assuming that old age induces physical constraints to engage in outdoor recreation), the average household size (assuming that larger household sizes carry greater family commitments), the unemployment rate (assuming that lower rates would result in greater money availability) and average weekly working hours (assuming that longer durations of work lead to less time for fishing despite greater perceived need to recreate). Availability of fishing opportunities was measured by two variables, the relative surface area of fresh water in a country or state and access to the coastline, the latter being coded as present or absent. Total fish landings were treated as an indicator of cultural importance of fish of a country/state, assuming that countries that have a large fishing fleet and correspondingly large landings attach great importance to fish and fishing as a lifestyle. Per capita fish consumption was similarly treated as a measure of cultural importance of fish.

All predictor variables were tested for bivariate correlations (Table 2), and the final set chosen (after occasional transformation to improve linearity) was only weakly correlated with each other. However, two exceptions occurred: first, there was a strong, unavoidable negative correlation of median age of a given society with average household size. Second, there was an unavoidable strong correlation between total fish landings and access to salt water (Table 2). Because these correlations were exceptions, the variables were retained.

Prior to building multivariate statistical models, bivariate scatter plots were used to examine the relationship between participation rate of recreational fishers and each of the potential predictor variables. All variables that showed nonlinear patterns were transformed to increase linearity. Accordingly, population density was log transformed (natural logarithm), and all ratio variables were arcsin$\sqrt{}$-transformed as per recommendations by Zar (1999) for inclusion of ratio variables in linear models. Similarly, the dependent variable participation rate in recreational fishing was arcsin$\sqrt{}$-transformed.

A series of multiple regression models were built by regressing the (transformed) participation rate variable

Table 1. Overview of recreational fishing participation rates including reference, year to which the estimate refers and certainty of estimate

Country	Population size (millions) (CIA 2013)	No. of recreational fishers	Participation rate (% recreational fishers of total population)	Year of estimate	Reference	Certainty of estimate[1]
Europe						
Austria	8 100 000	410 000	5.1	2000	Kohl (2000)	High
Belgium	10 100 000	300 000	3.0	1998	Pintér and Wołos (1998)	Low
Czech Republic	10 200 000	330 000	3.2	2003	Spurny *et al.* (2003)	Medium
Denmark	5 330 000	451 000	8.5	2000	Toivonen *et al.* (2000)	High
Finland	5 200 000	1 390 000	26.7	2000	Toivonen *et al.* (2000)	High
France	60 900 000	5 000 000	8.2	2008	Le Goffe and Salanié (2005)	High
Germany	83 250 000	3 300 000	4.0	2002	Arlinghaus (2004)	High
Hungary	10 100 000	325 000	3.2	1999	Kovács and Füresz (1999)	Medium
Ireland	4 000 000	218 000	5.5	2004	Williams and Ryan (2004)	High
Iceland	276 000	55 000	19.9	2000	Toivonen *et al.* (2000)	High
Latvia	2 350 000	200 000	8.5	2003	EAA (2003)	Low
Lithuania	3 560 000	1 000 000	28.1	2007	Domarkas & Radaityté in Ditton (2008)	Medium
the Netherlands	16 300 000	1 780 000	10.9	2004	Aarts in Ditton (2008)	High
Norway	4 500 000	1 450 000	32.2	2000	Toivonen *et al.* (2000)	High
Poland	38 600 000	2 000 000	5.2	2004	Wolos (2003)	Medium
Spain	40 400 000	1 333 000	3.3	2007	Gaudin and De Young (2007)	Low
Sweden	8 800 000	2 020 000	23.0	2000	Toivonen *et al.* (2000)	High
Switzerland	7 300 000	240 000	3.3	1999	Schwärzel-Klingenstein *et al.* (1999)	High
Ukraine	48 000 000	5 200 000	10.8	2003	Aps *et al.* (2004)	Low
United Kingdom	60 400 000	4 200 000	7.0	2005	Simpson and Mawle (2005)	High
European average (SD)			10.97% (95% CI 6.82–15.12, $N = 20$)			
Countries in other continents than Europe						
Australia	20 000 000	3 360 000	16.8	2003	Henry and Lyle (2003)	High
Canada	32 800 000	2 456 876	7.5	2005	DFO (2005)	High
Japan	127 775 000	11 430 000	8.9	2007	Japan Statistics Bureau (2008)	Medium
Mexico	106 200 000	3 500 000	3.3	2004	Conapesca (2004)	Low
New Zealand	3 950 000	674 300	17.1	2003	van Aalst *et al.* (2003)	Medium
South Africa	42 700 000	750 000	1.8	2004	IUCN (2004)	Low
USA	298 000 000	27 641 000	9.3	2006	USFWS (2006)	High
Overall average			10.52% (95% CI 7.27–13.77, $N = 27$)			

[1] Uncertainty was considered low if the estimate was based on a probability sample; it was considered medium if it was based on licence numbers and some form of survey; it was considered high if neither a survey nor licence numbers were available.

on all predictor variables. A sample size of 90 countries or states was used. Canada and USA were not used in the multiple regression model developed at the country level, but US states and Canadian provinces were used instead. Moreover, outlier analyses based on standardised residuals >3 identified the Canadian province Newfoundland and Labrador as outliers and were thus dropped from the final model, leaving $N = 87$ observations. Initially, all main effects in linear and some quadratic terms (GDP, population density) were tested. Neither of the squared terms were significant at $P < 0.05$ and were thus deleted from the final model. Due to the already high number of main effects for the sample size of 87 observations, interactions were not tested to avoid overfitting. The final multiple regression model was run with all predictor variables designed to test the five hypotheses (GDP, population density, median age, household size, unemployment rate, freshwater area, access to coast and reported fish landings). Due to the hypothesis testing nature, all coefficients were retained even if non-significant at $P < 0.05$.

Unfortunately, of the two cultural variables (total fish landings and per capita fish consumption), the latter variable was not available for US states and Canadian provinces and thus could not be used in the multiple regression model. However, initial bivariate analysis showed a high correlation between per capita fish consumption and percent participation rate in recreational fishing. Thus, a simple linear correlation of the participation rate variable with per capita fish consumption rate

Table 2. Bivariate Spearman's correlations between the state-/country-specific predictor variables used to model participation rates in recreational fishing across states/countries

Variables	Population density (no. km^{-2}) (ln)	Median age (years)	Average household size	Average weekly working hours	Unemployment rate (%) (transformed)	Water area (%) (transformed)	Access to coastline (1 = yes)	Commercial landings (t)
Gross domestic product (US $ per capita)	−0.120	−0.184	0.037	0.325**	−0.235*	0.370**	−0.068	−0.296**
Population density (# km^{-2}) (ln)		0.278**	0.045	0.014	0.119	0.156	0.190	0.242*
Median age (years)			**−0.617****	−0.331**	0.212*	0.106	0.115	0.182
Average household size				0.178	−0.024	0.044	0.224*	0.153
Average weekly working hours					−0.201	0.021	−0.287**	−0.316**
Unemployment rate (%) (transformed)						−0.019	0.240*	0.277**
Water area (%) (transformed)							0.397**	0.221*
Access to coastline (1 = yes)								**0.780****

*$P < 0.05$, **$P < 0.01$. Spearman's correlations >0.5 are boldfaced. All rate variables were arcsin√-transformed prior to analysis (indicated by transformed). Note the ln transformation for population density and the binary variable access to coastline.

was estimated, excluding US states or Canadian provinces and three outliers with standardised residuals > 3 from the data set. Outliers (Japan, Iceland and Spain) characterised substantially higher fish consumption than average for a given participation rate. In this regression model, USA and Canada were included as countries. See the Supporting Information for a full listing of countries, data, predictor variables and remarks on outliers for each of the two main models developed for this study. All statistical analyses were conducted with SPSS, version 9.0.

Results

Participation rates in recreational fishing related to the total population size varied widely between about 2% in South Africa and over 30% in Norway (Table 1). Reliable estimates were largely confined to North America, Oceania and selected European countries, and only one estimate was available for Asia (Japan), Africa (South Africa) and South America (Mexico). On average, across all countries with reliable data, participation in recreational fishing was 10.52 ± 3.25% (95% confidence interval, CI) ($N = 27$). Extrapolating this value to the populations in three continents that hosted most of the country estimates (North America = 346 million, Europe = 740 million, of which EU-27 = 501 million and Oceania = 37 million, www.nationsonline.org/oneworld/world_population.htm) resulted in an estimate of about 118.13 (95% CI, 81.64–154.63 million) million people fishing recreationally in these three continents. The average participation rate in recreational fishing in Europe was slightly higher (10.97 ± 4.15%, 95% CI, $N = 20$), suggesting 54.95 (95% CI, 34.16-75.75 million) million Europeans fish for recreation in the EU-27.

The multiple regression model predicted over 60% of the variance in recreational fishing participation rates as a function of macroeconomic, demographic, cultural and geographic predictor variables (Table 3). All five hypotheses were supported. Among the most important predictors of recreational fishing rates were GDP and population density. Both variables were negatively related to recreational fishing rate, in line with expectations (Table 3). Note that the population density was logged to linearise the relationship, indicating an exponential decline in fishing interest with increasing urbanisation of a given state or country, all else being equal. All indicators of resource availability of the average individual in a given country or state related to recreational fishing in the expected direction. Specifically, the average age of the public and the average household size as well as the unemployment rate were negatively related to recreational fishing rates (Table 3). The average household size constituted the variable with the greatest relative effect of all predicator variables tested (as judged from the standardised regression coefficient β). Weekly working hours were positively related to recreational fishing, suggesting that fishing is more pronounced in countries where people work, on average, long hours, all else being equal (Table 3). The two variables related to water availability and access to coastline only modestly affected recreational fishing participation in a positive

Table 3. Multiple regression model on participation rate in recreational fishing (arcsin√-transformed) and a range of predictor variables

Variables	Coefficient	Standardised coefficient β	*P*-value
Intercept	1.350 ± 0.230	–	<0.001
Gross domestic product (US $ per capita)	−0.0000041 ± 0.0001	−0.557	<0.001
Population density (no. km^{-2}) (ln)	−0.027 ± 0.004	−0.459	<0.001
Median age (years)	−0.0109 ± 0.004	−0.403	0.004
Average household size	−0.238 ± 0.035	−0.904	<0.001
Average weekly working hours	0.0071 ± 0.002	0.337	<0.001
Unemployment rate (%) (transformed)	−0.513 ± 0.120	−0.331	<0.001
Water area (%) (transformed)	0.122 ± 0.054	0.190	0.049
Access to coastline (1 = yes)	0.030 ± 0.017	0.156	0.086
Fish landings (t)	0.000000042 ± 0.0001	0.303	<0.001

Model: $F_{9,77} = 14.08$, $P < 0.001$, corrected $R^2 = 0.622$, Durbin-Watson = 1.934
See for details on predictor variables Table 2. The raw data are given in the Supporting Information.

manner. Strictly speaking, access to coastline revealed no significant impact (Table 3). Finally, as expected, the only variable in the multiple regression model measuring the cultural importance of fish – total landings of fish – was positively related to recreational fishing interest. Similarly, for a reduced data set excluding the US states and Canadian provinces, per capita fish consumption was positively and almost linearly related to recreational fishing interest (Fig. 1). When three outliners with very high consumption rates of fish were excluded (Japan, Iceland and Spain), the correlation explained over 70% of the variance.

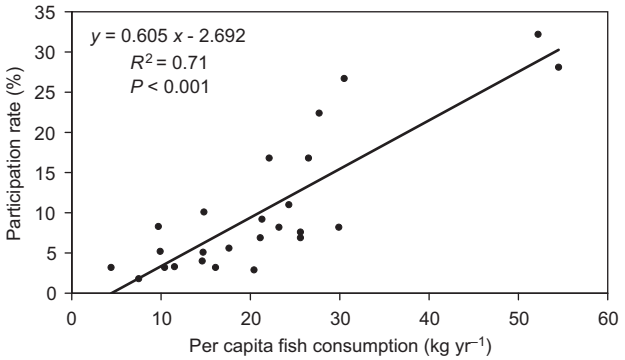

Figure 1. Linear regression of participation rate in recreational fishing on per capita fish consumption across various countries of the industrialised world. Note that Spain, Iceland and Japan were removed after outlier analysis (see Supporting Information).

Discussion

All five study hypotheses on the relationship of macroeconomic, demographic and geographic variables and participation in recreational fishing were confirmed. Taken together, the findings indicated an important influence of societal-level factors for shaping recreational fishing interest in a given society. Although only correlative evidence was presented, there is reason to believe that a range of theory-consistent causal relationships are at work at the scale of entire countries or states, which pervasively affect fishing interest by the public.

The first hypothesis stated that recreational fishing participation is positively related to the cultural importance of fish and fishing in a given country. Cultural importance was operationalised by the crude indicator total fishing landings, and as expected, a positive relationship between total fish landings and the fraction of a given society that fishes for recreation was found. It is likely that countries with a long tradition in harvesting fish for either subsistence or commercial purposes carry a legacy of fishing in society, which might spur interest in fishing for recreation as resources and free time become available with economic development. Support for the idea that culture shapes a general interest of society in fishing and that this interest is measured by the use of fish products in society was further generated from the linear bivariate relationship between per capita fish consumption and fishing participation rate (Fig. 1). It should be recognised, however, that total fishing landings were not among the most relevant predictors of recreational fishing participation rate. This reflected either that culture is less important compared with other societal factor in promoting fishing interest or that the independent variable supposed to measure cultural dimensions (total fish landings) was actually not operationalising the construct properly or was measured with error. The latter explanation is likely given that the total fish landings data relied on data by FAO (see Supporting Information), which are likely to be error-prone due to voluntary reporting of landings by member states. By contrast, due to the high bivariate correlation, per capita fish consumption rate could be used as a simple surrogate for recreational fishing participation across countries of the industrialised Western world.

The second hypothesis assumed a negative effect of post-industrialisation and urbanisation on recreational fishing rates, which was also supported. Post-industrialisation was assessed by the per capita GDP, and urbanisation was operationalised by population density. Both variables were independently significant. The negative impact of the size of the economy (GDP) on recreational fishing may look counterintuitive at first sight, but this effect agrees with the life cycle of fisheries as originally coined by Smith (1986) and further developed by Arlinghaus *et al.* (2002) and FAO (2012). Accordingly, interest in recreational fishing first rises with economic development and hence average prosperity of a country, but then declines after reaching a peak in fishing participation. Note that the data set in the present study encompassed already economically developed countries, with no coverage of developing nations. Hence, the decline in recreational fishing rates with GDP followed expectations by capturing the descending limb of the relationship between economic development and recreational fishing interest (see FAO 2012).

To explain the second hypothesis, multiple societal-level processes are likely responsible for the combined negative effects of economic development and urbanisation on fishing interest. Three shall be outlined here. First, modernisation forces associated with economic development and urbanisation entail a fundamental shift in social values, wildlife value orientations and environment-related norms (Inglehart 1990), which de-emphasise utilitarian and favour egalitarian world views (Manfredo 2008). Reductions in utilitarian values have been found to constrain the interest of the public in engaging in consumptive outdoor recreational activities, such as hunting and fishing (Bruskotter & Fulton 2008; Manfredo 2008; Manfredo *et al.* 2009). Thus, economic development may favour values and norms within society that reduce the social acceptability of fishing as a leisure activity. Second, with growing prosperity, there is the growth of alternative leisure activities, many of which may serve similar expected psychological outcomes as fishing. For example, an important motive for recreational fishing is temporary escape (Driver & Knopf 1976; Fedler & Ditton 1994; Ditton 2004) and personal achievement associated with the catch of challenging game fish (Freudenberg & Arlinghaus 2010). The very same benefits may also be served by alternative leisure activities such as golfing, indoor sports or wildlife viewing in urban green spaces – all activities that might be more accessible in post-industrialised societies. Third, the 'videophilia hypothesis' (Pergams & Zaradic 2006) argues that electronic entertainment increasingly competes with hunting, fishing and other nature-based recreational activities for time and attention in contemporary Western societies. Indeed, increasing use of electronic entertainment has been related to declines in the popularity of nature-based recreational activities by promoting a disconnect from direct interactions with wildlife and fish (Pergams & Zaradic 2006; Robison & Ridenour 2012).

One distinct feature of post-industrialisation is urbanisation, which has a range of effects that are not conducive for fishing and hunting participation by the public and may explain the empirical findings of the present study. First, urbanisation reduces the exposure of individuals to traditional rural recreational activities such as hunting and fishing (Heberlein *et al.* 2002). Urban development also affects the availability of unmodified land and water for hunting and fishing (Walsh *et al.* 1989), and it alienates large segments of society from direct contact with nature (Manfredo 2008). Tied to this are reductions in the social standing of fishing and hunting as a form of recreation and lifestyle (Manfredo 2008), which in turn might affect socialisation into fishing negatively. The early exposure of fishing and hunting to children by adult family members is probably the most important entry point to develop a fishing interest later in life (Sofranko & Nolan 1972; Arlinghaus 2004). If opportunities to go fishing are no longer available in the now-urbanised neighbourhood, it is likely that the younger generations seek alternative leisure activities to meet their expected psychological outcomes. These alternative activities may also provide more pleasures if they happen to coincide with the habitual environment experienced as built urban environment. The 'spillover leisure' theory (Kraus 2008) argues that people will choose recreational activities that are contextually similar to their work environment. As physically less-active indoor activities grow in urbanised countries, people may prefer recreation that is similarly structured (Robison & Ridenour 2012). Not surprisingly, more urbanised states and countries tend to host fewer recreational fishers (Adams *et al.* 1993; Aas 1996; Arlinghaus 2004) and hunters (Heberlein *et al.* 2002), corroborating the findings of this work in relation to the second hypothesis.

The third and forth hypotheses of this study related the availability of individual resources in terms of time and money as well as the perceived leisure need to recreational fishing interest. Both hypotheses received substantial support by the combined effects of average age, average household size, unemployment rate and weekly working hours on fishing rates (Table 3). The first three variables measured the availability of physical (age), time (household size) and monetary (unemployment rate) resources of the average member of society. Individual-level statistical models of fishing participation have previously documented that age (Walsh *et al.* 1989; Thunberg & Fulcher 2006), household size (Arlinghaus

2006) and low availability of monetary resources (Walsh *et al.* 1989; Floyd & Lee 2002; Arlinghaus 2006) negatively affect the probability of fishing for recreation, likely reflecting physical, time and financial constraints. On first sight, this may be counterintuitive because average weekly working hours exerted a positive relationship on the participation rate in recreational fishing. While one might be inclined to perceive work time as a constraint and hence barrier to fishing, it is important to realise that this variable rarely (<5% of all values) exceeded 42 weekly working hours. Such amount of work does not seem prohibitive and may not be sufficient to lead to lack of time (Aas 1995; Fedler & Ditton 2001; Sutton *et al.* 2009). The positive effect of weekly working hours on participation rate is thus consistent with the idea that a greater need for leisure activities increases the likelihood that people engage in fishing as outdoor recreational activity. Indeed, temporary escape in nature from work-related commitments has been consistently found to be the dominant fishing motive (Driver & Knopf 1976; Ditton 2004), while fishing constraints have had limited power to predict fishing participation (Kuehn *et al.* 2013).

The fifth hypothesis stated that availability of fishing opportunities would exert a positive effect on angling participation. Both variables chosen to operationalise the hypothesis (in-state or in-country water area) were significant or close to significance (access to coast), confirming earlier reports that availability of water and more generally access indeed positively influence recreational fishing rates (Walsh *et al.* 1989; Adams *et al.* 1993; Kuehn *et al.* 2013). While such effect is not surprising, it is the low relative ranking of the 'water factor' that is noteworthy. Indeed, macroeconomic, urbanisation and demographic factors exerted greater influence on explaining variation in angling rates across countries in this study than availability of water. This finding agrees with constraint studies in lapsed recreational fishers who consistently reported that structural aspects such as lack of time, too many commitments or poor fishing quality (i.e. catch rates, see Freudenberg & Arlinghaus 2010) exerted greater inhibitory effect than availability of water *per se* (Fedler & Ditton 2001; Sutton *et al.* 2009). Moreover, limited water availability may be compensated by more intensive fisheries management, evidenced by the intensively stocked still-water fisheries in the UK (North 2002). Hence, while availability of water is indeed important to stimulate fishing interest, it may be less important than other structural factors.

The study has a number of limitations. Most importantly, the lack of participation data from many regions biased the model outcomes to Western cultures. This limited the inference space of the model: while it may be used as a predictive tool in countries such as Bulgaria and Romania, it is likely less suited to predict fishing participation in culturally different developing nations or economies in transitions such as India, Brazil or Kenya. A second limitation is the correlative nature of the study, which prevented the derivation of cause-and-effect relationships. A final limitation related to the omission of alternative predictor variables related to culture, values and socialisation is that each of these variables is probably responsible for explaining a sizable portion of the unexplained variance in the present multiple regression model. More studies are thus needed to explain fully fishing participation within and across countries (Thunberg & Fulcher 2006). These studies should also study why people of the general population do not go fishing rather than exclusively focusing on the determinants on fishing choice (Aas 1995).

Conclusions and implications

On the basis of the model presented in this study, sustained and increased interest in recreational fishing is predicted for economies in transition in association with modernisation and economic development, while participation in recreational fishing will likely decay (further) in highly urbanised societies. Although the findings indicate that some of the changes in recreational fishing interest may be unavoidable (because they are affected by overarching society-level developments), results also suggest that dedicated management and marketing intervention could be used to promote or maintain fishing interest. In particular, the model presented here and related work (Kuehn *et al.* 2013) suggest that promotion of 'facilitators' related to ease of access and development of personal resources (including fishing knowledge) may be powerful to increase or maintain fishing interest even in highly developed societies. Ease of access relates to promoting fishing in environments where people increasingly live (i.e. urban centres) so that the youth may be more easily socialised into fishing, but also includes the removal of barriers to participation where they exist (such as the burden to pass courses including examinations in some countries, Heberlein & Thomson 1997). People must have the knowledge where fishing opportunities exist, feel confident in how to reach and use them and be empowered to try fishing with low-level transaction costs. Otherwise, fishing may increasingly loose against competitive leisure activities that may provide the same benefits to the individual but not involve interactions with nature or fish. Any promotional and educational initiatives may be complemented by professional marketing campaigns using modern information technologies, which has been found to increase fishing

interest in highly urbanised countries that have experienced drops in recent years (Aprahamian *et al.* 2010). The likelihood of success is good because people have an intrinsic desire to enjoy nature, but in urban environment, they have to be 'guided' so that fishing becomes the mode of nature experience.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Data S1. Predictor variables.

Data S2. References.