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Socio-economic portrait of Polish anglers: implications for recreational fisheries management in freshwater bodies

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Abstract – Recreational fisheries are an important element of contemporary fisheries. Detailed information about the motivation and opinions of anglers regarding catch-and-release fishing in post-communist countries, such as Poland, has not been widely available to date. The aim of this study was to fill this gap. We obtained 936 survey questionnaires completed by anglers from throughout Poland. The mean annual catch of a Polish angler is 126 fish weighing 46.1 kg. Anglers catch mainly cyprinids, but they would prefer to catch large predatory fishes, and they spend an average of 416.50 EUR on this activity annually. These results confirm the hypothesis that angling catches in Poland are decidedly of a recreational character and that catches targeted at fish consumption are of lesser importance. Simultaneously, we determined that younger anglers are more willing to release caught fish than older anglers.

Keywords: Angling / catch and release / expenditures / human dimension / recreational fishing

1 Introduction

Recreational fisheries are currently one of the most significant ways in which living resources of inland waters are exploited globally (Cooke and Murchie, 2015; Cowx, 2015; Cooke et al., 2018). Although this type of exploitation is conducted primarily with the specific gear that is the fishing rod, the concept of recreational fisheries does not exclude the use of other fishing gears or methods (Arlinghaus and Cooke, 2009). Angling exploitation happens on a mass scale, and it can have a significant impact on fish resources, other aquatic organisms, the quality of the natural environment (Post et al., 2002; Müller et al., 2003; Lewin et al., 2006; Czarkowski et al., 2016), and also on economic development (Cooke and Cowx, 2006; Cooke and Murchie, 2015; Cowx, 2015) Therefore, it is worth learning about the basic parameters of this type of exploitation. In this context, in addition to official statistics, it is necessary to know about the motives, needs, and opinions of the anglers themselves on the topic of angling conditions. This is essential for the proper management of fish resources,

recreational fisheries, and the entire inland fisheries sector (Beardmore et al., 2015; Arlinghaus et al., 2016).

A number of observations demonstrate an increased recognition of the need to consider incorporating human-dimension information into fisheries management decision making (Wilde et al., 1996). Investigations of the motives that lead anglers to fish have been a frequent topic of research of the human dimension of recreational fisheries (Arlinghaus, 2006). Motivations, attitudes, and other human-dimension categories are a central concept in social psychology and common concepts in the recreation and human dimensions of fisheries (Manfredo et al., 1996). The characteristics of angling, and in particular its socioeconomic aspects, in Central and Eastern European countries like Poland have not been fully described and remain somewhat obscure. Evidence of this is the fact that the last time a similar survey of Polish anglers was conducted in the late 1970s (Leopold et al., 1980). Since then, it is likely that many factors have changed, particularly in the context of the social and economic changes that happened in Poland following the transformation in the political system and the country acceding to the European Union. Recreational angling catches are deeply engrained in the traditions and culture of the country (Cios, 2007; Trapszyc, 2015). The number of people engaged in angling in Poland is estimated at approximately

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1.5 million, of which 630,000 are members of the Polish Angling Association (PAA) (Czerwiński, 2016; Wołos et al., 2016). The remaining anglers can be divided into three groups: 1) angling in the natural waters of other fishing users (mainly fishing companies, private individuals, national parks, etc.), for which fishing does not require being a member of the PAA. These are mainly lakes, of which only 30% of the area (out of 270,000 ha of the total area) is used by the PAA; 2) anglers in numerous put-and-take fisheries in the country, where the fishing permit only requires the payment of an appropriate fee; and 3) anglers who fish illegally, without permits and fees, which may be many, if only because the surveyed officers of the State Fisheries Guard mention those practiced by anglers as the most common type of poaching (Mickiewicz et al., 2020a). Therefore, the total number of people practicing recreational fishing in Poland can only be certain, but based on the above-mentioned matters, respectfully.

In Poland, recreational fisheries policy is quite restrictive. It includes a mandatory fishing license, size-based harvest limits, daily bag limits, and gear and effort limitations, as well as a ban on fishing protected fish species and closed seasons among others measures. The attitude of anglers to releasing caught fish is particularly important in the context of the relationship between the degree of social development and the objectives of inland fisheries (Smith, 1986; Arlinghaus et al., 2002; Cowx et al., 2010). The concept of catch-and-release (C&R) is a strategy that aims to reduce catch mortality without imposing on anglers unpleasant regulations to reduce fishing pressure. This is a powerful tool for reducing impacts on recreationally targeted fishes (Chapman et al., 2018). C&R ranges from legally required mandatory release of protected sizes and fish species to voluntary release of fish that may be retained. Cooke and Cowx (2004) contend that over 60% of fish caught globally by recreational anglers was returned to the water. C&R has become a major practice in many developed countries (Bartholomew and Bohnsack, 2005; Brownscombe et al., 2017), and is increasingly popular in developing countries (Freire et al., 2012; Gupta et al., 2015; Lyach and Čech, 2018).

Consequently, it was justified to determine to what degree anglers accept voluntary C&R, where, in recent years, there has been dynamic economic and social development. Simultaneously, the aim of this work was to characterize Polish anglers and to identify the most significant parameters associated with angling in Poland such as motives for angling, factors obstructing catches, the topic of the state of fish resources, primary angling locations and periods, quantity and structure of fish caught, and economic factors. On the one hand, the information collected illustrates comprehensively the character of Polish angling and the differences and changes that have occurred in them. Similarly, they indicate how to more effectively manage fish resources and recreational inland fisheries.

This article examines recreational fisheries in Poland. We present the results of a survey of anglers and compare them with similar studies conducted in the late 1970s (Leopold et al., 1980). We were primarily interested in the anglers' motivations to engage in fishing, their attitudes to C&R, and whether the current state of the fish fauna met their angling expectations.

2 Recreational fishing conditions in Poland

Recreational fisheries in Poland are regulated by laws passed by the national legislature. Inland surface waters, which include lakes, rivers, and dam reservoirs, are the property of the State. They are divided into smaller units (the so-called fishery zones) comprised of river segments and lakes that are leased to angling associations, fishery enterprises, or private persons. A small portion of these waters is under the control of local angling societies and local governments. Every angler aged 14 and older must have a fishing permit and a fishing license. A fishing permit entitles its holder to angle fish in Poland, while a fishing license entitles its holder to angle in particular fishing grounds and sets detailed angling rules, including minimum size limits, catch limits, and permissible angling times, places, and techniques. The general rules for recreational fisheries, including closed periods and minimum size limits for specific species are set forth in national regulations. Detailed regulations concerning fishing in individual fishing grounds are set by those permitted to exploit these angling grounds. Permits can also include the requirement of keeping individual angling logbooks.

Anglers associated with the PAA are obliged to keep individual angling logbooks when fishing. Logbooks for other users of the waters may be mandatory, but are usually voluntary. The logbook includes information on the fishing grounds, species, the number of fish caught, and their weights. Fish that are released are not recorded. State and local fisheries guards monitor compliance with fisheries regulations (Mickiewicz et al., 2020b). The PAA collects logbooks from anglers and then verifies information is entered into electronic systems and sent as annual reports to the national supervisory authority. Anglers submit their logbooks annually when paying dues to their local PAA chapter. Failure to submit logbooks results in increased permit fees in the subsequent year.

Stocking in Poland is conducted according to provisions in fishery management plans, which detail stocking guidelines, including species, minimum and maximum quantities of fish released, and the type of stocking material used. The most widely stocked fish is foraging hatchlings of pike, *Esox lucius*, that are released into public waters by more than 90% of those entitled to conduct fisheries and sell angling licenses (Mickiewicz, 2019).

3 Materials and methods

3.1 Data collection

The study was conducted throughout Poland with an estimated population of 38,434,000, of which 61.2% are persons of working age (Stańczak et al., 2018). It is estimated that anglers in Poland number approximately 1.5 million (630,000 are registered with the PAA), which is approximately 3.9% of the population (Czerwiński, 2016). Poland is located in the temperate climate zone that is influenced by oceanic climate factors from the west, and continental ones from the east (Cedro and Walczakiewicz, 2017).

In 2016, survey research was conducted among Polish anglers in cooperation with the Main Board of the PAA by mailing anglers survey questionnaires about recreational

fishing. The questionnaire was sent by mail to PAA chapters, angling clubs, and to lake fishery enterprises. Three thousand questionnaires were mailed to potential respondents, and all chapters of the PAA were also sent emails notifying them of the research project. We used an independent randomized study without stratification. The angler sample for the study was selected from a larger group. Each person was selected entirely at random and every angler had an equal chance of being included in the survey. The questionnaire comprised 25 detailed questions, five of which concerned the basic demographics of age, sex, place of residence, financial standing, and PAA membership. Eight questions referred to angling experience, fishing effort, type and location of fishing grounds, amount of catch, size of specimens caught, and groundbait use. The four economic questions enquired about expenditures on angling. Eight questions concerned angler motives, the conditions and factors associated with angling, and angler opinions on the state of resources and the management of Polish fishing grounds. Three of these questions related directly to C&R. These questionnaires were distributed and completed between May and October 2016, and the mailing procedures followed were those recommended in Dillman et al. (2014). In all, 1080 usable questionnaires were returned (a 36% response rate). Before analysis, questionnaires were screened to remove those completed by any person other than an angler. The final sample consisted of questionnaires from 936 Polish anglers.

3.2 Data analysis

Most responses were given on an ordinal scale, i.e., the data were grouped into classes, and were based on the previous angling year, which included the full calendar year from January to December. The results are presented as percentages (%) calculated from the total number of responses obtained per question. Not all respondents answered all the questions, which is why the number of respondents who answered the individual questions differs (differences in number N). All questionnaires, even those that were only partially complete, were analyzed. The rank scale method was used to determine which factors disrupted angling the most by calculating the percentage (%) of the total sum of points awarded. Respondents could add any factor that most disrupted their angling experience. A five-point Linkert scale was used to record angler perceptions. The scale used was from 1 to 5; the most disruptive factor was awarded 5 points, and the least disruptive factor was awarded 1 point. Then, the number of points for each factor was summed up, and the percentage share of each factor in the total sum of points awarded to all factors was calculated. The same procedure was applied to the question regarding the fish species preferred by anglers, but the points were awarded on a scale of 1 to 3 (Murphy et al., 1994). The answers regarding fishing motives, angling factors, the willingness to release caught fish, and size limits were ranked. The effectiveness of fishing was reported as CPUE (Catch Per Unit Effort) in $kg \times h^{(-1)} \times angler^{(-1)}$ by dividing the average annual catch by the number of days spent angling and the number of angling hours. Anglers determined their catch themselves by responding to the questionnaire, we did not analyze the catch logs. We were unable to verify the expenditures reported by the anglers, which is why these survey results should be viewed as estimates supplied by the respondents.

For the purposes of the analysis, pike, *Esox lucius*, pikeperch, *Sander lucioperca*, wels catfish, *Silurus glanis*, perch, *Perca fluviatilis*, and eel, *Anguilla anguilla*, were classified as predatory. Species identified as typically mountainous were those of the family Salmonidae, while typically riverine fish species included rheophilic carp species such as chub, *Squalius cephalus*, common barbel *Barbus barbus*, ide, *Leuciscus idus*, common dace, *Leuciscus leuciscus*, common nase, *Chondrostoma nasus*, vimba bream, *Vimba vimba*, and asp, *Aspius aspius*. All other carp species were classified as common carp.

3.3 Statistical analysis

Regression analysis was used to determine the dependence between the age of anglers surveyed and their experience. The significance of the regression was determined using ANOVA ($\alpha = 0.05$) with a null hypothesis assuming the existence of a relationship between angler age and experience. The Chi^2 test was used to examine the null hypothesis that there were no differences in dwelling places between the Polish population and surveyed anglers. ANOVA was also used to determine the relationship between the willingness to release fish (dependent variable) and angler age, the size of annual catches, and the value of fishing tackle owned (independent variable). Levene's test was used to determine the homogeneity of variance, and the normality of the data was confirmed using the Shapiro-Wilk normality test. Post hoc analysis was performed using the Tukey test. All statistical calculations were performed with Statistica 12 (StatSoft, Tulsa, OK, USA).
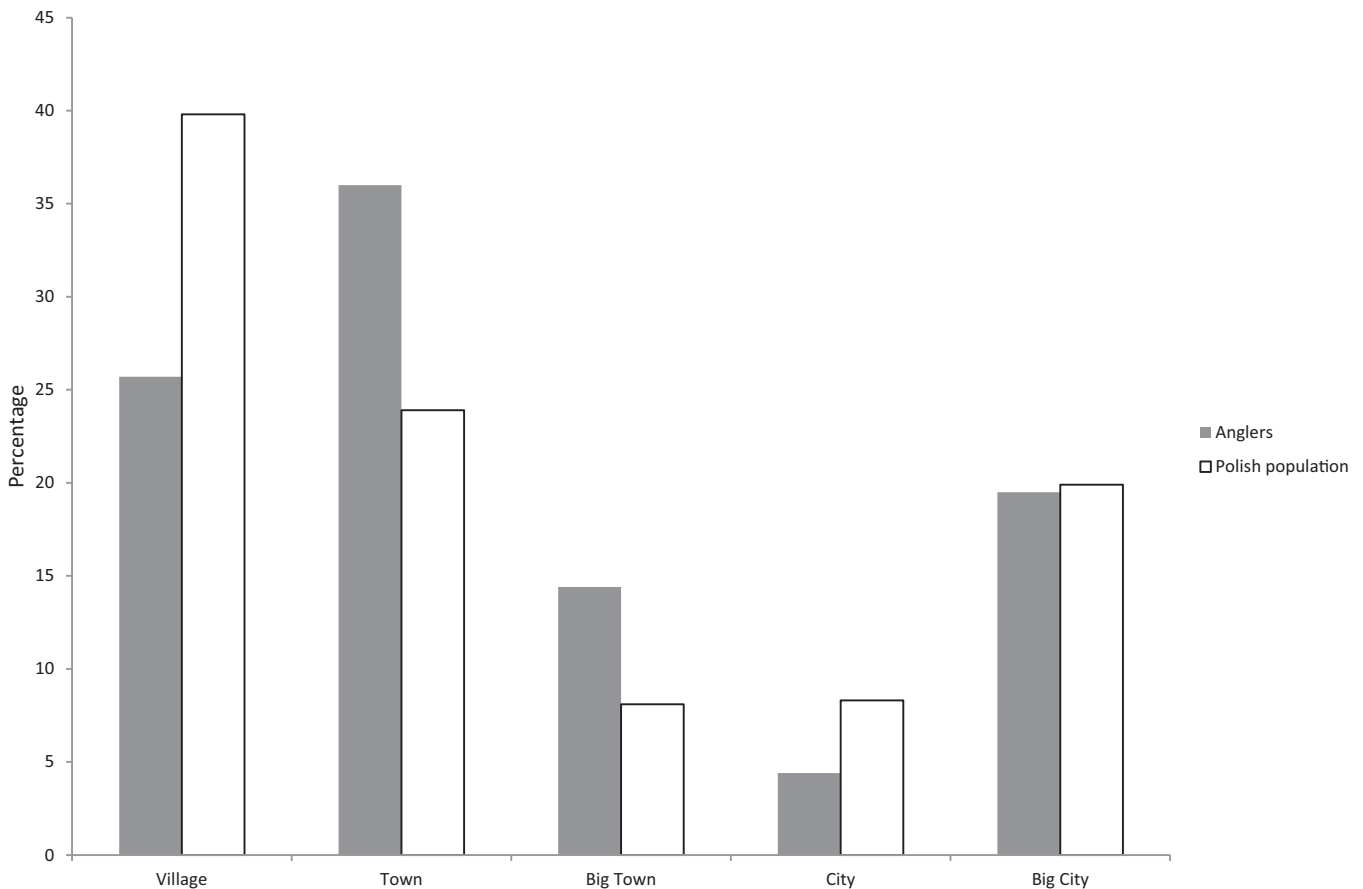
4 Results

4.1 Demographics and the characteristics of participation, catches, and expenditure

The majority of anglers were men (95.1%) who belonged to the PAA (95.1%), and the average age of respondents was 51.2 years (Tab. 1). The oldest anglers dominated the age groups with those over the age of 60 accounting for 34.7% of all respondents. The next largest group were respondents aged 50–59 (22.0%), followed by anglers aged 40–49 (20.8%). Younger anglers (aged 30–39) accounted for 14.7% of the respondents, those from the age group 20–29 constituted 5.8%, and the youngest anglers (under age 20) were the least numerous, constituting only 2.0% of the total. Most of the respondents were residents of small towns and inhabitants of rural areas (Fig. 1). There were significant differences regarding the frequency distribution of the anglers dwelling places and the Polish population (Chi$^2 = 18.024$, df = 4, $p = 0.001$). Residents of medium-sized and large cities together accounted for 18.8% of the respondents. A significant share of anglers came from the largest urban agglomerations with more than 200,000 inhabitants (Fig. 1). The average monthly income per family member did not exceed 480 EUR for the vast majority of anglers (70.7%) surveyed.

Table 1. Selected demographics, participation, catch, and economic characteristics (group average or percentage of total and range $\pm$ SD).

Parameters	N	Group mean or percent of total $\pm$ SD	Range
Age (years)	921	51.2 $\pm$ 14.47	11.0–88.0
Gender (% males)	926	95.1	–
PAA membership (% members)	876	95.1	–
Angling experience (years)	895	29.5 $\pm$ 14.43	1.0 − 71.0
Time fishing per year (days)	926	48.4 $\pm$ 42.58	3.0 − 300.0
Time fishing per day (hours)	871	6.2 $\pm$ 3.88	0.5 − 24.0
Annual catch (kg/angler)	450	46.1 $\pm$ 79.79	0.0 − 700.0
Annual catch (indiv./angler)	450	126.0 $\pm$ 312.73	0.0 − 4,852.0
Daily catch (kg/angler)	450	1.1 $\pm$ 1.62	0.0 − 17.5
Daily catch (indiv./angler)	450	3.5 $\pm$ 7.99	0.0 − 121.3
CPUE (kg/h/angler)	430	0.2 $\pm$ 0.46	0.0 − 0.7
CPUE (indiv./h/angler)	430	0.8 $\pm$ 2.34	0.0 − 24.3
Weight of groundbait used (kg/day)	700	2.7 $\pm$ 5.48	0.1 − 90.0
Anglers' annual expenditures (EUR)	847	416.5 $\pm$ 581.53	11.9 − 5059.7
Value of fishing gear and equipment owned (EUR)	819	1,424.2 $\pm$ 2,000.48	23.9 − 23,866.3

Fig. 1. Percentage of the surveyed anglers and of the Polish population per place of residence.
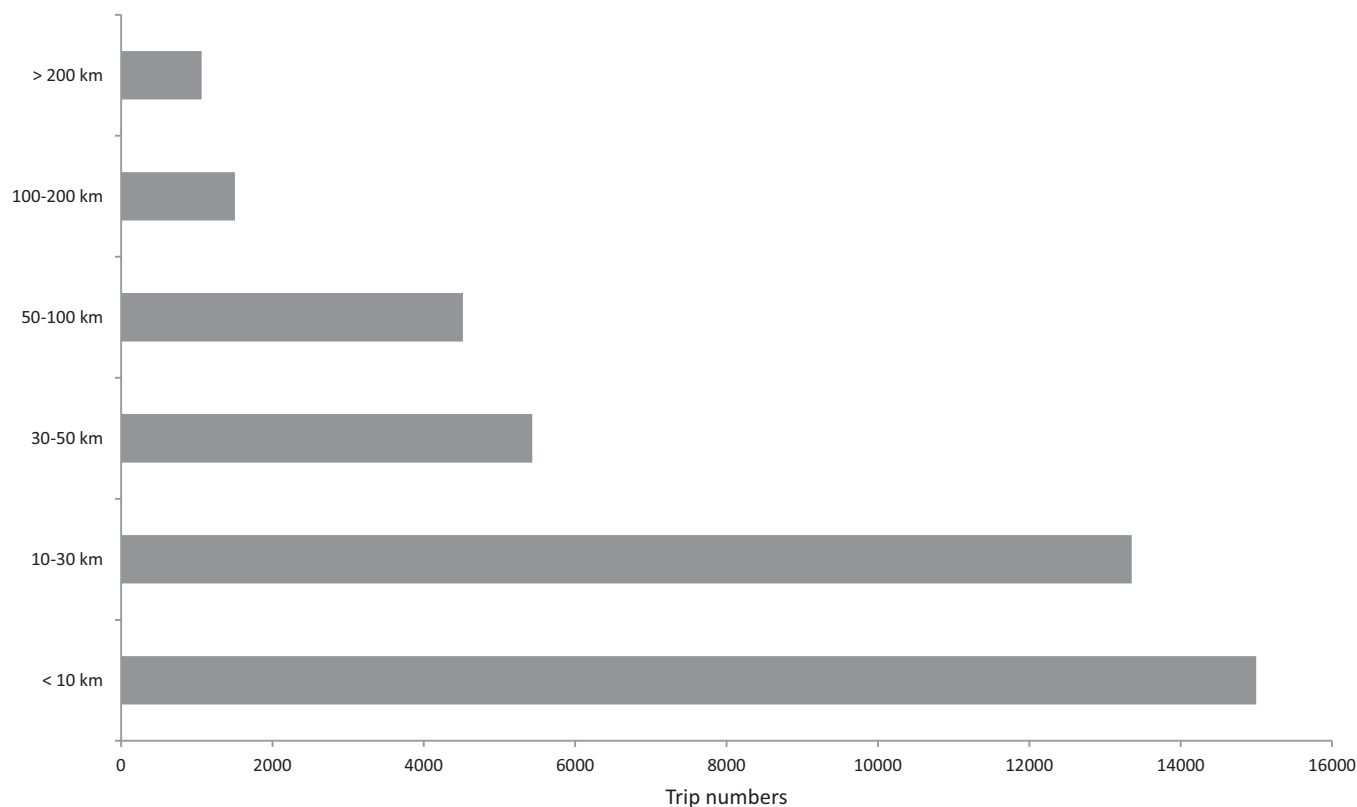
Fig. 2. Structure of the distance (km) of fishing trips from places of residence ($N = 859$).

The average length of angling experience was 29.5 years (Tab. 1). The groups of the most experienced anglers with over 40 years of experience (28.9%) and that with 30–39 years of experience (27.7%) dominated among those surveyed. The least numerous was the group of novice anglers (1.7%), who had fewer than three years of experience. Angling experience calculated as the number of years the anglers had angled was strongly correlated with the age of those surveyed ($F = 1070.32$, df $= 1.892$, $p < 0.001$, $r^2 = 0.54$). The average angler fished 48.4 days per year, and the average fishing trip duration was 6.2 hours (Tab. 1). The average Polish angler fished mainly in lowland rivers and canals and spent 40.0% of all angling days at these types of fishing grounds. These were followed by lakes, on which the average angler spent 38.3% of his/her fishing days. He/she spent less time angling in ponds and other small reservoirs (14.6%) and the least time angling in mountain rivers and streams (4.9%) and in the sea (2.2%). Polish anglers did not travel far to fish, and they angled mainly in the immediate vicinity of their places of residence, at a distance of no more than 30 km from them (Fig. 2).

The average annual fish catch per angler was 126.0 ind. at a weight of 46.1 kg, and the average daily catch was 1.1 kg (3.5 ind.) (Tab. 1). The average CPUE was 0.2 kg × h$^{(-1)}$ × angler$^{(-1)}$ (0.8 ind. × h$^{(-1)}$ × angler$^{(-1)}$). Angling catches were dominated by common carp with the highest weight share (19.6%), followed by bream, *Abramis brama* (16.9%), and roach, *Rutilus rutilus* (12.6%). In terms of quantity, roach dominated (37.0%) followed by perch (16.4%) and bleak, *Alburnus alburnus* (12.2%) (Fig. 3). The average individual weight of the cyprinids caught by anglers was as follows:

common carp, *Cyprinus carpio*, 3.0 kg, bream 0.8 kg, and roach 0.1 kg. The average weight of predatory fish species caught was 1.5 kg for pike, 1.4 kg for pikeperch, and 0.2 kg for perch. In general, wels catfish exhibited the highest average individual weight (6.8 kg), while the heaviest carp caught was 25.1 kg in body weight, and the longest pike was 120.0 cm in total length. Polish anglers used groundbait during angling, and 80.4% of respondents reported using commercial ready-made bait. Decidedly fewer anglers (46.2%) used groundbait they prepared themselves at home. The amount of bait used during one day of fishing ranged from 0.1 to 90.0 kg; however, the average weight of bait used by anglers on one day was 2.7 kg (Tab. 1). Average angler expenditure was 416 EUR, of which 40.5% was spent on fishing tackle and equipment, 19.2% on fuel and transport, and 15.4% on fishing permits. The histograms of mean tourist angler expenditure in Fig. 4 illustrate the variance in expenditure across the anglers surveyed. The average Polish angler owned equipment of an average value of 1,424 EUR.

4.2 Motivations, opinions, and attitudes to catch-and-release

The anglers' primary motive for recreational fishing was to spend leisure time on the water (Tab. 2). As many as 78.9% of respondents indicated that this motive for angling was very important. The least important motive was fish consumption, which most anglers described as less important (Tab. 2). The most important factor associated with angling was the size of the fish caught, followed by the water level in fishing grounds,
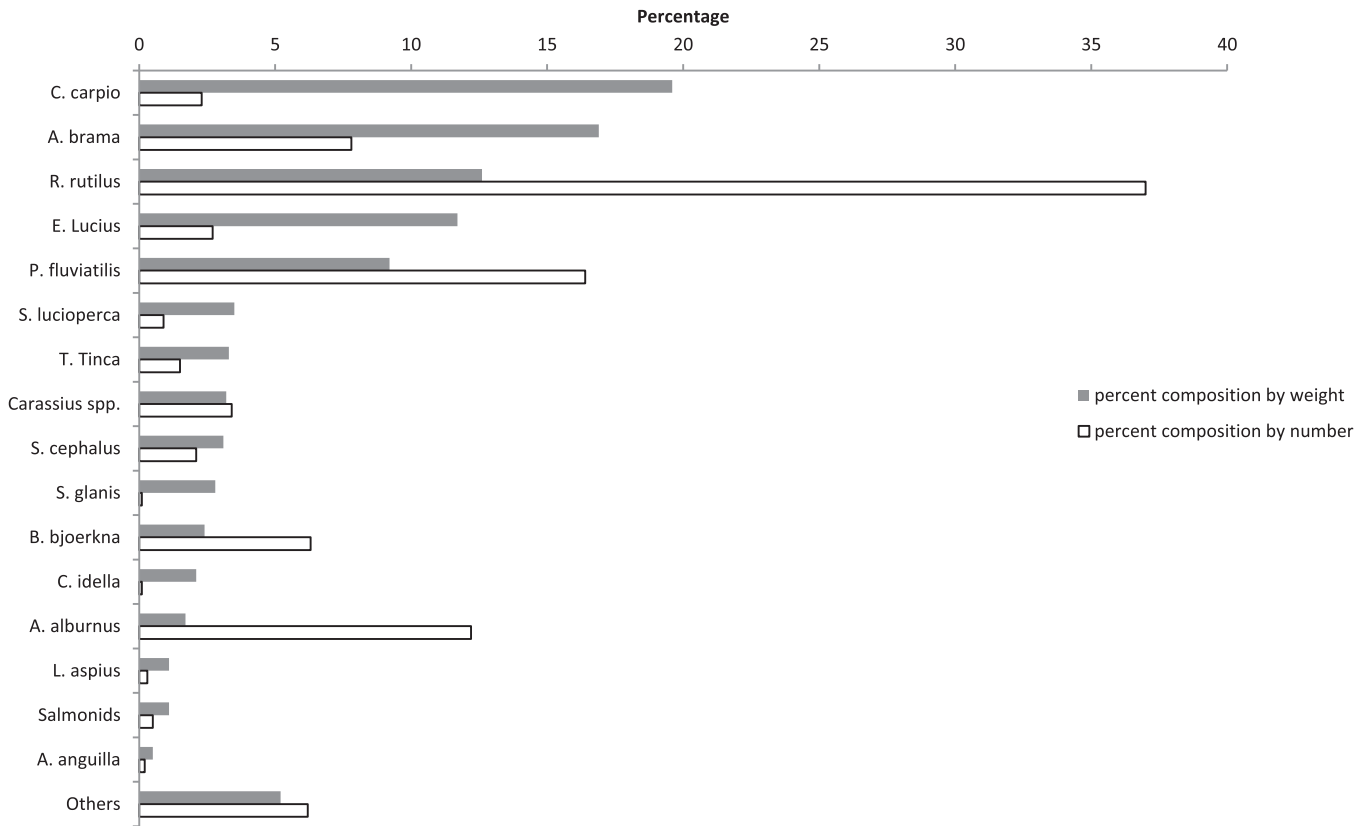
Fig. 3. Weight and numerical share of fish species caught by surveyed anglers.
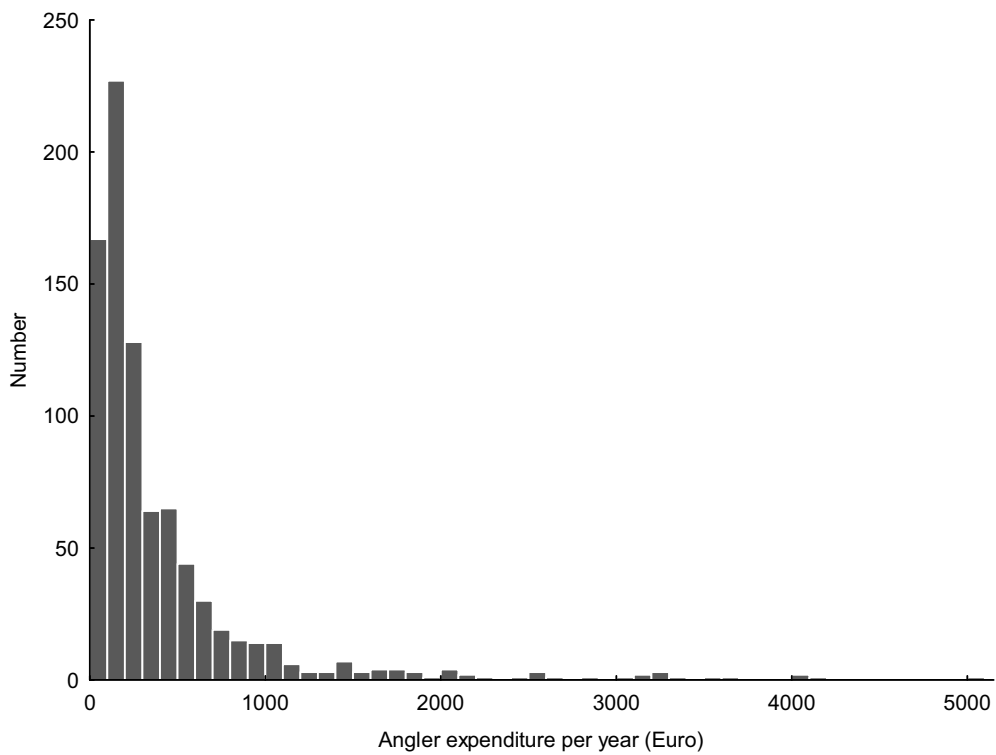

Fig. 4. Total expenditure per Polish angler per year.

Table 2. Distribution of motives for angling according to the importance anglers assigned to various reasons for angling in Polish inland waters, ranked according to the importance of the response.

Statement	Percent by category				N	Mean
	1	2	3	4		
Spending leisure time on the water	0.5	1.2	19.5	78.9	848	3.8
Sport	5.7	14.7	34.2	45.4	843	3.2
Fish consumption	25.2	44.8	21.7	8.4	811	2.1

1 = unimportant, 2 = less important, 3 = important, 4 = very important.

Table 3. Distribution of factors linked with angling in Polish inland waters, ranked according to the importance of the response.

Statement	Percent by category				N	Mean
	1	2	3	4		
Size of fish caught	6.4	15.0	45.4	33.2	840	3.1
Water level in fishing grounds	7.9	14.3	44.5	33.2	831	3.0
Releasing fish of legal size	7.7	18.3	42.5	31.4	830	3.0
Possibility of fishing particular species	10.9	22.7	44.1	22.3	829	2.8
Weather conditions	12.6	24.5	37.0	25.9	838	2.8
Participation in competitions	15.3	23.3	35.6	25.7	836	2.7
Number of fish caught	16.2	38.3	30.1	15.4	835	2.4
Possibility of obtaining bait	21.4	30.5	36.6	11.5	819	2.4
Isolation from other anglers	19.2	37.2	30.2	13.5	829	2.4
Fishing piers	27.7	25.8	32.9	13.6	826	2.3
Cleaning caught fish personally	36.8	25.2	26.5	11.5	824	2.1
Angling hostels	36.9	30.5	23.3	9.3	816	2.1
Desire to consume fish	35.7	42.1	17.5	4.7	832	1.9
Possibility of renting a boat	45.8	27.5	21.0	5.6	818	1.9

1 = unimportant, 2 = less important, 3 = important, 4 = very important.

the release of fish caught (C&R), the possibility of angling for particular species, and weather conditions (Tab. 3). The number of fish caught was a less important factor than the size of the fish. However, the desire to consume the fish and the anglers processing them themselves was one of the least important factors associated with angling (Tab. 3). The most disturbing factor in angling was shoreline litter, and the total rank sum of this factor was 21.7%. The subsequent problems according to rank were as follows: high angling pressure and the behavior of other anglers (12.5%), noise (10.1%), and bureaucracy and poor fish stock and commercial and recreational fisheries management (8.7%). In the next part of the survey, the respondents were asked how often they encountered litter and the destruction of the shoreline by anglers; 45.0% of the respondents reported that this happened often while 34.9% reported that it was a very common occurrence.

The ranking of fish species anglers preferred to catch was as follows: pikeperch, pike, common carp, and perch (Fig. 5). The subsequent species were bream, salmonids, tench, *Tinca tinca*, wels catfish, and roach. According to the majority of Polish anglers, the state of fish stocks in inland waters has deteriorated in recent years. This opinion was expressed by as many as 79.5% of respondents, only 7.9% said that its condition has improved, while 12.6% reported that fish stocks

have not changed in recent years. The majority of anglers who concluded that resources had deteriorated believed that the following factors were responsible (in order): poaching, adverse environmental changes, commercial fishing, lack of or insufficient stocking, and high fishing pressure (Fig. 6). Anglers were asked about the economic value of a day of spending successful leisure time on the water and reported values ranging from 0 to 477 EUR, at an average value of 30 EUR. However, as many as 20.0% of respondents said that this had no measurable financial value and was priceless. Anglers who were asked about the value of one day of successful fishing gave similar values that ranged from 0 to 477 EUR, at an average of 28 EUR, and, similarly, as many as 21.0% said that this value was immeasurable and priceless.

Generally, most anglers (55.3%) declared that they often released fish that were above the minimum size, 15.2% always did, while only 4.7% of anglers never did. When divided into the various groups of fish caught, anglers most often released trophies, while generally they were least likely to release predatory species (Tab. 4). The attitude of respondents to C&R was significantly statistically related to their age ($F = 16.92$, df $= 3$, 789, $p < 0.001$); those who declared that they often or always released fish were younger than those who rarely or never released them. The willingness to release fish was related to annual catch. Anglers who caught the most fish declared
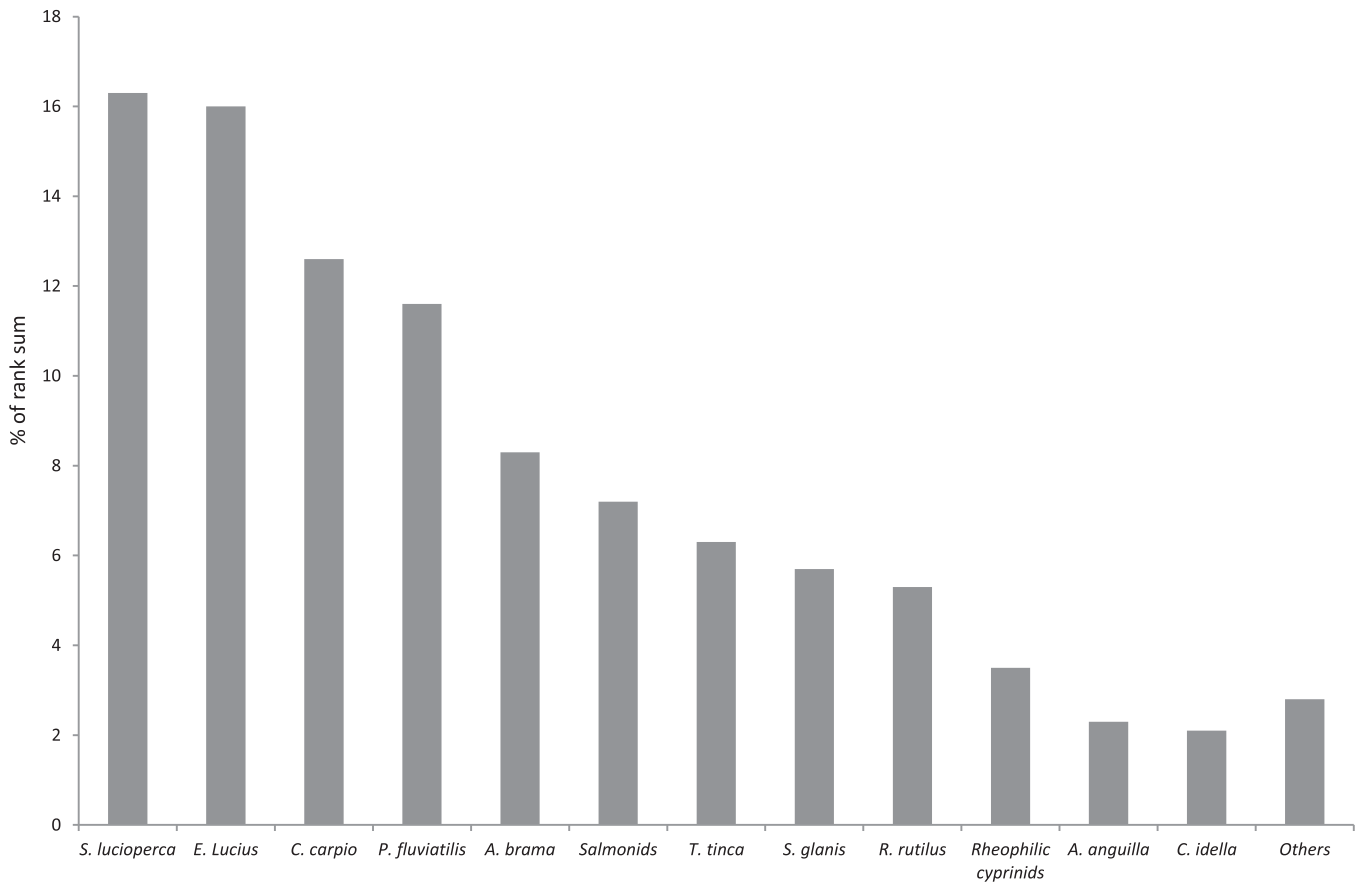
Fig. 5. Percentage rank of preferred species in angling. On the survey, anglers named their three preferred species. The following species received from 3 to 1 point. The shares of particular species were determined based on the total points awarded to all species.

more often than others that they always released them ($F = 12.51$, df $= 3$, 671, $p < 0.001$). A similar relationship was noted with regard to anglers with the most expensive angling equipment ($F = 6.72$, df $= 3$, 702, $p < 0.001$). Most anglers favored the introduction of obligatory upper size limits, of which 41.8% would like this to apply to all waters, 40.5% in selected fishing grounds, while only 17.7% of respondents completely disagreed with this solution (Tab. 5). Most anglers were also in favor of the introduction of the principle of the obligatory release of all caught fish (C&R) in selected fishing grounds. On the other hand, as many as 62.6% of anglers surveyed agreed with the introduction of the obligatory release of selected species in selected fishing grounds (Tab. 5).

5 Discussion

The present research confirms that angling in Poland is still a typically masculine activity, although the number of women currently participating in angling is slightly higher than it was almost 40 years ago, when women constituted only 1.2% of anglers (Leopold et al., 1980). This figure (around 5%) is similar to that in other European countries, e.g., Spain, where women constituted 7.0% (Pérez-Bote and Roso, 2014), but slightly fewer women (1.6%) angled for carp in Germany (Arlinghaus and Mehner, 2003). Small numbers of women

anglers are also confirmed by studies conducted outside of Europe (Ferrer et al., 2005; Peixer and Petrere, 2009). However, the share of women anglers will grow in the future, as predicted by American researchers (Burkett and Winkler, 2018). The average age of Polish anglers was close to the average age of German anglers. Arlinghaus et al. (2008) reported that the average age of respondents, depending on their place of residence, was 46–50. Research indicates that recreational fishing is not the domain of young people since as many as 34.7% of all anglers were over the age of 60. However, comparing our data with those from the previous survey (Leopold et al., 1980), it is clear that the participation of the oldest anglers definitely increased, because in 1980 the group over the age of 60 accounted for only 8.8% of the total. A similar relationship was described by Aprahamian et al., (2010) among anglers fishing for salmonids in England and Wales; this research also simultaneously indicated reductions in the sale of fishing licenses. This dependence and overall reduction in the number of anglers in developed countries stems from the increasing diversity of attractive recreational activities and opportunities for leisure and relaxation (Cowx, 2015). Angler age was strongly correlated with angling experience, which indirectly indicated that the anglers surveyed caught their first fish fairly early and most often around the age of 20. Angling experience is an important factor that has an impact on other parameters, for example, angling
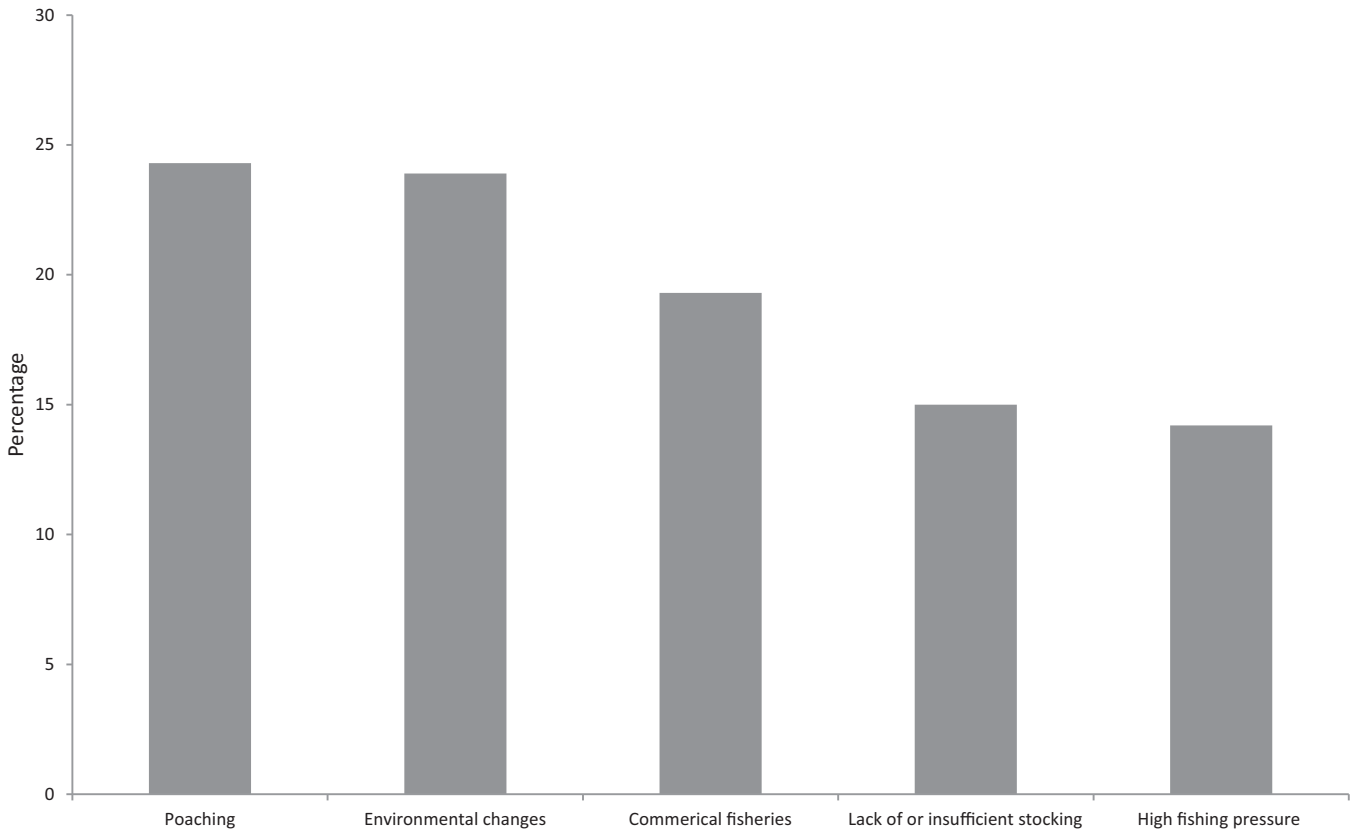
Fig. 6. Structure of responses of anglers surveyed regarding factors responsible for deteriorating fish stocks ($N = 725$).

Table 4. Distribution of willingness to release caught fish of over minimum size limit by anglers fishing Polish inland waters, ranked according to the importance of the response. The share of category 0 (not fished) was determined separately from the other categories.

Statement	Percent by category					N	Mean
	0	1	2	3	4		
Only trophies	19.4	9.5	22.0	25.5	42.9	806	3.0
Typical mountain species	66.1	16.8	19.7	28.5	35.0	808	2.8
All species	0.0	4.7	24.8	55.3	15.2	807	2.8
Typical riverine species	19.3	6.7	24.6	52.7	16.0	815	2.8
Common cyprinids	9.3	7.8	27.2	46.5	18.5	816	2.8
Predatory species	8.3	9.5	33.9	43.4	13.2	811	2.6

0 = not fished, 1 = not at all, 2 = rarely, 3 = often, 4 = always.

Table 5. Distribution of angler answers regarding applicable size limits for fish in Polish inland waters, ranked according to the importance of the response.

Statement	Percent by category			N	Mean
	Disagree	Selected fishing grounds	All waters		
Upper size limit	17.7	40.5	41.8	849	2.2
Principle of releasing selected species	14.7	62.6	22.6	835	2.1
Principle of releasing all species	36.4	51.9	11.7	830	1.8

efficiency. A study by Heerman et al., (2013) indicates that anglers with the most experience (over 40 years) were the most effective and achieved the highest CPUE. In our research, there was no clear correlation between age and experience and the amount of fish caught. This may be because the most experienced anglers were also the oldest, and therefore probably also less physically fit than the younger anglers. On the one hand, angling plays a significant role in the development of tourism (Arlinghaus et al., 2016), and in northeastern Poland it is also a significant element of agritourism since it is one of the leisure activities offered to tourists in rural areas (Czarkowski et al., 2014). However, it is an important leisure activity in the day-to-day lives of inhabitants of rural and suburban areas (Arlinghaus et al., 2008; Pérez-Bote and Roso, 2014; Kupren et al., 2018). This is confirmed by the present research, because Polish anglers are largely residents of small towns and villages.

The average Polish angler spends an average of 48.4 days angling anually. This figure is slightly higher than those reported in Trella and Wołos (2015) and Wołos et al. (2015) regarding angling in lakes in Poland. This difference probably stems from the fact that these studies focused only on angling in lakes that were also exploited by commercial fishery enterprises, without taking into account rivers and other waters exploited by the PAA, where fishing pressure could have been higher. However, compared to data from the past, this figure is lower than the 61 fishing days Leopold et al. (1980) reported. In comparison, data from Spain regarding the number of angling days are similar; according to Pérez-Bote and Roso (2014), most anglers go fishing from 30 to 50 days annually and angle for 4–6 hours per day. The total annual yield per angler of several dozen kilograms does not differ significantly from the results obtained in other Central European countries. Previous studies showed that the average angler catch in Poland ranged from 34.8 to 49.1 kg per year (Czerniawski et al., 2010; Wołos et al., 2015); however, in 1980 annual angler catches were 54.3 kg (Leopold et al., 1980). Our research shows that it is currently 46.1 kg; however, if we take into account the higher fishing effort (more fishing days) from years ago, a single angler's CPUE is basically identical at 0.2 kg/h in both cases. In Germany, the annual catch ranged from 20 to 62 kg, depending on the group of anglers (Arlinghaus et al., 2008), while data from more southern countries indicate that anglers catch slightly less fish by weight. For example, in the Danube River, Croatian anglers catch an average of 14.2 kg per year, while Hungarian anglers catch 22.8 kg (Treer and Kubatov, 2017).

Changes in annual anglers' catches in recent years in the neighboring Czech Republic were different (Lyach and Čech 2018). Czech anglers now catch less fish than they did ten years ago, despite increased fishing effort. These authors noted an increase in the number of anglers at fishing grounds and an increase in the number of fishing trips with a significant decrease in fishing efficiency (Lyach and Čech, 2018). Currently, cyprinids decidedly predominate catches harvested by Polish anglers. If we combine this with preferences, which, however, favor large predatory fish, we note that Polish anglers do not necessarily catch the fish that they prefer, but those that are the most accessible. In light of the previous data in Leopold et al. (1980), we can conclude that the proportion by weight of predatory fish in angling catches has decreased. According to

our research, predatory fish currently constitute 28.8% of the weight fraction of catches, while 40 years ago they accounted for 36.1% (Leopold et al., 1980). Polish anglers prefer to angle for large fish, like Czech anglers (Lyach and Čech, 2017), but in Poland they do not always have these opportunities. One of the characteristics of Polish angling is the quite low weight and individual sizes of the fish caught, especially those of key predatory species. This could indicate that we are dealing with the phenomenon of ecosystem overfishing, which is manifested in the lack of sufficiently abundant groups of large, fertile predatory fish that are quite susceptible to overfishing (Francis et al., 2007). Data from some other European countries also indicate similarly small mean sizes of fish caught by anglers (Treer and Kubatov, 2017).

Polish anglers mainly fish in lowland rivers and lakes, and spend the least time fishing in mountain rivers and in the sea, and this has not changed fundamentally over the many years since Leopold et al. (1980) reported similar findings. Hyder et al., (2018) also confirm this to some extent in their data that show that the fishing effort of Polish sea anglers is one of the lowest in Europe. Another characteristic of Polish anglers is that they do not travel far to fish and angle mainly in the immediate vicinity of their places of residence. In addition to the relatively low incomes and possible lack of time, another reason for not taking long trips to other fishing grounds could be low angling attractiveness. Polish anglers used groundbaits to attract the cyprinids fishes (Czerniawski et al., 2010), because there is a positive relationship between amount of groundbaits and size of fish catch (Wołos et al., 1992; Arlinghaus and Mehner, 2003; Mehner et al., 2019). On the one hand, the data indicate an increase in the quantity of groundbait used, and on the other, qualitative changes in favor of commercial ready-made bait. Data obtained in the 1980s indicated that about 50% of anglers used groundbait (Wołos, 1984). Subsequent research showed that the bait was used by 53.4% of anglers in amounts of 1 kg per day per angler (Wołos et al., 1992). Ten years later, this amount reached 2.2 kg, while groundbait was used by 66% of the anglers surveyed (Wołos and Mioduszewska, 2003). Our research indicates further increases in the quantity of groundbait used to 2.7 kg and an increase in the share of anglers using bait to over 80%. Recreational fishing is an important element of the economy because of the revenue it generates (Cooke and Cowx, 2006; Cooke and Murchie, 2015). In Poland, there is also the potential for recreational fishing to generate high revenues while facilitating economic development. However, the present research indicates that most Polish anglers are not particularly wealthy. The average monthly wage in Poland in 2014 was approximately 948 EUR. The average Polish angler allocates an average of 416 EUR annually on angling. Of this amount, the highest share goes to cover expenditures on equipment and fishing tackle. This is why producers and distributors of angling equipment can count on the growth of their businesses in Poland.

Our research indicates that the most important aspect of recreational fishing for Polish anglers is to enjoy leisure time on the water and, to a slightly lesser extent, the sporting aspects of angling. The consumption aspect of angling and catching fish for consumption were definitely less important to the anglers surveyed. These results confirm the thesis that angling in Poland is now definitely of a recreational nature.

The number of fish caught was less important to Polish anglers than the size of the fish. This is understandable, especially in the context of the primary motive for angling. Large fish, so-called trophies, are particularly sought after by anglers (Arlinghaus, 2006; Lyach and Čech, 2017). This is another reason, this time a socioeconomic one, why it is worth protecting large individuals in populations, apart from purely ecological reasons (Arlinghaus et al., 2010).

Our research shows that the next most important factor associated with fishing is the release of fish caught. Polish anglers are currently willing to release caught fish, especially large specimens. The aim of C&R is to reduce fishing mortality without the unpleasant effects of regulations to reduce fishing pressure. In most cases, C&R is the autonomous choice of individuals, although it can also be applied obligatorily as a considered recreational fishing management strategy (Brown-scombe et al., 2017). This strategy allows anglers to maintain a steady or even higher level and quality of catches, while simultaneously increasing fishing effort, and it is becoming increasingly popular in highly developed countries and also in other countries (Freire et al., 2012). Our research shows that a large share of Polish anglers readily accept the C&R concept. This strategy for managing recreational fisheries can be extremely beneficial, and in some instances of overfished Polish fishing grounds, it is absolutely necessary. At present, only minimum sizes are obligatory in Poland, although it is known that this regulation does not offer sufficient protection against demographic changes in exploited fish populations (Pierce, 2010; García-Asorey et al., 2011). However, tightening this regulation in the form of increasing minimum sizes does not always produce the desired effects (Coggins et al., 2007; Rogers et al., 2010). Voluntary or mandatory C&R aims to conserve fish stocks, but its efficacy depends on the survival of the fishes released. Some studies have pointed out the high direct mortality indexes (Bartholomew and Bohnsack, 2005) or many of the sub-lethal effects (Catalán et al., 2018; Pullen et al., 2019). Therefore, other available measures should also be considered as options for more effectively managing recreational fishing grounds. In addition to closed seasons, minimum fork-length sizes are also widely implemented in Poland (Kapusta et al., 2018), while closed areas to protect fish are applied less frequently.

Polish anglers declared that they often released the fish they catch. However, it should be remembered that the willingness to release or take fish caught can be of a more local or regional character. Additionally, it should be noted that this is the main limitation of our study, as mainly organized anglers were surveyed. Addressing the survey to anglers who were members of the PAA could have resulted in reaching respondents who were more avid anglers and were more focused on protecting fish and less so on their consumption. For example, according to Kupren et al., (2018), anglers living in Warmia and Mazury (northeastern Poland) are more inclined to take the fish they catch as only fewer than 6% of respondents released the fish caught. The reason for this phenomenon could lie in the lower incomes and higher unemployment noted in these areas coupled with the desire to supplement diets with fish. In comparison, German studies indicate that the percentage of fish taken from fishing grounds in relation to all the fish caught ranged from 58 to 70% (Arlinghaus et al., 2008). Germany is a country, like Poland,

where there is a long tradition of consuming freshwater fish caught by anglers, which is in contrast to England where these fish, except for salmonids, are not consumed (Cooke et al., 2018). Stronger C&R traditions exist in England, Wales, Canada, the USA, and Scandinavia (Cooke and Murchie, 2015; Cooke et al., 2018). Although Canadian anglers catch approximately 215 million fish specimens annually, 66% of them are returned to the water (Cooke and Murchie, 2015). Anglers' decisions to harvest the fish caught are often associated with social factors and motivations (Hunt et al., 2002). Consumption is focused on particular species and is fisheries specific, and it also varies according to culture, location, species, and fisheries (Cooke et al., 2018). Interestingly, the attitude toward C&R was related significantly to the age of the surveyed anglers, because younger anglers declared more frequently that they always release caught fish. Statistical analysis also showed that the willingness to release fish is related to the annual catch. Anglers who caught the most fish and who fished more often than others declared that they released caught fish; this could indicate a higher degree of awareness among the more effective anglers. A similar relationship is seen in anglers with the most expensive angling equipment. These groups are among the most active anglers who seek out news and information about global fishing on the internet and through other media. They also have closer contacts with foreign anglers, and it is mainly through these channels that these anglers learn about the benefits of releasing caught fish and also how to do it properly. Campaigns conducted in the fishing press and by distributors of fishing equipment are of great importance in the promotion of C&R in Poland. In contrast, governmental and non-governmental organizations in Poland are definitely less important and effective in this respect, which is also a characteristic noted in other parts of the world (Cooke et al., 2013; Danylchuk et al., 2018).

Anglers also listed a number of factors that, in their opinion, are problematic at angling sites and that decrease the comfort of fishing. As the most disturbing factor, which, it turned out, was not only of an esthetic nature, anglers cited the ubiquitous littering of Polish fishing grounds and shorelines. This is a serious problem in recreational fishing in Poland (Skłodowski and Lipka, 2011; Czarkowski et al., 2016) and in other parts of the world (O'Toole et al., 2009). In the opinion of Polish anglers, the state of fish resources in inland waters has deteriorated in recent years and this view was expressed by almost 80% of respondents. This should be a signal to the institutions and people involved in the management of fish stocks and the commercial and recreational sectors in Poland, and it should provide them with the impetus to solve this problem.

We are aware of certain limitations and weaknesses of the survey, which are mainly due to the reluctance of Polish anglers to cooperate and respond to surveys. This stems mainly from historical circumstances when Poland was not a sovereign country, and any attempts by the authorities to obtain information were associated with attacks on citizens' freedoms and any cooperation with the authorities was viewed as collaboration. Despite these limitations and weaknesses, the present study was the first conducted in Poland since 1980, and, as such, it provided information that we believe will help better manage Polish recreational fisheries. Future angling

research should take into account the correction of the accuracy of the estimates, e.g. by examining the scale of systematic errors in existing test methods and refining methodologies so that they clearly control for method effects (Tarrant et al., 1993; Connelly et al., 2000).

Our research highlights the challenges of understanding the human dimension of recreational fishing and the need to have these data as a basis for management. Identifying anglers' motivations behind and approaches to the consumption of the fish they catch are the main advantages of the research. Our desire to compare the present results with previous studies (Leopold et al., 1980) influenced the content and structure of the questionnaire. Unfortunately, this resulted in our inability to explain the heterogeneity of anglers, including their specializations and their different responses to management measures. There are large research needs that should be addressed in the future. The longitudinal nationwide study of the economic and social aspects of angling is necessary to monitor the key factors related to recreational fisheries in Poland, and to identify changes and trends. Such research is also needed for marketing reasons, especially for the angling industry, including the development of angling tourism. Ideally, nationwide cross-sectional studies should be conducted regularly using identical questions to enable comparisons and evaluation of trends.

6 Conclusion

The results presented in this article confirm the thesis that angling catches in Poland are now decidedly recreational. Anglers in Poland fish primarily for recreation and sport, while consumption was less important in the opinion of respondents. We also know that C&R is an important element of Polish angling and that young, effective anglers are especially willing to release caught fish. The research also indicated that not all factors related to angling are easily quantifiable, because the emotional aspect associated with practicing this activity is particularly strong. This applies, for example, when determining the economic value of successfully spending leisure time on the water and the satisfaction derived from angling. The survey indicated that a significant proportion of anglers recognized that this value was immeasurable by using the word "priceless" in their answers. It is our hope that this work will facilitate a better understanding of the nature of recreational fisheries and the problems facing them, because they are also currently the most important element of the exploitation of fish stocks in Central and Eastern Europe.

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