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POLLUTION CAUSED BY RECREATIONAL FISHING

ABSTRACT

Recreational fishing is a widely practiced activity both in our country and around the world. While fishing was once done with simple tools, it now shows great variety due to the use of plastics. Studies on using these plastic waste materials and their potential harm to aquatic habitats have remained limited. Plastic waste and microplastics (<5 mm) in marine and freshwater environments have become a significant concern due to their harmful effects on aquatic ecosystems, the fishing and tourism industries, and human health. Therefore, it is necessary to prefer environmentally friendly fishing equipment that causes less harm to nature and to reduce the use of heavy metals like lead. However, data on pollution levels caused by recreational fishing in marine and freshwater environments are difficult to obtain and limited. Pollution caused by recreational fishing, which is often carried out away from public view, is not considered significant compared to general aquatic pollution. In conclusion, to the environmental impacts of recreational fishing, it is important to raise awareness through education, promote alternative natural materials, enforce legal regulations, and implement inspections.

Keywords: Recreational Fishing, Plastics, Pollution, Sustainable Fishing, Environment

1. INTRODUCTION

Plastics and microplastics (<5mm) in marine and freshwater environments have become a major concern due to their harmful effects on aquatic ecosystems, the fishing and tourism industries, and human health [1 and 2]. These impacts are attributed to the rapid increase in plastic production, widespread use of single-use packaging materials, and the consequent rise in waste generation. While land-based marine debris used to be one of the most significant contributors to aquatic pollution, pollution caused by recreational angling has recently gained importance [2, 3, and 4]. However, determining the level of pollution caused by recreational angling in both marine and freshwater environments is challenging and limited [5], primarily due to spatial and temporal variations in data collection. Activities and industries such as commercial fishing, aquaculture, and maritime transportation also contribute to pollution in marine and freshwater systems. Notably, discarded fishing gear from commercial fishing results in ghost fishing, which continues to harm aquatic life [6]. Since these fishing tools are often made from synthetic materials, they persist in the aquatic environment for many years. Over time, these synthetic materials degrade into micro-level particles, adversely affecting aquatic organisms [7]. These micro-level materials, once ingested by aquatic organisms, are

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passed on to other species higher in the food chain, including humans, through predation [8].

Globally, studies on waste generated by recreational fishing activities are limited [9]. Some studies classify this activity as terrestrial because it occurs at the boundary between land and sea, contributing to the scarcity of data [10]. Another reason for the limited data is that pollution from recreational angling conducted in remote areas is often perceived as insignificant compared to general marine pollution [11]. Hooks, one of the materials used in recreational angling, are designed to lodge in and snag on the bodies of organisms. As a result, discarded hooks negatively impact both aquatic and terrestrial organisms during and after the fishing activity [12].

This impact occurs in two primary ways. First, the hooks may entangle or attach to the limbs of organisms, adversely affecting their survival. Second, they may enter the bodies of organisms, causing internal injuries and toxic effects [13]. Even when not intentionally discarded, such waste harms all marine and aquatic organisms [14].

Recreational angling has significant socio-economic importance in some countries [15] and is a growing sector. This growth is expected to lead to increased pollution in the future. Swallowed hooks or those caught on ropes can harm wildlife, causing gastrointestinal perforations, blockages, sepsis, toxicity, and even death [3]. A study in Korea identified recreational angling waste as the primary factor negatively affecting wildlife in 60% of cases [10]. Similarly, a study in the United States found that recreational fishing waste (e.g., ropes, fishing lines, hooks, and lead) significantly impacts benthic invertebrates [16]. Given the difficulties in retrieving discarded fishing lines and hooks and the risks they pose to wildlife through entanglement and ingestion, specific strategies must be developed to minimize these impacts.

Lead, commonly used in recreational fishing, is one of the heavy metals that negatively impact the environment. When ingested by organisms, it combines with certain enzymes, leading to severe toxic effects [11 and 17]. Studies have reported that waste in commercial and recreational fishing areas is more abundant than in areas without such activities [10 and 18].

Recreational angling is a highly popular activity in our country. Due to the length of our coastline and the richness of our inland waters, our geography is well-suited for this activity. While the exact number of recreational anglers is unknown, it is widely recognized that this activity is common in lakes, ponds, rivers, and coastal areas across all regions of the country. Recreational angling, which is particularly popular among people living near the coast, offers the opportunity to connect with nature and relieve stress, making it an activity that people enjoy and cannot give up [19, 20, and 21].

The number of individuals participating in this activity is increasing daily. In many countries, recreational fishing is one of the key elements used to boost the tourism sector [15, 22, and 23]. It contributes to the national economy by generating foreign currency through tourism and fosters social integration by revitalizing regional economies when organized for both domestic and international tourists. Recreational angling is a rapidly growing and increasingly popular activity worldwide. According to FAO data, global participation in this activity is estimated to range between 220 and 700 million people. Recreational fishing has significant socio-economic effects in some countries, where participants spend considerable amounts on this activity [24].

Unregulated destruction of wetlands in our country leads to numerous irreversible problems. Many settlements near wetlands pollute

these areas with various human-induced contaminants or alter their physical structure, thereby changing their biological makeup.

2. RESEARCH SIGNIFICANCE

Studies on pollution caused by amateur angling activities worldwide have been limited. Especially in studies conducted in marine environments, amateur angling is known as a developing sector. For this reason, it is known that this developing sector causes pollution both in marine environments and freshwaters. Studies should be intensified to calculate and minimize these plastics and lead wastes.

Highlights

- It is necessary to create an alternative to plastics, which constitute a source of microplastics in amateur angling resources.
- Natural materials should replace lead material.
- Studies should be conducted to determine this pollution load in marine and fresh waters. To reduce these loads, amateur fishing associations and federations should be informed.

3. MATERIAL AND METHOD

This study was carried out by compiling the literature to study the pollution caused by amateur angling, which is neglected in our country. In this review, photographs used in angling and causing negativity to aquatic life were taken and interpreted from scientific articles and the web environment.

4. FINDINGS AND DISCUSSIONS

This review study compiles research on the impact of pollution caused by recreational angling in the waters of our country. Accordingly, recreational angling is a developing ecotourism activity in our country, and it is known that synthetic materials, heavy metal waste such as lead, and plastic-derived waste are used extensively in this activity. Particularly in inland waters with potential as drinking water sources, careful management of such waste is necessary, and recreational anglers must be educated to minimize these pollution effects. In Figure 1, we observe that the damage is not limited to aquatic life but also affects birds that rely on water for feeding. As a result of these damages, the affected organisms may lose their feeding habits, leading to their death.

Figure 1. The harm caused to a bird by fishing-related waste pollution [26]

In Figure 2, the struggle of a sea turtle to survive due to fishing waste is depicted. This waste can originate from either commercial fishing or recreational angling; as such, net fragments can be found in

both types of fishing activities. Regardless of the source, this waste hinders the vital activities of marine organisms.

Figure 2. An example of the impact of fishing waste on aquatic organisms [27]

Marine debris, composed of human-made materials discarded into seas, rivers, and wetlands, negatively impacts marine environments and ecosystems [28]. Materials such as nylon, polyethylene, and polypropylene, commonly used in fishing gear, can persist in the environment for years without degrading. These materials pose a significant threat to aquatic ecosystem organisms. Waste from recreational fishing activities can provide a hard substrate for settling pollutant species such as Polychaeta (marine worms), hydrozoans, and barnacles. This disrupts the natural balance of aquatic ecosystems and adversely affects ecosystem health. Therefore, implementing effective measures to reduce and control marine debris is critical [1].

Figure 3 shows an image of a tangled fishing line left behind after fishing activities. Its presence near the water not only poses a risk to aquatic life but also endangers terrestrial organisms by entangling them, leading to potentially fatal consequences.

Figure 3. Waste from recreational fishing activities [29]

Plastics discarded into aquatic environments can lead to severe problems in the future. Over time, these wastes degrade into microplastics [30]. When introduced into aquatic environments, these wastes can entangle the propellers of marine vessels involved in fishing or other activities or clog water intake hoses, causing significant operational issues [31]. As a result of these adverse effects, the efficiency of targeted fishing activities may decrease, and substantial economic losses may occur due to damaged or lost fishing gear. A previously less understood but now emerging threat is the pollution caused by recreational fishing activities, which affects fish and other marine animals [9]. This situation endangers the health of aquatic ecosystems and marine organisms while also leading to economic losses. Therefore, urgent measures must be taken to control and reduce plastic waste in aquatic environments (Figure 4).

Figure 4. A fish trapped in a plastic bottle cap after growing from a small fish that was once inside the bottle [32]

Plastics are widely used by consumers due to their lightweight, low cost, long lifespan, and excellent insulation properties. However, recent studies have shown that, in addition to these benefits, plastics have many harmful environmental effects. Waste derived from plastics tends to break down into smaller particles under the influence of light rather than degrading into molecular or biologically biodegradable compounds, negatively impacting marine and freshwater ecosystems. The economic damage caused by plastic waste in the world's oceans is estimated at 22 billion Euros [33]. While there has been an increase in research on plastic waste in marine environments, the impact of plastic-based waste in freshwater ecosystems is still not well understood. Some critical issues that are relatively well understood in marine environments are often overlooked or underestimated in freshwater systems [34]. One significant recreational activity carried out in coastal areas worldwide is marine recreational fishing. Considering its potential impact on marine ecosystems, this activity has been gaining increasing attention in recent years. However, the growing popularity of recreational sea fishing can also negatively affect marine ecosystems and fish populations. Therefore, sustainable management of these activities and efforts to minimize their environmental impacts are essential. Activities should be carried out consciously to minimize harm to nature and protect fish populations.

A common fishing tool used by amateur anglers, known by lawmakers as the "Tırıvırı Parachute" or "Killer Tor," is relatively simple to make but causes significant harm to aquatic organisms. This fishing gear

has become a major issue for both recreational fishing and aquatic ecosystems. Studies have shown that it causes considerable problems for aquatic organisms [12]. Figure 5 illustrates the danger posed by this type of waste, which retains its ability to catch fish until it loses its effectiveness.

Figure 5. The negative impact of Tırıvırı usage on aquatic organisms [36]

Globally, recreational amateur angling encompasses millions of people [37]. However, the contribution of recreational angling to marine debris has been rarely studied. Considering the high number of recreational sea anglers, the significance of waste related to amateur angling emerges. Therefore, the environmental impacts of recreational fishing activities in the sea and their contribution to marine debris should be examined in more detail, and awareness-raising measures should be taken. This will help ensure the protection and sustainable use of marine ecosystems. Research conducted in inland waters has found that a large amount of recreational fishing gear (such as fishing rods, lead weights, and soft plastic baits) is lost and that general waste is also found in fishing areas [38]. These studies concluded that fishing areas contain large amounts of both fishing-related and non-fishing-related waste, and that freshwater fishing can contribute to water pollution [18]. These findings highlight the necessity of conscious efforts to understand the environmental impacts of recreational angling activities in freshwater environments and reduce these impacts.

It has been observed that fishing areas with recreational angling contain more plastic waste compared to areas without fishing [18]. Moreover, human-related waste is more prevalent in places where recreational fishing takes place. Plastic-derived waste is the most commonly observed type of waste in all areas. It is known that plastic-derived waste has harmful effects on aquatic organisms, such as the ingestion of cigarette butts [39]. Additionally, food thrown into fishing areas can attract wildlife, which may lead to animals swallowing or becoming entangled in it. These findings emphasize the importance of the environmental impact of recreational angling and the need for conscious efforts.

Measuring the contribution of amateur angling-related waste to general waste is difficult, but packaging materials, cigarette butts, bottle caps, or similar items detected during recreational fishing are likely sources of this waste [40]. Previous studies have found that many seabird and shorebird species become entangled in fishing lines and ingest fishing materials left behind by recreational anglers, leading to severe injuries and even death [41]. People may encounter the negative effects of waste on wildlife. These findings highlight the environmental

impacts and potential harm of recreational angling activities on natural life. Therefore, it is crucial to engage in conscious waste management and environmentally responsible behaviors.

When lead weights left in fishing areas are not collected, they can accumulate in these environments, leading to negative effects on wildlife. A study conducted in Korea on the effects of marine debris on wildlife reported that fishing materials such as fishing lines, hooks, and lead weights were responsible for 73% of wildlife injuries, despite being based on voluntary reporting [11]. Such studies are crucial for understanding the effects of fishing materials on natural life and taking environmental protection measures. In Figure 6, a bird (a) takes a piece of broken fishing line to build its nest, a fish (b) dies due to a hook left in its mouth after fishing line breakage, and a fish (c) is entangled in a piece of broken fishing line, leading to its death.

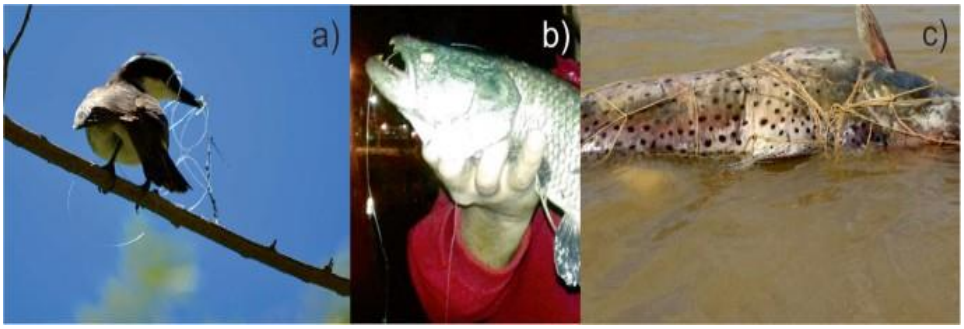

Figure 6. Examples of negative effects of fishing waste [42]

Monofilament lines used in recreational angling are difficult for wildlife to detect because they are transparent, making them vulnerable to entanglement [14]. Once entangled, the animals may become immobile as their ability to move is restricted, preventing them from feeding. This situation can lead to starvation and even death [43]. For aquatic birds, getting tangled in fishing gear is quite easy [44]. Recently, fishing lines have been identified as a source of entanglement in freshwater environments and have even been used as nesting materials by wildlife. Therefore, the negative effects of fishing materials on natural life should be considered, and the disposal of such materials into the environment should be prevented.

Although some studies classify recreational angling activities as terrestrial because they occur at the boundary between land and aquatic environments, some researchers place this issue in aquatic environment studies [10]. Despite their small amount, fishing hooks, for example, are often small enough to be ingested by fish or seabirds and are designed to remain inside marine animals [11]. Fishing hooks often become entangled with obstacles other than the intended prey and are lost along the lines. Additionally, recreational fishing generates single-use plastic waste, such as food containers. Improper disposal of plastic waste can harm aquatic environments, like land-based plastic waste [45]. Therefore, special attention should be given to environmental sensitivity and waste management in recreational angling activities.

5. CONCLUSION AND RECOMMENDATIONS

Few management plans are addressing the responsible disposal of pollution resulting from recreational amateur angling. Globally, some strategies such as cleaning fishing grounds, social campaigns, and placing trash bins have been implemented to tackle this issue.
In a study, participants indicated that placing trash bins was the most preferred solution for reducing fishing waste. It was also suggested

that containers be installed for used fishing gear to reduce improper disposal of fishing rods [46]. The effectiveness of trash bins in reducing fishing gear waste in fishing areas increases when used with informative signs. This will encourage the proper disposal of fishing gear. Moreover, trash bins should be placed at recreational amateur angling spots to make it easier for anglers to dispose of their waste without needing special bags and to allow recyclable materials to be discarded.

The disposal of all hunting materials in nature poses environmental threats. Broken fishing rods, hooks, and other fishing materials can create serious dangers for living creatures in aquatic environments or on the shore. It is known that nets used in hunting cause ghost fishing with the captured prey. The ingestion of hooks or pieces of gear can cause inflammation in living creatures, and the accumulation of heavy metals like lead can create toxic effects concerning ecosystem health. Therefore, it is important to behave consciously and responsibly to minimize the environmental impact of angling activities. The proper disposal of materials used and the preference for alternatives that do not harm nature are crucial for the protection of ecosystems and wildlife.

The release of lead into the environment and its entry into aquatic environments can seriously threaten wildlife. lead weights left in aquatic environments can be accidentally ingested by fish and other aquatic organisms, leading to toxic effects. Lead poisoning can cause serious health problems that threaten the lives of animals. Therefore, using lead in angling is an environmentally and ecologically concerning issue.

Increasing awareness of environmental pollution may encourage anglers to be more environmentally conscious. In this context, a licensing system for recreational angling can raise awareness among anglers about environmental issues and encourage them to act in a solution-oriented manner. Additionally, the integration of fishing with tourism and family leisure activities may lead to more people obtaining fishing licenses. This could increase interest in fishing and make it a more widespread activity. Strengthening or introducing new regulations for the recreational amateur angling licensing system could contribute to environmental protection efforts and ensure the sustainability of fishing. In this way, important steps can be taken for environmental and fish stock preservation [20].

A recreational amateur angling license could provide numerous benefits and support the sustainability of fishing activities. This license system could support environmental protection efforts by ensuring habitat preservation and restoration. It could also support the protection of threatened species and help preserve biodiversity.
The licensing system can play a key role in managing fish stocks, population management, and harvest regulations. Licensed anglers must follow specific rules, making it easier to control pressure on fish populations and ensure sustainable fishing.

Furthermore, the recreational amateur angling license could enhance anglers' experiences and contribute to their education. Through training provided to license holders, environmentally responsible fishing practices could be taught, and awareness could be raised. To encourage social assistance and community participation, the licensing system could also increase anglers' satisfaction and experiences. Additionally, tracking the number of licensed anglers could help monitor the effects of fishing activities and guide future management decisions. Ultimately, a recreational amateur angling license could provide significant benefits in environmental protection, species conservation, fish stock management, anglers' experiences, and community involvement.

Therefore, implementing or strengthening such a licensing system could be an effective tool for sustainable fishing management.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to be disclosed.

FINANCIAL DISCLOSURE

The authors declare that this study has received no financial support.

DECLARATION OF ETHICAL STANDARDS

The authors of this article declare that the materials and methods used in this study do not require an ethical committee.

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