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Clinical Review

Impacts of Abandoned, Lost, or Discarded Fishing Gear (ALDFG)

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Introduction

The widespread adoption of plastic as a versatile and durable material has significantly eased everyday life. However, the global surge in plastic consumption has resulted in a substantial increase in plastic waste, particularly in marine ecosystems, posing a significant environmental challenge. The fishing industry notably contributes to marine plastic debris as abandoned, lost, or discarded fishing gear (ALDFG). It is also indicated as ghost nets or derelict fishing gear (DFG) which includes fishing equipment or its parts that are deliberately discarded, abandoned, or accidentally lost in marine ecosystems [1]. The generation, dispersal, and build-up of DFG differ considerably across different locations and time periods, influenced by factors such as the type of fisheries, fishing intensity, coastal geomorphology, environmental conditions, and the waste management practices of fishers [2]. Research reveals that, globally, around 5.7 percent of all fishing nets, 8.6 percent of all traps, and 29 percent of all lines are lost yearly [3]. The consequences of this ALDFG affect a range of marine species within the ocean and individuals who rely on the ocean for multiple activities, including their livelihoods through fishing, tourism, and navigation.

Here is an overview encompassing the environmental, economic, and social impacts of the issue, alongside the mitigation strategies aimed at addressing it.

Environmental impacts

- **Ghost Fishing and ingestion**: ALDFG continues to trap and kill marine organisms long after being lost [4] before becoming physically damaged or heavily colonised by incrusting biota, thus losing their catching ability [5]. This phenomenon, known as ghost fishing, affects a wide range of species, including commercial and non-commercial fish, crustaceans, birds, marine mammals, and turtles [6]. Variations in exposure time and the type of fishing gear make it challenging to evaluate its impacts [7] highlighting that not all ALDFG remains effective in capturing fish, while other impacts may also be significant [8]. The ingestion of debris poses a significant risk to marine organisms, particularly cetaceans and turtles. Alarmingly, 45% of marine mammals listed on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species have experienced adverse effects due to marine plastic debris and ALDFG, primarily as a result of ingestion and entanglement [9]. It is estimated that a single discarded fishing net can lead to the deaths of around 500,000 marine invertebrates, 1,700 fish, and 4 seabirds [10].
- **Damage and modifications of marine habitats**: ALDFG, especially nets, and traps, can cause physical damage and modification to sensitive habitats such as coral reefs, seagrass beds, and the seafloor, leading to the loss of biodiversity and ecosystem function by limiting gas exchange, providing an artificial substrate etc. Long-term contact with ALDFG may lead to pulling, skin abrasion, open wounds, infection etc. and eventually lead to the death of the ecosystem [11].
- **Pollution and debris accumulation**: ALDFG contributes to marine pollution accounting for 20% of marine debris in the ocean [12], adding to the global issue of marine debris. It can also fragment into microplastics if subject to UV radiation and mechanical abrasion, which are ingested by marine organisms, potentially entering the food chain and causing harm to aquatic and terrestrial life [13].

- **Introduction of invasive species**: ALDFG can serve as a vector for the spread of invasive species by providing a surface for organisms to attach to and be transported across ecosystems. These invasive species can lead to profound consequences, including the modification of habitats, disruption of native species interactions, significant mortality among native species, competition with them, and serving as carriers of diseases [9].

Economic impacts

- **Reduced fish stocks**: Ghost fishing reduces fish stocks, impacting fisheries and leading to economic losses for fishers and communities reliant on fishing for their livelihoods. Takehama [14] estimated that marine debris caused damage amounting to 0.3% of Japan's fish catch. Mouat., et al. [15] found that 86% of fishermen reported reduced catches, 82% reported contaminated catch, and 95% reported snagged gear due to marine litter.
- **Damage to vessels and equipment**: ALDFG can entangle propellers and rudders, causing damage to vessels and posing safety risks to mariners. When a vessel's propeller, rudder, jet drives, or water intakes are fouled or entangled, it can impair stability and manoeuvrability, particularly in low visibility conditions, which increases the risk of collision with larger vessels [7]. Debris on the seafloor or below the surface can also snag anchors and equipment deployed from research vessels and fishing trawlers, endangering the vessel and its crew. Collisions with ALDFG may damage the propeller shaft seal, potentially requiring hazardous underwater clearance by divers [7].
- **Costs of clean-up and gear replacement:** The processes of locating, retrieving, and either disposing of or recycling ALDFG from marine environments and the replacement of lost gear are costly for governments, organizations, and fishers when considering the expenses associated with allowing ALDFG to persist in marine ecosystems. Losing any parts of the gear, or the gear is temporarily misplaced or tangled damages the net, which can result in a scenario where the effort to retrieve it reduces fishing time and raises fuel costs [7].

Social impacts

- **Community livelihoods:** In regions where communities depend on fishing, the loss of fish stocks due to ghost fishing and habitat degradation can lead to reduced employment and food security.
- **Cultural impact:** Fishing is often a cultural practice in coastal communities, and the loss of fish and marine biodiversity can erode cultural heritage and traditional ways of life. Additionally, the debris can adversely impact recreational activities, tourism, and diving experiences linked to discarded equipment located on shorelines and within marine ecosystems.
- **Human safety:** ALDFG can pose risks to human safety, particularly for fishers, divers and those involved in the maritime industry, through entanglement and accidents.

Mitigation strategies

- **Fishing gear marking:** The practice of marking fishing gear is an essential component in the management of ALDFG. By facilitating the tracking and recovery of lost gear, marking gears plays a vital role in reducing the incidence of ALDFG [16].
- **Innovative gear design:** Developing biodegradable or eco-friendly fishing gear could help reduce the impact of ghost fishing. According to a recent study by Cerbule [17], substitution of synthetic fibres with biodegradable materials such as PBSAT did not result in a reduced catch efficiency of gillnets and longlines. Consequently, this approach may prove to be a viable method for addressing the issue of ALDFG.
- **Policy and legislation:** Strengthening international and local regulations regarding gear disposal, gear marking, and ghost fishing can help mitigate the impacts of ALDFG. Implementing structures that reduce burdens, and the challenges faced at port disposal facilities can incentivize fishers to properly dispose of their gear.
- **Education and awareness:** Raising awareness among fishers and communities about the impacts of ALDFG and promoting optimal gear management can foster more responsible practices.

Conclusion

ALDFG poses a significant threat to environmental, economic, and social systems, underscoring the need to effectively manage and minimize the impact. These consequences extend to all life forms within the biosphere, although the effects vary among species. To protect organisms and reduce the severity of this issue, it is crucial to implement mitigation strategies and conduct further research. Key solutions include improved gear marking and design, modifications of fishing gears, implementation of strict regulations, and educating people on its consequences and about the proper gear disposal to mitigate its effects.

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