


## RESEARCH ARTICLE

# Long-term perceptions of freshwater anglers about abandoned, lost or discarded fishing gear during their fishing careers

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National Multidisciplinary Laboratory for Climate Change, Grant/Award Number: RRF-2.3.1-21-2022-00014

**Handling Editor:** Michael Roast**Abstract**

1. Abandoned, lost or discarded fishing gear (ALDFG) represents a significant pollutant in wetland ecosystems globally. While the impacts of ALDFG are increasingly recognised as exacting a substantial toll on the world's oceans, reliable data on freshwater ecosystems remain scarce.
2. We explored the scale and causes of fishing gear loss in freshwater locations by engaging recreational anglers through an online questionnaire in Hungary. Respondents provided self-reported estimates of lost fishing gear over their angling careers and shared perceptions of the circumstances leading to these losses. From the total of 416 responses, 332 respondents provided data that we were able to analyse in detail.
3. Results indicated that anglers who fished regularly reported greater fishing gear loss than older anglers and those that fished predominantly in faster-flowing waters. Using the self-reported numbers, we estimated that at least 126.0–196.2 million fishing gear items have accumulated in Hungary's freshwater over the past 18 years. Annual lost fishing gear items therefore must weigh 1800–2900 tons, equivalent to ~40,500 tons (40.5 million kg) over this study period.
4. *Practical implication:* If current trends persist and based upon time-series modelling, fishing gear loss could amount to 301.0–468.7 million items in the next 25 years. Our findings highlight the urgent need for targeted interventions, such as public awareness campaigns and gear recovery programmes, to mitigate this growing problem in environmental pollution.

Viktor Löki and Jenő Nagy contributed equally.

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## KEYWORDS

abandoned, ALDFG, Europe, lost or otherwise discarded fishing gear, recreational anglers, survey, time-series modelling, water pollution

## 1 | INTRODUCTION

In aquatic environments, the interaction between people and nature is often exemplified by the relationship between anglers and water bodies. Abandoned, lost or discarded fishing gear (ALDFG) (also known as 'derelict' fishing gear; Scheld et al., 2016) poses significant environmental threats to aquatic ecosystems (e.g. Gilman et al., 2021; Macfadyen et al., 2009).

Globally, an estimated 2% of all fishing gear, including gillnets, trawl nets, pots and traps, is lost to the ocean annually (Richardson et al., 2022). According to the Organization for Economic Cooperation and Development (OECD) (2024), 20 million tons (Mt) from a total amount of 360 Mt of plastic waste were lost to terrestrial or aquatic environments in 2020, reflecting an increase of nearly one-third compared to the previous decade. In marine ecosystems specifically, the amount of plastic pollution in the form of lost fishing gear is far from trivial; for example, in the EU, this accounts for 27% of all marine littering (Charter & Whitehead, 2022). This is a critical issue considering the potential human health impacts of consuming seafood containing micro- and nanoplastics (Muñiz & Rahman, 2025).

Obtaining qualitative and empirical estimates of regional or global ALDFG is often challenging (Richardson et al., 2021), with the single estimate of approximately 2% of annual gear loss by recreational and commercial anglers alike (Richardson et al., 2022) being frequently cited by many studies. Existing studies show considerable uncertainty in this estimate as applied to freshwater ecosystems. For example, Nelms et al. (2021) found 701 lost gear items along a 6761-m long stretch of the River Ganges which, by extension, translates into >250,000 lost gear items along its entire course. In marine environments, the loss of ALDFG is far more acute, with Rijkure et al. (2024), for example, estimating that approximately 38,496 hooks and snoods were lost between 2010 and 2023 in Latvian coastal areas, while Unsbo et al. (2023) estimated annual losses of 28 million baits, 11.2 million sinkers and 140 million metres of fishing line in Nordic countries. These disparities in estimates, reflecting in part difficulties with data collection approaches, underscore the importance of further research in freshwater environments directed towards a wider base of stakeholders to obtain more precise data related to ALDFG.

Many parts of ALDFG degrade into microplastics that can threaten aquatic organisms in various ways (e.g. Enrichetti et al., 2021). In addition to microplastics, lead weights from lost fishing gear expose aquatic organisms to direct toxicological dangers (Grade et al., 2019). Harmful effects from ALDFG also include habitat degradation, propagation of invasive alien species and entanglement or entrapment of organisms, causing injury or

mortality (Gilman et al., 2021). For instance, in a review study covering a total of 76 relevant articles, over 5400 individuals of 40 different species have been reported as being entangled in lost gear (Stelfox et al., 2016), with seabirds being particularly susceptible (Beron & Pon, 2021). Furthermore, Perroca et al. (2024) identified 86 Mediterranean species entangled in ghost nets, of which 10 are considered threatened with extinction according to the International Union for Conservation of Nature (IUCN).

Despite these impacts, the extent of ALDFG in freshwater systems, especially in developing regions, remains under-appreciated, particularly in inland fisheries (Ssempijja et al., 2024). Anglers negatively impact these ecosystems in various ways, with pollution being one of the most obvious, but details of their more subtle impacts are under-researched (Lewin et al., 2006; Shephard et al., 2022). Modern anglers can be sensitive to this socio-environmental problem and their perceptions can provide valuable insights (Barbosa-Filho et al., 2020; Löki et al., 2023). Nevertheless, interviews have revealed that many anglers still perceive gear loss as a rare occurrence (Lewin et al., 2020).

This study aims for the first time to examine the perceived impacts of ALDFG on freshwater ecosystems by anglers in Hungary, one of the European countries where angling is a major pastime (Tímár et al., 2022). Specifically, we investigate the long-term perceptions of anglers to identify commonly lost items of ALDFG and the frequency of their loss. In addition, we provide an estimate of the annual number and weight of ALDFG in Hungarian waterbodies. We hypothesize that anglers can estimate the quantity and type of lost gear based on their own long-held perceptions, while we also predict that anglers with longer fishing careers will report fewer gear losses over time.

## 2 | MATERIALS AND METHODS

### 2.1 | Online questionnaire

Data were collected using an online questionnaire that contained 35 questions, divided into two sections. The first section sought information about respondents' socio-demographic characteristics, and the second section focused on ALDFG, including types, quantity and circumstances of loss. Respondents were asked about both their recent and cumulative fishing gear losses. The questionnaire was implemented using Google Forms and distributed across 23 Hungarian angler communities on Facebook, ensuring broad (country-level) geographic coverage. The online distribution method followed Vitál et al. (2024): we posted the questionnaire publicly on selected Facebook group pages on multiple (2–4)

dates, and a day after the posted questionnaires were published online, we wrote a 'reminder' comment under the post. Responses to open-ended questions were grouped by content for subsequent analysis.

## 2.2 | Profiles of recreational anglers

A total of 416 anglers completed the survey, of whom 398 were male, 17 were female, and one did not disclose gender. Respondents ranged in age from 14 to 74 years (mean: 41 years). The sample included primarily blue-collar ( $n=187$ , 45.0%) and white-collar ( $n=117$ , 28.1%) workers. Most anglers reported a weekly fishing frequency of  $\geq 2$  ( $n=126$ , 30.3%), a minority of single weekly fishing outings ( $n=141$ , 33.9%) and on average 25 years of fishing experience. Common techniques included bottom angling ( $n=348$ , 83.6%), spinning ( $n=239$ , 57.4%) and float angling ( $n=204$ , 49.0%). Many anglers reported visiting at least two ( $n=129$ , 31.0%) or three ( $n=118$ , 28.3%) types of waters (e.g. natural lakes, rivers, oxbow lakes, canals, fishing lakes or other small watercourses) most frequently and regularly using boats ( $n=150$ , 36.1%), although participation in fishing competitions was low (13.2%). For more detailed demographics and information see [Table 1](#).

## 2.3 | Statistical analysis

### 2.3.1 | Type and number of lost fishing gear items

Respondents estimated the number of (most frequently) lost gear items during their fishing careers, and this was used as the response variable in a linear regression model. Since lower values were more frequent, resulting in a lognormal data distribution, the values were log-transformed prior to analysis. Predictor variables included fishing frequency (on a scale from 1=very rare, i.e. a maximum of a few times in a year, to 5=very often, i.e. several times a week), years of fishing experience, respondents' age and the primary water type visited (i.e. flowing, standing or both). Blank responses were treated as missing values, and only complete records ( $n=332$ ) were used in the linear regression model.

### 2.3.2 | Estimated number and weight of lost fishing gear items

The average annual number of lost fishing gear items was calculated by dividing the total number of lost items (self-reported) by the years of fishing experience of respondents. This annual average was then scaled using the total number of anglers with active licences in Hungary, available only for 2007 to 2024 (National Food Chain Safety Office, 2018). We did not have information for the years 2018 and 2024. Therefore, we estimated these values by applying Kalman

**TABLE 1** Selected demographics, socio-economic details and characteristics of fishing activities between 2007 and 2024 reported by recreational freshwater anglers ( $n=416$ ) in Hungary during completion of the questionnaire.

Subject of question and available responses	Number of respondents (% of those responding)
Age (years)	
20–39	177 (42.6)
40–59	180 (43.3)
60+	38 (9.1)
Not stated	21 (5.0)
Occupation	
White-collared worker	117 (28.1)
Blue-collared worker	187 (45.0)
Retired	19 (4.6)
Student	21 (5.0)
Not stated	72 (17.3)
Fishing frequency	
Multiple times per week	126 (30.3)
Weekly	141 (33.9)
Multiple times per month	89 (21.4)
Monthly	36 (8.6)
A few times per year	18 (4.3)
Not stated	6 (1.5)
Fishing experience (years)	
1–5	50 (12.0)
6–19	87 (20.1)
20–39	168 (40.3)
40+	97 (23.3)
Not stated	14 (3.3)
Fishing methods employed	
Bottom angling	348 (83.6)
Float angling	204 (49.0)
Spinning	239 (57.4)
Not stated	20 (4.8)
Categories of frequently visited fishing waters	
Natural lakes	284 (68.2)
Rivers	288 (69.2)
Oxbow lakes	187 (44.9)
Canals	177 (42.5)
Fishing lakes	187 (44.9)
Other small watercourses	23 (5.5)
Frequency of visits to different water type categories	
1	61 (14.7)
2	129 (31.0)
3	118 (28.4)
4	57 (13.7)
5	43 (10.3)

(Continues)

TABLE 1 (Continued)

Subject of question and available responses	Number of respondents (% of those responding)
6	5 (1.2)
Not stated	3 (0.7)
Participation in fishing competitions	
Yes	55 (13.2)
No	259 (62.3)
Not stated	102 (24.5)
Boat use for fishing	
Yes	150 (36.1)
No	262 (62.9)
Not stated	4 (1.0)

Note: In the case of categories of fishing waters visited and fishing methods employed questions, multiple responses were possible.

filtering (Gardner et al., 1980) on a time-series model fitted with the missing values. Finally, we auto-fitted time-series models (the best-fitting model was ARIMA [1,1,0], meaning that the model uses one lagged value and first differencing, with no moving average component) to the entire 18-year study period estimation and forecasted until 2050. To estimate the approximate weight of lost fishing gear per year, we used the number of lost items annually from 2007 to 2024, estimated in the previous step, and multiplied it by the average weight (i.e. 260.69 g) of different types of fishing gear collected from various online sources (Web 2–Web 5).<sup>1,2,3,4</sup>

All statistical analyses were conducted in R v4.2.2 (R Core Team, 2022), using the ‘forecast’ package (Hyndman et al., 2024; Hyndman & Khandakar, 2008) for time-series modelling.

### 3 | RESULTS

#### 3.1 | Anglers' perceptions about the number of fishing gear items purchased and lost on a yearly basis

Most anglers ( $n=194$ , 46.6%) reported purchasing 10 or fewer items of fishing gear annually; 97 respondents (23.4%) reported purchasing up to 50 items. Fifty to 100 items were purchased annually less frequently (21.3%). Of lost gear, 361 (86.7%) anglers reported losing some fishing gear during their careers, while 49 (11.7%) claimed they had never lost any. Among those who reported losses, less than half ( $n=187$ , 44.9%) reported losing 50 or fewer gear items during their entire careers, and only 27 (5.5%) reported losing more than 500 items (Table 2). The types of gear lost most frequently were hooks or jigs ( $n=246$ ), wire leaders ( $n=210$ ) and ground bait feeders ( $n=192$ , Figure 1).

<sup>1</sup>Web 2: <https://energofish.hu/> [Accessed: 17/01/2025].

<sup>2</sup>Web 3: <https://www.halcattraz.hu/> [Accessed: 17/01/2025].

<sup>3</sup>Web 4: <https://www.eurostar.hu/> [Accessed: 17/01/2025].

<sup>4</sup>Web 5: <https://www.xfish.hu/> [Accessed: 17/01/2025].

TABLE 2 Estimated annual numbers of purchased and lost fishing gear items during the entire fishing careers of Hungarian freshwater anglers answering the questionnaire about their fishing activities between 2007 and 2024.

Fishing gear details	Number of respondents (% of those responding)
Number of yearly fishing gear items purchases	
10 or less	194 (46.6)
10–49	97 (23.4)
50–99	49 (11.7)
100+	40 (9.6)
Not stated	36 (8.7)
Number of lost fishing gear items during entire fishing careers	
Less than 50	187 (44.9)
50–99	86 (20.7)
100–199	49 (11.8)
200–499	36 (8.7)
More than 500	27 (6.5)
Not stated	31 (7.4)

#### 3.2 | Circumstances of fishing gear loss

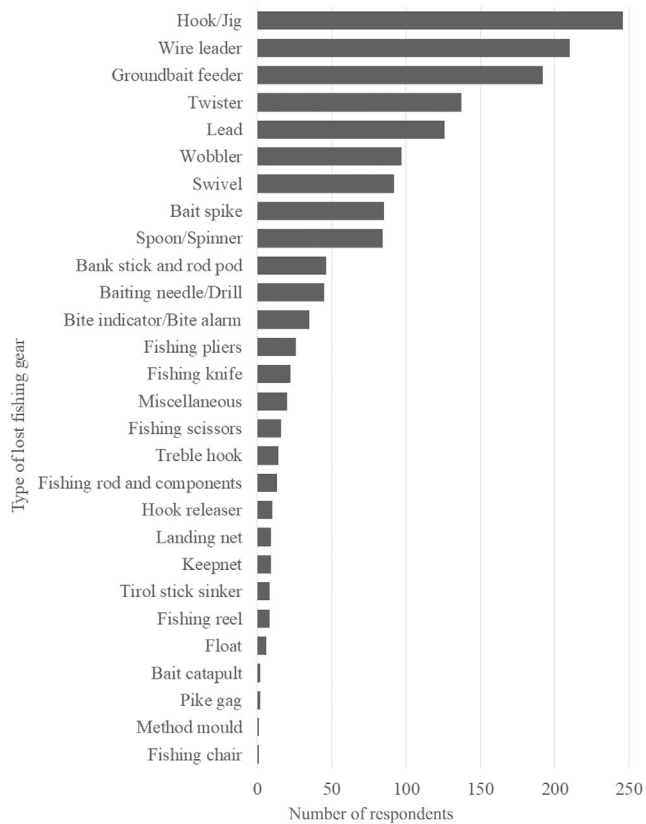
Most respondents ( $n=318$ , 76.4%) identified gear failure as the primary cause of loss, followed by leaving items at fishing locations ( $n=46$ , 11.0%). Other reasons, such as falling into the water at night, theft or falling while walking, were less common ( $n=22$ , 5.2%, Figure 2). Additionally, a large number of respondents ( $n=371$ , 89.1%) reported finding fishing gear lost, presumably by fellow anglers.

#### 3.3 | Environmental and wildlife impacts

Most respondents ( $n=323$ , 77.6%) believed that lost fishing gear causes environmental harm. Commonly reported concerns included pollution ( $n=144$ , 34.6%), various threats to wildlife ( $n=120$ , 28.8%) and risk to people ( $n=120$ , 23.5%). Specific issues expressed included lead poisoning ( $n=105$ , 25.2%), plastic pollution ( $n=47$ , 11.2%), birds incorporating lost fishing gear into their nests ( $n=4$ , 0.9%) and ingestion by animals (e.g. birds,  $n=112$ , 26.9%; other non-avian animals,  $n=104$ , 25.0%). A smaller subset of the respondents highlighted secondary issues such as algal blooms. A total of 276 respondents (66.6%) had caught fish that were entangled in lost fishing gear.

#### 3.4 | Preventing gear loss

When asked how to reduce gear loss, the most common suggestion ( $n=144$ , 34.6%) was for anglers to act more responsibly and carefully manage their equipment. Other recommendations were the use of appropriate ( $n=31$ , 7.4%) or biodegradable equipment ( $n=9$ , 2.1%), environmental education campaigns ( $n=10$ , 2.4%), alcohol restriction ( $n=7$ , 1.6%), excavation and removal of littoral and in-water

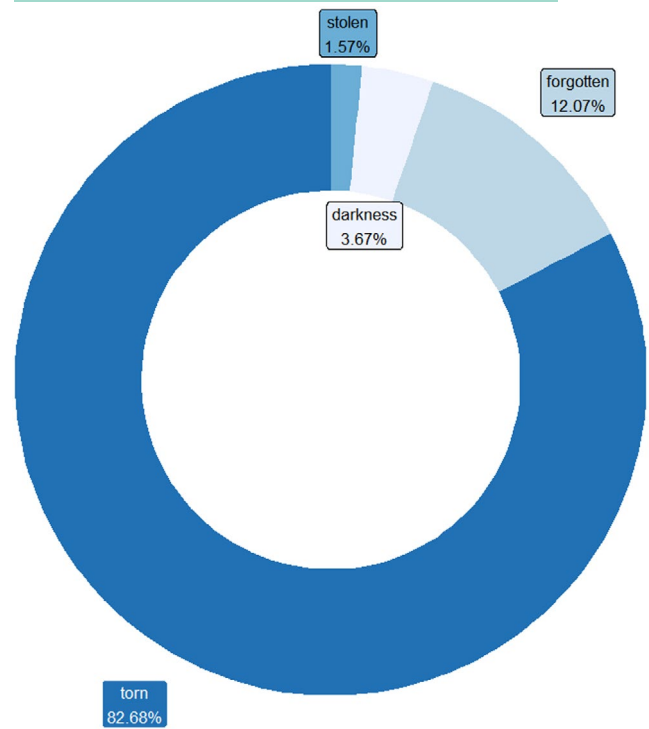


**FIGURE 1** The most frequent types of fishing gear lost at least once during the fishing careers of Hungarian freshwater anglers responding to the questionnaire about their fishing activities between 2007 and 2024.

obstructions ( $n=6$ , 1.4%), bins at fishing sites ( $n=5$ , 1.2%) and collection of lost fishing gear for secondary use ( $n=5$ , 1.2%). Many respondents ( $n=384$ , 92.3%) reported retrieval of lost gear either for re-use or disposal, while 214 (51.4%) expressed an interest in knowing about the type of fishing gear commonly lost by others.

### 3.5 | Fishing habits and water body type

Due to only partial completion of some online questionnaires, we were able to analyse only 332 responses of participants in detail. The linear regression analysis of these responses revealed several trends. The estimated amount of (most frequently) lost fishing gear ranged annually from 1 to 1000 with an average of  $93.38 \pm 158.18$  (1 standard deviation [SD]) items per capita. Those anglers who reported frequent fishing activity lost more gear items ( $\beta=0.14$ ,  $t_{312}=1.96$ ,  $p=0.051$ ), as did those with more years of fishing experience ( $\beta=0.03$ ,  $t_{312}=3.89$ ,  $p<0.001$ ). In contrast, older anglers lost significantly less fishing gear ( $\beta=-0.02$ ,  $t_{312}=-2.81$ ,  $p=0.005$ ), and those fishing primarily in fast-flowing waters lost fewer items than on both standing and slower flowing waters ( $\beta=-0.46$ ,  $t_{312}=-2.44$ ,  $p=0.015$ ). Anglers visiting predominantly standing water lost less, but statistically similar amounts of, fishing gear compared to those on both types of water ( $\beta=-0.23$ ,  $t_{312}=-1.35$ ,  $p=0.178$ , Figure 3).



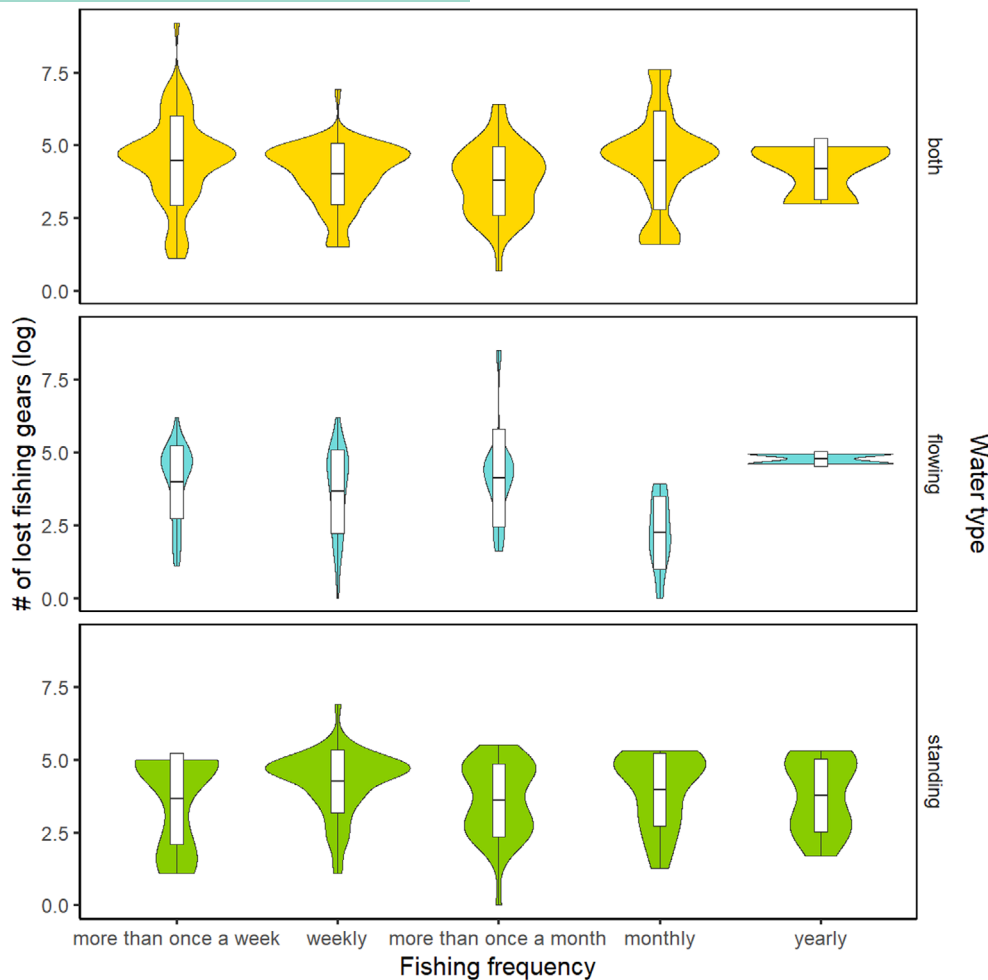
**FIGURE 2** Percentage of gear-loss circumstances mentioned by anglers.

### 3.6 | Estimated number and weight of lost fishing gear over the course of the study and in the future

Based on respondents' self-reported estimates, the average number of lost items per year was 19.7. Factoring in the number of anglers with active licences annually (range: 357,483–553,261) between 2007 and 2024, we estimated that 7.0–10.9 million fishing gear items are lost in Hungarian freshwaters each year, amounting to 126.0–196.2 million lost items over the 18 years of our study. Based on the time-series forecasting, the predicted annual losses of fishing gear items could exceed 9.2 million by 2050 (80% confidence interval: 3.5–14.9 million, Figure 4). Finally, the average weight of lost fishing gear per year was estimated to be between 1,832.9 and 2,836.7 tons (Figure 5), amounting to 40,488 tons (40.5 million kg) by 2050.

## 4 | DISCUSSION

This study aimed to survey online recreational freshwater anglers to identify the types of fishing gear lost, estimate the magnitude of these losses and understand the circumstances that led to their loss at Hungarian fishing locations. By gathering data on gear loss over a longer period of anglers' careers, we not only gained insights into the identity of the most frequently lost items but also provided estimates of the current quantity of lost gear in the country as well as forecasting losses over the next 25 years (i.e. until 2050).



**FIGURE 3** Violin plots showing the number of (most frequently) lost fishing gear items (log-transformed) by frequency of fishing activity at different water types visited by freshwater anglers in Hungary between 2007 and 2024. Shapes, boxes (from the embedded box-and-whisker plot) and lines indicate the distribution, average and standard deviation of the values, respectively.

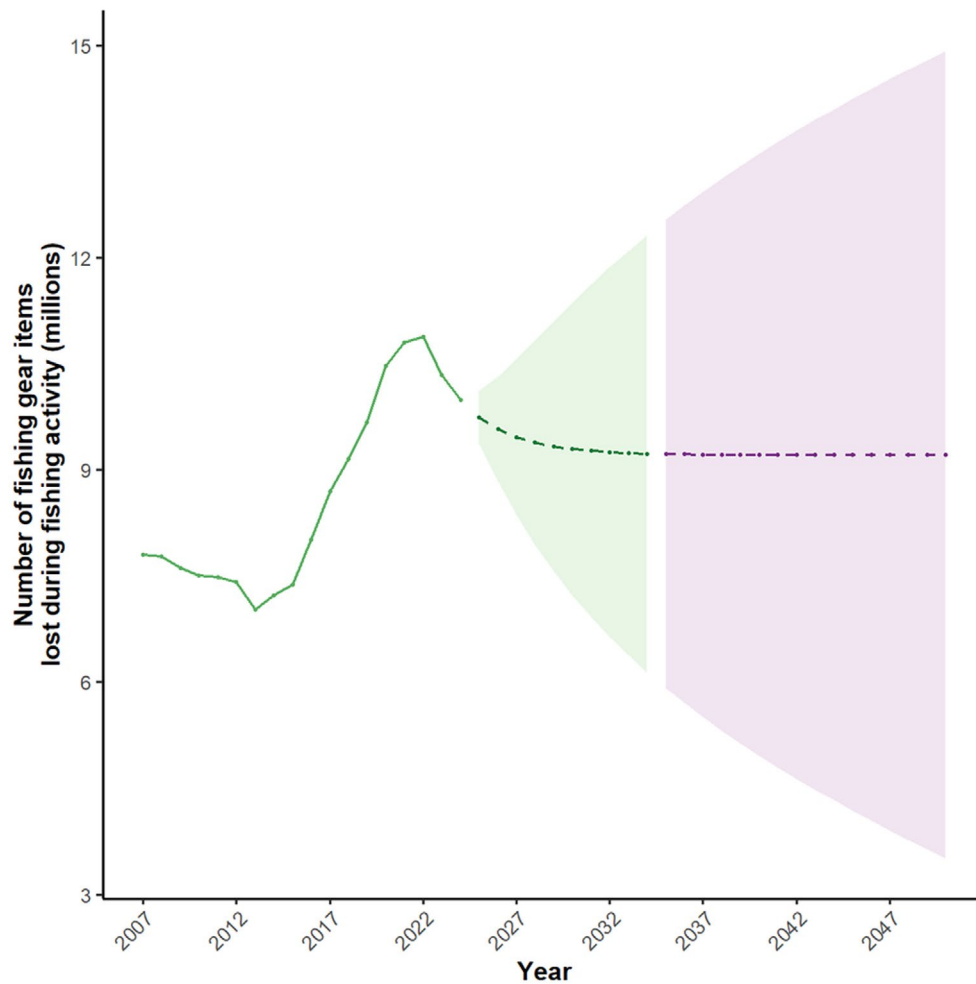
#### 4.1 | Numbers and weights of lost fishing gear items

Our findings suggest that tens of millions of fishing gear items may currently exist in Hungary's freshwaters, weighing thousands of tons. According to the most recent data, this represents 0.37–0.57% of the annually generated waste in the agricultural and food sectors (Hungarian Central Statistical Office, 2025). Despite this, Hungary's current National Waste Management Plan for 2021–2027 does not specifically address the issue of ALDFG (OHT, 2021). Therefore, these items are most likely not accounted for in the statistics of any waste management sector of the country.

Anglers' perceptions of their annual fishing gear purchases also indicate potentially high turnover rates of such gear. If these estimates are accurate (i.e.  $\text{mean} \pm 1 \text{ SD} = 44.62 \pm 116.75$  items/year) and scaled up to the 526,090 active Hungarian anglers in 2023 (MOHOSZ, 2024), more than 23 million fishing gear items may be purchased annually, of which 30–47% are lost each year, based on our current estimates. To improve the accuracy of such estimates, future studies should refine methods for data collection and consider involving additional

stakeholders such as fishing shop employees and magnet fishers (Neményi et al., 2024). Involving such anglers directly in ALDFG data collection may foster stewardship and collaborative problem solving (Richardson, Asmutis-Silvia, et al., 2019). Because recreational fishing often engenders a sense of responsibility for aquatic habitats, engaging anglers in research and fishing habitat management could enhance conservation outcomes (Shephard et al., 2022).

While our estimates provide valuable insights into the annual number and approximate weight of lost fishing gear in Hungary, several limitations should be noted. First, the calculations were based on self-reported data, which may provide less accurate results compared to more systematic data collection. Secondly, the predictions relied on the accuracy of annual angler licence statistics, the validity of which can vary markedly between years (Gusman Costa & Hause, 2023). Thirdly, our online survey approach may have limited the participation of older anglers who were less routinely active on digital platforms; consequently, their perceptions were likely under-represented. Finally, the estimation of the average weight of lost fishing gear was based on secondary data, which may not fully describe the diversity of fishing gear used by anglers.



**FIGURE 4** An estimate of the number of items of fishing gear that will be lost annually until 2050 by Hungarian freshwater anglers based on present estimates (see text for details). Pale green (2025–2034) and purple (2035–2050) colours show 80% confidence intervals.

## 4.2 | National insights and global relevance of freshwater fishing gear loss

Complementary data about the amount and type of ALDFG in Hungarian freshwaters were obtained from Neményi et al. (2024) via a social media analysis of the catches of recreational magnet anglers. Comparing the 10 most commonly caught items of fishing gear, their findings strongly supported ours in the present study. The two notable exceptions were fishing knives and wire leaders, with freshwater anglers reporting rare loss of the former and more frequent loss of the latter. We believe that both can be explained by the specificity of magnet fishing as knives are usually made of stainless steel and thus are attracted to magnets. In contrast, modern wire leaders are made from tungsten, titanium or fluorocarbon that are not as strongly attracted to fishing magnets.

To the best of our knowledge, this study is therefore among the first to derive country-wide estimates of freshwater ALDFG based on anglers' self-reported experiences, which provide a cost-effective method to estimate such losses compared with previous fishing gear retrieval campaigns (e.g. Pander et al., 2022; Spirkovski et al., 2019). Moreover, our finding that commonly lost fishing gear types included

hooks or jigs, leaders and bait feeders agrees with those of studies in other countries where angling is a common freshwater pastime (e.g. Baltic countries, Unsbo et al., 2023; Germany, Pander et al., 2022; UK, Grade et al., 2019). Therefore, our finding appears to be of broad ecological relevance outside of our domestic domain, strengthening our suggestions related to more active participation of anglers in research in this subject area. Moreover, aligned with global recommendations, our results underscore the need for targeted mitigation strategies, ranging from awareness and recovery campaigns to innovations in fishing gear design and stakeholder-driven retrieval initiatives (cf. Badola et al., 2024; Drinkwin, 2022; He & Suuronen, 2018).

## 4.3 | Relationship of fishing gear losses to angler experience and waterbody type

We found that age, fishing habits, fishing methods and freshwater habitat types significantly influenced the amount of fishing gear lost. The higher rates of gear loss by frequent anglers and those with more years of fishing experience align with public perception (e.g. Richardson et al., 2018; Richardson, Hardesty, & Wilcox, 2019),

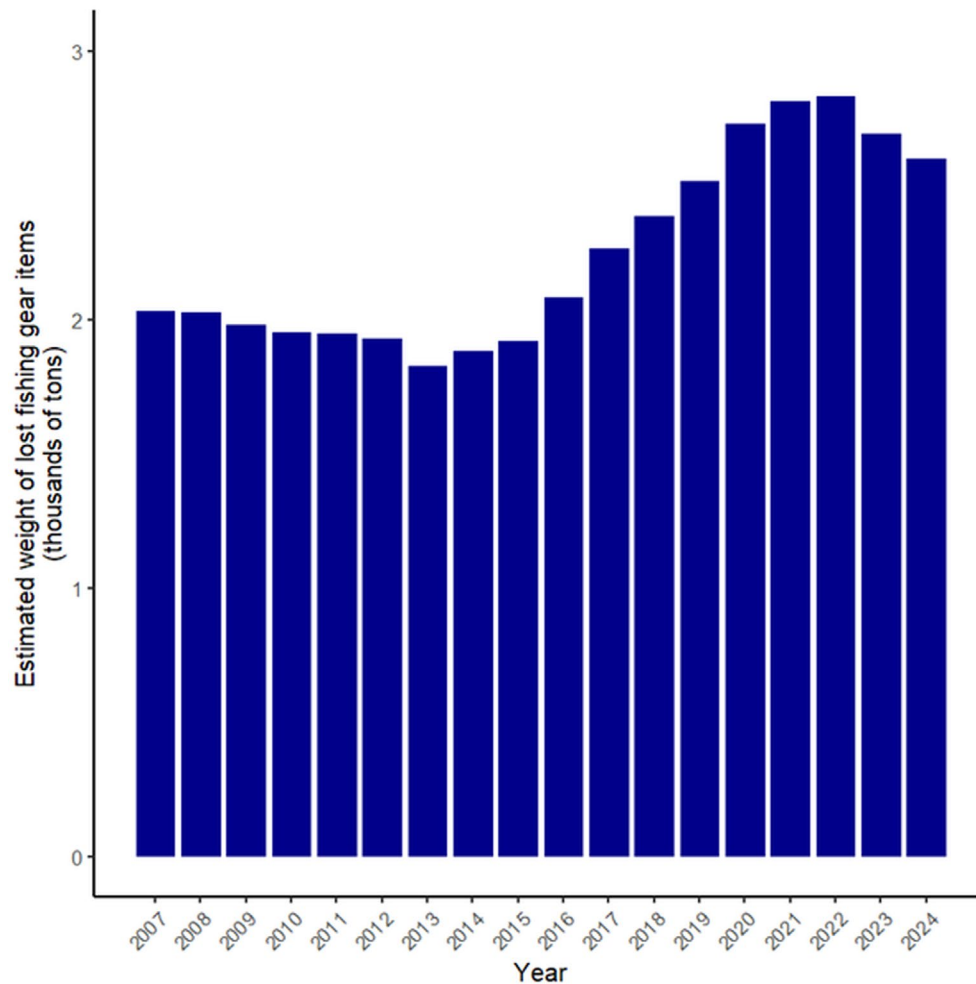


FIGURE 5 The estimated weight of fishing gear items lost by Hungarian freshwater anglers between 2007 and 2024 (inclusive).

which suggests that experienced and frequent anglers are more likely to lose gear. They are also likely exposed to a broader range of environmental and climatic conditions, resulting in increased damage to and fatigue of, their gear and the increased likelihood of its loss. Additionally, they may fish at different locations with more diverse forms of fishing gear, inadvertently increasing the risk of snagging and/or breakage of it. These findings emphasize the complex interplay between behaviour, experience and environmental factors in recreational fishing gear loss, underscoring the need for targeted mitigation strategies.

The notably lower occurrences of fishing gear loss among older anglers appear to be influenced primarily by socio-psychological factors. With greater experience, older anglers may adopt refined practices that reduce the likelihood of losses. Additionally, they may exhibit heightened environmental stewardship and caution, and/or be more risk-averse due to the economic consequences of losing expensive equipment. It should also be noted that given the nature of the fishing pastime, which inevitably results in the loss of fishing gear over time, it is also possible that some respondents to our questionnaire (49, 11.7%) may have feared some form of sanction and, therefore, did not want to admit to losing their fishing gear.

Anglers fishing predominantly in flowing waters reported fewer gear losses compared to those on both standing and flowing waters. Flowing waters typically present more dynamic conditions, including currents, debris and variable substrates, which might lead to distinct patterns of fishing gear use and entanglement compared to standing waters. Anglers, particularly in faster-flowing waters, tend to use thicker main lines, often made of braid, which have significantly higher tensile strength. Furthermore, river-dwelling fish such as European Barbel (*Barbus barbus*) or European Catfish (*Silurus glanis*), particularly those in faster currents, are known for their vigorous fighting behaviour (Boulêtreau et al., 2016; Roberts et al., 2025). As a result, anglers commonly rely on more robust and durable equipment, which may inherently reduce the frequency of losses. These adaptations highlight the interplay between environmental demands and angler behaviour in shaping patterns of fishing gear loss.

#### 4.4 | Mitigation measures

Most of the respondents agreed that lost fishing gear causes environmental harm, including pollution, threats to wildlife and risks to

human safety. They also emphasized the need for anglers to adopt more responsible practices and carefully manage their equipment to mitigate these impacts. Our findings suggest that targeted management interventions could effectively reduce ALDFG. Educational programmes targeting younger and/or less experienced anglers, along with habitat-specific guidelines to minimize entanglement risks, could be particularly impactful. However, as respondents highlighted, addressing ALDFG requires a multifaceted approach that combines education, behavioural change and practical measures.

Marking of fishing gear improves its visibility and traceability (Gilman, 2015; He & Suuronen, 2018), and innovative technologies such as side scan sonars can also aid its retrieval (Fulton, 2021). However, the marking of angling gear such as hooks, lines and feeders greatly reduces its effectiveness. Therefore, we should concentrate on retrieval programmes combined with reliable reporting systems targeted at ALDFG hotspots to reduce the quantity of ALDFG that is responsible for the entrapment and death of fishes and other aquatic animals in the absence of angler awareness, losses known as 'ghost fishing' (Drinkwin, 2022; Gajanur & Jaafar, 2022). The inclusion of stakeholders such as local divers in ALDFG retrieval campaigns can be extremely effective (Lloret et al., 2014). For example, a cleaning survey in Lake Eixendorf (Germany) found more than 65 kg of various types of fishing gear, including much lead and plastic (Pander et al., 2022). Citizen scientists reporting ALDFG online can also yield substantial benefits (Gajanur & Jaafar, 2022; Richardson, Asmutis-Silvia, et al., 2019). If implemented in combination with a retrieval programme, reporting systems on ALDFG have been shown to reduce the quantity of ALDFG and, thus, incidents of ghost fishing (Gilman, 2015). While retrieval campaigns remain valuable, they are inherently more expensive and logistically difficult to conduct effectively. Prevention, however, remains the most effective long-term strategy (Yang, 2022).

Brown and Macfadyen (2007) suggested that preventative measures are generally preferable to curative ones, as they immediately reduce the risks and costs associated with fishing gear loss. Biodegradable fishing gear holds promise (Deroiné et al., 2019; Gilman, 2016), but its uptake by the angling community is limited by production costs and market availability, challenges that may be particularly acute for anglers in lower-GDP countries. Grade et al. (2019) emphasized the urgent need for accelerated development, marketing, adoption and regulatory frameworks of non-toxic fishing gear, but while environmental education campaigns can help, lasting change may require state, authority or organisational support for the use of biodegradable materials in fishing gear and improved regulatory frameworks (Deshpande & Aspen, 2018; Jennings & Revill, 2007). Implementing Extended Producer Responsibility (EPR) schemes for fishing gear containing plastic also can incentivize manufacturers to design more durable, repairable and recyclable products, while funding collection and recycling systems that reduce the likelihood of gear entering the environment as ALDFG (European Commission, 2019; UNEP, 2021). Furthermore, the active involvement of national angling associations, such as the

Hungarian National Anglers' Association (MOHOSZ), could help to co-develop preventative strategies and coordinate periodic retrieval initiatives, thereby strengthening stakeholder ownership and outreach. Although, above, we have detailed some viable mitigation strategies to reduce the negative impacts of ALDFG, their broad acceptance could be challenging, given that anglers' understanding of fisheries management measures is often limited and heavily dependent on personal communication networks (Cardona & Morales-Nin, 2013). Furthermore, awareness-raising alone may have limited long-term impact without sustained incentives and monitoring, and campaign outcomes can be difficult to measure due to the diffuse nature of gear losses over time and space (Macfadyen et al., 2009; Richardson et al., 2021).

## 5 | CONCLUSIONS

Lost fishing gear represents a substantial source of freshwater pollution, with disproportionate negative impacts on wildlife and extensive social and economic impacts. Our estimates represent the first country-wide assessment of the quantitative amounts of ALDFG in freshwater ecosystems, utilizing data obtained directly from responses by freshwater anglers. Our approach highlights the value of first-hand reporting of such losses.

While previous studies (e.g. Gilman, 2015; Richardson et al., 2022) have emphasized the environmental harms caused by ALDFG, including pollution and risks to wildlife, our findings provide a more nuanced understanding of how angler behaviour, socio-demographics and location of fishing activities contribute to this issue. The acknowledgement by respondents of the environmental harm caused by loss of their fishing gear, combined with their suggestions for more responsible fishing practices, underscores the need for education and behavioural interventions.

While this study provides estimates of fishing gear loss in terms of the total number of items lost, future research would benefit from quantifying fishing gear losses in terms of their mass (e.g. kilograms or tons) across various different types of gear. Such data would enable a more comprehensive assessment of the environmental impacts associated with fishing gear loss, including pollution load and material persistence in ecosystems. Additionally, mass-based estimates would provide a stronger basis for developing targeted mitigation measures, such as prioritizing the reduction of heavier or of more environmentally damaging fishing gear.

Our findings highlight the necessity of integrating anglers' knowledge into freshwater ALDFG research and management. By combining technological innovation, stakeholder engagement and supportive policy measures, we can move towards more sustainable and responsible recreational fishing practices.

## AUTHOR CONTRIBUTIONS

**Viktor Löki:** Conceptualisation, methodology, writing—original draft, writing—review and editing. **Jenő Nagy:** Conceptualisation, methodology, statistical analyses, visualisation, writing—review

and editing. **Zsolt Neményi:** Investigation, writing—review and editing. **András Nagy:** Investigation, writing—review and editing. **Attila Hagyó:** Investigation, writing—review and editing. **Zoltán Vitál:** Investigation, writing—review and editing. **Attila Mozsár:** Investigation, writing—review and editing. **S. James Reynolds:** Writing—review and editing. **Balázs András Lukács:** Writing—review and editing, funding acquisition. All authors contributed critically to the drafts and gave final approval for publication.

## ACKNOWLEDGEMENTS

We thank all anonymous respondents for providing valuable data by completing our online survey. This work has been implemented by the National Multidisciplinary Laboratory for Climate Change (RRF-2.3.1-21-2022-00014) project within the framework of Hungary's National Recovery and Resilience Plan supported by the Recovery and Resilience Facility of the European Union. The research presented here was carried out with the support of the University of Debrecen Programme for Scientific Publication. We thank the anonymous reviewers and editor for their valuable comments and suggestions, which helped to improve the quality of our manuscript.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## PEER REVIEW

The peer review history for this article is available at <https://www.webofscience.com/api/gateway/wos/peer-review/10.1002/2688-8319.70123>.

## DATA AVAILABILITY STATEMENT

Data are available from the Dryad Digital Repository <https://doi.org/10.5061/dryad.7pvmcvf6k> (Löki et al., 2025).

## ETHICS STATEMENT

The methods of building the online questionnaire obtaining data followed the International Society of Ethnobiology's Code of Ethics (Ethnobiology I.S.O., 2006). No ethical committee permits were required.

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## REFERENCES

- Badola, S., Gill, A. K., Dobriyal, P., Patel, S., Khan, M. Z., & Hussain, S. A. (2024). Haunting the Ganges: Addressing the issues of ghost gear in the Ganga River through an incentive-based institutional mechanism. *Frontiers in Conservation Science*, 5, 1341434.
- Barbosa-Filho, M. L. V., Seminara, C. I., Tavares, D. C., Siciliano, S., Hauser-Davis, R. A., & Mourão, J. S. (2020). Artisanal fisher perceptions on ghost nets in a tropical South Atlantic marine biodiversity hotspot: Challenges to traditional fishing culture and implications for conservation strategies. *Ocean and Coastal Management*, 192, 105189.
- Beron, M. P., & Pon, J. P. S. (2021). Fishing gear-related injuries and mortality of seabirds in coastal northern Argentina. *Marine Ornithology*, 49, 321–327.
- Boulêtreau, S., Verdeyroux, P., Lorthiois, E., Azémar, F., Compin, A., & Santoul, F. (2016). Do you eat or not? Predation behaviour of European catfish (*Silurus glanis*) toward live bait on a hook. *The Open Fish Science Journal*, 9, 8–14.
- Brown, J., & Macfadyen, G. (2007). Ghost fishing in European waters: Impacts and management responses. *Marine Policy*, 31(4), 488–504.
- Cardona, F., & Morales-Nin, B. (2013). Anglers' perceptions of recreational fisheries and fisheries management in Mallorca. *Ocean and Coastal Management*, 82, 146–150.
- Charter, M., & Whitehead, P. (2022). *Local innovation systems related to waste fishing gear: Research report on the findings from stakeholder workshops related to local innovation systems related to waste and "end of life" fishing gear*. Report of the Blue Circular Economy, Trondheim, Norway.
- Deroiné, M., Pillin, I., Le Maguer, G., Chauvel, M., & Grohens, Y. (2019). Development of new generation fishing gear: A resistant and biodegradable monofilament. *Polymer Testing*, 74, 163–169.
- Deshpande, P. C., & Aspen, D. M. (2018). A framework to conceptualize sustainable development goals for fishing gear resource management. In W. Leal Filho (Ed.), *Handbook of sustainability science and research. World sustainability series* (pp. 727–744). Springer. [https://doi.org/10.1007/978-3-319-63007-6\\_45](https://doi.org/10.1007/978-3-319-63007-6_45)
- Drinkwin, J. (2022). *Reporting and retrieval of lost fishing gear: Recommendations for developing effective programmes*. FAO and IMO. <https://doi.org/10.4060/cb8067en>
- Enrichetti, F., Bavestrello, G., Betti, F., Rindi, F., Tregrosso, A., & Bo, M. (2021). Fate of lost fishing gears: Experimental evidence of biofouling colonization patterns from the northwestern Mediterranean Sea. *Environmental Pollution*, 268, 115746.
- Ethnobiology, I. S. O. (2006). *International Society of Ethnobiology Code of Ethics (with 2008 additions)*. Accessed February 06, 2025. <https://www.ethnobiology.net/what-we-do/core-programs/ise-ethics-program/code-of-ethics/>
- European Commission. (2019). Directive (EU) 2019/904 of the European Parliament and of the council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment. *Official Journal of the European Union*, L 155, 1–19. Accessed August 15, 2025. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0904>
- Fulton, L. (2021). *Untangling the problem of abandoned, lost, and discarded fishing gear: Evaluating the benefits of side scan sonar as a gear detection method*. Master's thesis, Dalhousie University, Halifax, Nova Scotia, Canada. 80 pp.
- Gajanur, A. R., & Jaafar, Z. (2022). Abandoned, lost, or discarded fishing gear at urban coastlines. *Marine Pollution Bulletin*, 175, 113341.
- Gardner, G., Harvey, A. C., & Phillips, G. D. (1980). Algorithm AS 154: An algorithm for exact maximum likelihood estimation of autoregressive-moving average models by means of Kalman filtering. *Applied Statistics*, 29, 311–322.
- Gilman, E. (2015). Status of international monitoring and management of abandoned, lost and discarded fishing gear and ghost fishing. *Marine Policy*, 60, 225–239.
- Gilman, E. (2016). Biodegradable fishing gear: Part of the solution to ghost fishing and marine pollution. *Animal Conservation*, 19(4), 320–321.
- Gilman, E., Musyl, M., Suuronen, P., Chaloupka, M., Gorgin, S., Wilson, J., & Kuczynski, B. (2021). Highest risk abandoned, lost and discarded fishing gear. *Scientific Reports*, 11, 7195. <https://doi.org/10.1038/s41598-021-86123-3>
- Grade, T., Campbell, P., Cooley, T., Kneeland, M., Leslie, E., MacDonald, B., Melotti, J., Okoniewski, J., Parmley, E. J., Perry, C., Vogel, H., &

- Pokras, M. (2019). Lead poisoning from ingestion of fishing gear: A review. *Ambio*, 48, 1023–1038.
- Gusman Costa, V. M., & Hause, C. L. (2023). Human dimensions of angler nonresponse in California's recreational steelhead fishing report card program. *California Fish and Wildlife Journal*, 109, e11.
- He, P., & Suuronen, P. (2018). Technologies for the marking of fishing gear to identify gear components entangled on marine animals and to reduce abandoned, lost or otherwise discarded fishing gear. *Marine Pollution Bulletin*, 129(1), 253–261.
- Hungarian Central Statistical Office. (2025). *The volume of each type of waste by method of treatment*. Hungarian Central Statistical Office. [https://www.ksh.hu/stadat\\_files/kor/en/kor0029.html](https://www.ksh.hu/stadat_files/kor/en/kor0029.html)
- Hyndman, R. J., Athanasopoulos, G., Bergmeir, C., Caceres, G., Chhay, L., O'Hara-Wild, M., Petropoulos, F., Razbash, S., Wang, E., & Yasmeen, F. (2024). forecast: Forecasting functions for time series and linear models. R package version 8.22.0. <https://pkg.robjhyndman.com/forecast/>
- Hyndman, R. J., & Khandakar, Y. (2008). Automatic time series forecasting: The forecast package for R. *Journal of Statistical Software*, 27(3), 1–22.
- Jennings, S., & Revill, A. S. (2007). The role of gear technologists in supporting an ecosystem approach to fisheries. *ICES Journal of Marine Science*, 64(8), 1525–1534.
- Lewin, W. C., Arlinghaus, R., & Mehner, T. (2006). Documented and potential biological impacts of recreational fishing: Insights for management and conservation. *Reviews in Fisheries Science*, 14(4), 305–367. <https://doi.org/10.1080/10641260600886455>
- Lewin, W. C., Weltersbach, M. S., Denfeld, G., & Strehlow, H. V. (2020). Recreational anglers' perceptions, attitudes and estimated contribution to angling related marine litter in the German Baltic Sea. *Journal of Environmental Management*, 272, 111062.
- Lloret, J., Garrote, A., Balasch, N., & Font, T. (2014). Estimating recreational fishing tackle loss in Mediterranean coastal areas: Potential impacts on wildlife. *Aquatic Ecosystem Health & Management*, 17(2), 179–185.
- Löki, V., Nagy, J., Neményi, Z., Hagyó, A., Nagy, A., Vítál, Z., Mozsár, A., & Lukács, B. A. (2023). Exploring ecological knowledge in recreational fishing for conservation purposes: A literature review. *Global Ecology and Conservation*, 48, e02697.
- Löki, V., Nagy, J., Neményi, Z., Nagy, A., Hagyó, A., Vítál, Z., Mozsár, A., Reynolds, J. S., & Lukács, B. A. (2025). Long-term perceptions of freshwater anglers about abandoned, lost or discarded fishing gear during their fishing careers [Dataset]. Dryad. <https://doi.org/10.5061/dryad.7pvmcvf6k>
- Macfadyen, G., Huntington, T., & Cappell, R. (2009). *Abandoned, lost or otherwise discarded fishing gear. UNEP regional seas reports and studies, No. 185; FAO fisheries and Aquaculture Technical paper, No. 523* (p. 115). UNEP/FAO.
- Magyar Országos Horgász Szövetség (MOHOSZ). (2024). *A legnagyobb baráti társaság: 1 millió horgász Magyarországon*. Magyar Országos Horgász Szövetség (MOHOSZ). <https://nyito.mohosz.hu/index.php/szovetseg/19-kozlemenyek/629-a-legnagyobb-barati-tarsasag-1-millio-horgasz-magyarorszagon>
- Muñiz, R., & Rahman, M. S. (2025). Microplastics in coastal and marine environments: A critical issue of plastic pollution on marine organisms, seafood contaminations, and human health implications. *Journal of Hazardous Materials Advances*, 18, 100663. <https://doi.org/10.1016/j.hazadv.2025.100663>
- National Food Chain Safety Office. (2018). *Tájékoztató az állami horgászjegy váltásának alakulásáról a gyermekhorgászok és felnőtt horgászok tekintetében, az elmúlt 10 évet felölelő időszakban*. National Food Chain Safety Office. <https://portal.nebih.gov.hu/-/az-allami-horgaszjegy-valtasanak-alakulasa-az-elmult-10-evben-2007-2017>
- Nelms, S. E., Duncan, E. M., Patel, S., Badola, R., Bhola, S., Chakma, S., Chowdhury, G. W., Godley, B. J., Haque, A. B., Johnson, J. A., Khatoon, H., Kumar, S., Napper, I. E., Niloy, M. N. H., Akter, T., Badola, S., Dev, A., Rawat, S., Santillo, D., ... Koldewey, H. (2021). Riverine plastic pollution from fisheries: Insights from the Ganges River system. *Science of the Total Environment*, 756, 143305.
- Neményi, Z., Nagy, A., Hagyó, A., Nagy, J., Vítál, Z., Lukács, B. A., & Löki, V. (2024). Tracking abandoned, lost or discarded fishing gears of anglers by analyzing magnet fishers' catch. *Hydrobiologia*, 851(9), 2249–2260.
- OECD. (2024). *Policy scenarios for eliminating plastic pollution by 2040* (p. 132). OECD Publishing. <https://doi.org/10.1787/76400890>
- Országos Hulladékgazdálkodási Terv (2021–2027). (2021). *Innovációs és Technológiai Minisztérium [Ministry for Innovation and Technology]* (p. 303). Ministry for Innovation and Technology (Innovációs és Technológiai Minisztérium in Hungarian).
- Pander, J., Dobler, A. H., Hoos, P., & Geist, J. (2022). Environmental pollution by lost fishing tackle: A systematic assessment in Lake Eixendorf. *Environments*, 9(11), 144.
- Perroca, J. F., Giarrizzo, T., Azzurro, E., Rodrigues-Filho, J. L., Silva, C. V., Arcifa, M. S., & Azevedo-Santos, V. M. (2024). Negative effects of ghost nets on Mediterranean biodiversity. *Aquatic Ecology*, 58, 131–137. <https://doi.org/10.1007/s10452-022-09985-3>
- R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Richardson, K., Asmutis-Silvia, R., Drinkwin, J., Gilardi, K. V., Giskes, I., Jones, G., Gilardi, K. V. K., O'Brien, K., Pragnell-Raasch, H., Ludwig, L., Antonelis, K., Barco, S., Henry, A., Knowlton, A., Landry, S., Mattila, D., MacDonald, K., Moore, M., Morgan, J., ... Hogan, E. (2019). Building evidence around ghost gear: Global trends and analysis for sustainable solutions at scale. *Marine Pollution Bulletin*, 138, 222–229.
- Richardson, K., Gunn, R., Wilcox, C., & Hardesty, B. D. (2018). Understanding causes of gear loss provides a sound basis for fisheries management. *Marine Policy*, 96, 278–284.
- Richardson, K., Hardesty, B. D., Vince, J., & Wilcox, C. (2022). Global estimates of fishing gear lost to the ocean each year. *Science Advances*, 8(41), eabq0135.
- Richardson, K., Hardesty, B. D., & Wilcox, C. (2019). Estimates of fishing gear loss rates at a global scale: A literature review and meta-analysis. *Fish and Fisheries*, 20(6), 1218–1231.
- Richardson, K., Wilcox, C., Vince, J., & Hardesty, B. D. (2021). Challenges and misperceptions around global fishing gear loss estimates. *Marine Policy*, 129, 104522.
- Rijkure, A., Cerbule, K., & Megnis, J. (2024). Abandoned, lost, or otherwise discarded fishing gear in coastal fisheries: A case study in the Baltic Sea coastal waters of Latvia. *Marine Policy*, 165, 106187.
- Roberts, C. G., Tarkan, A. S., Hanley, M. E., & Britton, J. R. (2025). Angler catch data as a monitoring tool for European barbel *Barbus barbus* in a data limited recreational fishery. *Fisheries Research*, 281, 107224.
- Scheld, A. M., Bilkovic, D. M., & Havens, K. J. (2016). The dilemma of derelict gear. *Scientific Reports*, 6(1), 19671.
- Shephard, S., List, C. J., & Arlinghaus, R. (2022). Reviving the unique potential of recreational fishers as environmental stewards of aquatic ecosystems. *Fish and Fisheries*, 24(2), 339–351.
- Spirkovski, Z., Ilik-Boeva, D., Ritterbusch, D., Peveling, R., & Pietrock, M. (2019). Ghost net removal in ancient Lake Ohrid: A pilot study. *Fisheries Research*, 211, 46–50.
- Ssempijja, D., Einarsson, H. A., & He, P. (2024). Abandoned, lost, and otherwise discarded fishing gear in world's inland fisheries. *Reviews in Fish Biology and Fisheries*, 34(2), 671–683.
- Stelfox, M., Hudgins, J., & Sweet, M. (2016). A review of ghost gear entanglement amongst marine mammals, reptiles and elasmobranchs. *Marine Pollution Bulletin*, 111(1–2), 6–17.
- Tímár, V., Miklósné, V. A., & Kalmár, S. (2022). A horgászturizmus helyzete és lehetőségei hazánkban a 2020-as évek elején. [the state

and opportunities of fishing tourism in Hungary at the beginning of the 2020s]. *Acta Agronomica Óváriensis*, 63(2), 72–98.

- United Nations Environment Programme [UNEP] (Ed.). (2021). *Addressing abandoned, lost or otherwise discarded fishing gear: A global directory of initiatives*. UNEP. Accessed August 05, 2025. <https://wedocs.unep.org/20.500.11822/35454>
- Unsbo, H., Granberg, M., Boltensern, M., Olshammar, M., & Karlsson, M. (2023). *Quantification and environmental pollution aspects of lost fishing gear in the Nordic countries* (p. 63). Nordic Council of Ministers.
- Vitál, Z., Chapman, D. C., Sallai, M., & Mozsár, A. (2024). Themed social networking groups as effective sources of data: A country-wide survey on invasive bigheaded carp (*Hipophthalmichthys molitrix* and *H. nobilis*) detection and distribution. *Citizen Science: Theory and Practice*, 9(1), 1–14. <https://doi.org/10.5334/cstp.780>
- Yang, C. M. (2022). Stakeholders' perspectives for taking action to prevent abandoned, lost, or otherwise discarded fishing gear in gillnet fisheries, Taiwan. *Sustainability*, 15(1), 318.

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**Data S1.** Questions used in the online questionnaire.

**How to cite this article:** Löki, V., Nagy, J., Neményi, Z., Nagy, A., Hagyó, A., Vitál, Z., Mozsár, A., Reynolds, S. J., & Lukács, B. A. (2025). Long-term perceptions of freshwater anglers about abandoned, lost or discarded fishing gear during their fishing careers. *Ecological Solutions and Evidence*, 6, e70123. <https://doi.org/10.1002/2688-8319.70123>