



Fishing Gear That Leaves Less Behind: Innovations for Safer, More Sustainable Seas

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ABSTRACT

Abandoned, lost or otherwise discarded fishing gear (ALDFG), commonly known as “ghost gear,” is a persistent source of marine pollution and a significant threat to marine organisms and habitats. Although fishing gear is designed for efficient and durable operation, its loss or abandonment can allow nets, lines, pots and ropes to continue catching or entangling marine animals long after they have left the control of fishers. This article highlights emerging solutions to reduce this impact, including biodegradable fishing gear, gear marking, tracking and navigation technology and recycling of discarded nets. Wider adoption of these innovations can support sustainable fisheries by reducing marine pollution, protecting biodiversity and minimizing resource loss. Designing fishing gear for durability, recovery, recycling and reduced environmental impact can promote a more circular and resilient fisheries sector, while safeguarding healthy oceans, sustainable livelihoods and long-term food security.

KEYWORDS

Biodegradable fishing gear; bycatch reduction; circular economy; ghost gear; marine plastic pollution

Introduction

Fishing gear is designed to catch aquatic organisms efficiently, but when it is abandoned, lost or discarded (ALDFG), it can continue to catch and kill marine life long after it has left the hands of fishers. This phenomenon, known as “ghost fishing,” makes lost fishing gear a persistent threat to marine biodiversity, habitats and ocean health. ALDFG also contributes substantially to marine litter and can fragment into microplastics, creating impacts that extend well beyond the initial loss of the gear. The scale and persistence of the problem highlight the need for a fundamental shift in how fishing gear is designed and managed. Gear loss can result from adverse weather, seabed entanglement, interactions with other fishing operations, operational pressures and economic constraints. Bottom-contact and unattended gear, including trawls, traps, pots and gillnets, are particularly vulnerable to loss. Once lost, synthetic fishing materials can remain in the marine environment for decades or even centuries, while continuing to interact with marine organisms. These challenges are driving a new generation of innovation focused not only on preventing gear loss, but also on reducing the consequences when loss occurs. The emerging approach considers fishing gear across its entire life cycle—from design and material selection to deployment, retrieval, recovery and end-of-life management. The innovation agenda is therefore built around three complementary priorities: better prevention, safer materials and more effective recovery (Pandey et al., 2025).

Innovations That Prevent Loss

Preventing the loss of fishing gear represents the most cost-effective strategy for mitigating ALDFGs impacts. Preventative measures are generally more economically efficient than remedial interventions, while also contributing to broader fisheries management objectives, including improved operational efficiency, resource conservation, and long-term sustainability.

Gear Marking: International agreements increasingly encourage the marking of fishing gear to help identify its owners and promote the reporting of lost gear. Traditional methods, such as flags, reflectors, buoys, inscriptions, and tags, are now being complemented by electronic buoys and other electronic marking technologies being tested in different fisheries. In addition to helping identify and recover lost gear, proper marking makes passive fishing gear more visible to passing vessels, reducing navigational risks and the likelihood of accidental damage or gear loss (He and Suuronen 2018).

Tracking and navigation technology: GPS and seafloor mapping reduce the chance of losing gear through accidental contact with the seabed. Radar reflectors and radio buoys on fishing gear reduce the risk of loss, avoid interactions with towed gear, and make lost gear easier to locate, while markers of gear position below the surface reduce the risk of damage from being cut by passing vessels (Macfadyen et al. 2009).

Design, inputs, and rules of the fishery: Reducing gear loss requires improved gear design, appropriate material selection, and responsible fishing practices. Limiting fishing effort and soak time, regular gear monitoring and retrieval, and spatial-temporal separation of fishing operations can minimize gear loss and ghost fishing. Effective surveillance, enforcement, and deterrents against IUU fishing are also essential to prevent intentional gear abandonment and at-sea discarding (Pandey et al., 2025).

Innovations That Make Lost Gear Less Deadly

As gear loss cannot always be completely avoided, next-generation fishing gear is being developed to minimize its environmental impacts through biodegradable materials, escape mechanisms, and rapid deactivation or neutralization after loss.

Biodegradable and less durable gear: The persistence of conventional plastic fishing gear contributes to long-term aquatic pollution and increases the risks of entanglement, ingestion,

and ghost fishing. To address these impacts, biodegradable alternatives are being explored for nets, fishing lines, pots, lures, and soft lures. A key approach is to modify the material composition of fishing gear so that it maintains adequate mechanical strength and fishing efficiency during normal operation but degrades more rapidly after loss (Byrnes and Dunn, 2020).

Recent research has investigated biodegradable polymers such as polybutylene succinate (PBS) and polybutylene adipate terephthalate (PBAT) as potential alternatives to conventional nylon in fishing nets, pots, and lines. As the material degrades, the loss of structural integrity can reduce the fishing efficiency of derelict gear and facilitate the escape of trapped organisms. Similarly, degradable escape panels and release components in traps can provide an effective means of rapidly reducing ghost-fishing activity. Biodegradable lures and soft lures can further reduce the persistence of fishing-related plastic debris in aquatic environments (Deroine et al., 2019; Byrnes and Dunn, 2020; Pandey et al., 2025). The major challenge is to achieve an appropriate balance between operational strength, fishing performance, durability, and controlled degradation after gear loss. Despite these challenges, biodegradable materials and gear designs offer a promising pathway towards reducing the environmental persistence and ecological impacts of lost fishing gear.

Bringing Gear Back: Retrieval, Reporting, and Circularity

Recovery of lost fishing gear is an important component of ALDFG management, as timely retrieval can prevent continued ghost fishing, habitat damage, and navigational hazards. Accurate reporting of gear loss is therefore essential for identifying high-risk areas, understanding the causes and scale of gear loss, and enabling targeted recovery. A non-punitive reporting system can encourage fishers to report losses without fear of penalties, thereby improving opportunities for retrieval. The effectiveness of recovery also

depends on gear type and timing; for example, gillnets may require rapid retrieval because their fishing efficiency can persist after loss, whereas lost traps and pots may remain recoverable over longer periods. Effective retrieval should be supported by accessible port reception facilities, dedicated recovery programmes, and appropriate economic incentives for fishers to return lost, damaged, or end-of-life gear. Recovered gear can subsequently be directed towards reuse, recycling, or other material-recovery pathways, supporting a more circular fishing-gear economy. Training and awareness programmes can further improve fishers' capacity to prevent gear loss and safely recover ALDFG. At the international level, initiatives such as the Global Ghost Gear Initiative (GGGI) promote best-practice approaches for preventing, retrieving, and managing lost fishing gear across the seafood supply chain (Pandey et al., 2025).

Governance: The Framework That Lets Innovation Work

Innovation can achieve its full potential only when supported by an effective governance framework. An international policy architecture for addressing abandoned, lost and discarded fishing gear (ALDFG) already exists in part. The International Maritime Organization (IMO), through MARPOL, provides the principal international framework for preventing pollution from ships, while the United Nations Environment Programme (UNEP) addresses ALDFG within the broader context of marine litter. The Food and Agriculture Organization of the United Nations (FAO) promotes responsible fishing practices through its Code of Conduct for Responsible Fisheries, complemented by the Voluntary Guidelines for the Marking of Fishing Gear. These guidelines distinguish abandoned gear as fishing gear unintentionally left at sea under unforeseen circumstances, lost gear as gear that inadvertently goes out of the owner's control, and discarded gear as gear released without an attempt at recovery.

Despite these existing instruments, ALDFG remains a persistent challenge, indicating that policy frameworks alone are not sufficient. Effective management must account for the diversity of fishing gears, operating environments, target species and socio-economic conditions across fisheries. Consequently, a uniform approach is unlikely to be effective. Instead, successful interventions require fishery-specific strategies developed through collaboration among fishers, fishing industries, resource managers, researchers and other relevant stakeholders. Such participatory approaches can improve both the practicality of interventions and their acceptance at the community level (Pandey et al., 2025).

Conclusion

Addressing abandoned, lost and discarded fishing gear requires a shift from simply managing lost gear to preventing its loss and reducing its impacts throughout its life cycle. No single innovation can solve the problem; effective solutions must combine improved gear design, marking and tracking, responsible fishing practices, timely retrieval, safer materials, and recycling. The success of these approaches depends on practical, affordable solutions developed with fishers and supported by effective reporting systems, recovery incentives, port facilities and sound governance. Ultimately, sustainable fishing gear is not only gear that performs efficiently at sea, but gear that is designed to be recovered, reused or recycled—and to leave less behind when its working life ends. Bringing science, innovation, policy and fishing communities together can help build healthier oceans and more resilient, sustainable fisheries.

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