

Implications of Ghost Fishing on Marine Biodiversity

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ABSTRACT

Ghost fishing has grown worse because modern fishing practices uses more durable synthetic materials which allow gillnets and traps and longlines and trawl nets to stay active in ocean waters for longer durations. The fishing equipment keeps capturing numerous marine species which results in ongoing animal deaths and large amounts of bycatch and discards. These effects have created the situation of extreme damage to endangered and vulnerable species. Ghost gear not only results in direct animal deaths but it also destroys habitats by putting permanent damage on coral reefs, seagrass beds and benthic ecosystems. The ecological effects cause disturbances to trophic relationships and they lead to population decline and genetic diversity loss which combine to weaken ecosystem resilience. Ghost fishing gear represents one of the major contributors to the pollution of oceans with plastic waste. The synthetic materials break down into microplastics which then enter marine food systems to accumulate throughout all levels of the ecosystem while creating environmental risks and possible dangers to human health. The solution for this problem depends on organizations which will establish unified plans that use both technological advancements and regulatory systems and international partnerships to achieve their goals. The article presents information about ghost fishing by describing its origins and operational processes and environmental effects and management methods.

INTRODUCTION

Ghost fishing denotes the ongoing capture of marine organisms which occurs through abandoned, lost, or discarded fishing gear (ALDFG) that remains active in aquatic environments without human control. The problem has become a worldwide concern because industrial and small-scale fisheries are expanding their operations while fishermen use permanent synthetic materials due to their durability, which include nylon and polyethylene and polypropylene to construct their fishing nets. The fishing nets, traps, lines, and other equipment which fishermen discard at sea evolved into ghost gear now known as ghost nets. The system works as a passive fishing device which captures all marine creatures within its operating range from fish to sea turtles, marine mammals, seabirds and crustaceans. Global fisheries expansion together with increased non-biodegradable material usage intensifies the problem because these materials enable gear to function from multiple months up to several years. Approximately 6,40,000 tonnes of fishing gear enter marine environments each year according to estimates which constitute almost 10% of total marine litter which makes ghost fishing an important cause of marine pollution and biodiversity decline. The invisible and persistent nature of ghost gear creates an extremely hazardous situation because it traps multiple organisms which results in injuries and starvation and suffocation and death and it damages marine ecosystems. Effects of this debris on marine fauna and ocean health have become a critical environmental priority, especially for threatened and endangered species (Drinkwin, 2022).

Sources of Ghost Fishing Gear

The production of ghost fishing gear results from both human activities and environmental conditions which create the suitable

environment for gear production. The most frequent cause of accidental loss during fishing operations occurs in fishing areas which experience fishing activity with trawl gear, gillnets, traps and pots have all been identified as having a high risk of being lost (Gilardi *et al.*, 2020; Gilman *et al.*, 2021). Fishing gear abandonment happens due to several reasons such as weather events which include storms, cyclones and strong ocean currents which displace or damage the equipment. Fishermen who operate illegal, unreported and unregulated fishing activities use gear which they discard to prevent law enforcement from detecting their illegal operations. Fishermen choose to abandon damaged gear at sea because they face heavy costs and lengthy repair procedures which result from economic limitations. The absence of standardized gear marking and tracking systems further exacerbates the problem by hindering identification and recovery efforts. The combination of these factors creates a situation where large quantities of ALDFG accumulate in marine environments which mainly occur in coastal regions and fishing zones that face intense fishing activities.

Mechanism of Ghost Fishing

Ghost fishing functions through its ability to continuously trap marine animals through the permanent fishing gear which remains in the ocean after its loss or abandonment. Gillnets function as invisible barriers which remain suspended in the water to capture fish and marine mammals and other sea creatures. Traps and pots remain in operation because they continue to capture crustaceans and fish without providing any way for the captured creatures to escape. Ghost fishing operates through a process that enables captured organisms to attract predators while they remain stuck in fishing equipment. The cyclical process enhances the operational

efficiency of ghost fishing gear which enables it to capture marine organisms for multiple consecutive times. Synthetic materials have a long lifespan which allows fishing equipment to remain active for several months to multiple years until it becomes unusable. Ghost gear travels through ocean currents to create environmental damage that reaches various ecosystems throughout the oceanic region. The persistent and dynamic nature of ghost fishing makes it an environmental problem which groups actively work to control.



(Credit: Josephine Jullan)

Impacts On Marine Biodiversity

Continuous Mortality and Bycatch

Ghost fishing creates most of its damaging impacts through its unyielding and unmonitored death toll which affects many different species of marine life. Ghost gear captures both target species and non-target species which also includes juvenile fish and fish that hold no economic value due to its unrestricted operation in all times and all places. The fisheries stock assessments and management efforts get disrupted through unrecorded bycatch, which generates substantial bycatch that remains undocumented. Caught organisms in ghost gear die from multiple causes which include starvation, predation, and physical injury and suffocation. The removal of biomass from marine ecosystems causes fish stocks to decline while it diminishes the overall productivity of the ecosystem. The unrecorded marine resource mortality from this process

leads to overfishing, which threatens the sustainability of our marine resources.

Impact on Endangered Species

Ghost fishing poses great risks to endangered species and protected species which include sea turtles, dolphins, whales, seabirds, sharks and rays. These species exhibit particular vulnerability because they migrate through fishing areas which they frequently cross. Ghost gear entanglement can lead to death because it makes drowning, restricted movement and impaired feeding and severe injuries happen. For species with low reproductive rates and long-life cycles, even minimal increases in mortality can have significant population-level consequences. The human activity of ghost fishing adds to the existing dangers which already threaten protected species through its impact on marine turtle populations. In certain areas of the ocean, ghost nets represent the main cause of death for both marine turtles and other protected species. The world's smallest porpoise, the Vaquita, is nearing extinction due to entanglements with lost gill nets (Pandey *et al.*, 2025).

Habitat Destruction

Ghost fishing gear not only directly harms marine life but it also destroys marine habitats through its physical destruction. The drifting and entangled gear poses the most serious threats to coral reefs and seagrass meadows and benthic ecosystems. Nets become stuck on coral structures, which results in coral damage through breakage and abrasion and smothering, leading to a decrease in coral cover and growth and reproductive capacity of coral. Ghost gear behaves like a dragging object that moves along the seabed because of currents, which results in sediment disturbance and benthic organism damage. The critical nursery functions of seagrass beds result in their destruction through two processes which

include uprooting and suffocation caused by debris accumulation. The process of habitat degradation results in a loss of biodiversity because numerous marine species rely on these habitats for their essential needs of shelter, feeding and breeding. ALD hook-and-line fishing which serves as a standard method for both commercial and recreational use achieves low capture efficiency while creating risks for marine animal entanglement and habitat destruction at complex inshore sites such as reef structures (Macfadyen *et al.*, 2009).

Genetic and Population Effects

Ghost fishing produces ecological effects that persistently impact population distribution and genetic material diversity within ecosystems. The continuous removal of individuals from the population results in both population decline and changes to the demographic makeup of the group. This situation leads to both decreased reproductive output and reduced recruitment rates. The decrease of genetic variability in small or isolated populations creates a higher risk of inbreeding which decreases their capacity to adapt to environmental changes that include climate variations and ocean acidification. The genetic impacts and population impacts will eventually result in local extinctions which will decrease ecosystem resilience and worsen the effects of human environmental changes.

Contribution to Marine Pollution

Link with Plastic Pollution

Ghost fishing gear constitutes a major portion of marine plastic pollution because it leads to substantial increases in marine debris that accumulates within marine habitats. Synthetic fishing materials demonstrate exceptional longevity because they maintain their presence within oceans for multiple decades without breaking down. Coastal regions, open oceans and deep-sea environments function as accumulation zones where these materials

create massive debris patches that block marine organisms and disrupt ecosystem operations. Ghost gear serves as the most dangerous type of marine debris because it causes two harmful effects, which include both physical entanglement and pollution.

Microplastic Formation

The combination of ultraviolet light exposure and mechanical wear and natural biological processes lead to the breakdown of ghost fishing gear into tiny fragments that become microplastics. Marine ecosystems contain these particles, which marine organisms from plankton to large fish can ingest. Microplastics that come from fishing gear contain various additives and chemicals which can escape into nature and create toxicological threats. Small particles remain in the environment because they are both difficult to eliminate and maintain their presence for extended periods.

Bioaccumulation in Food Webs

Microplastics from ghost gear enter the marine food web when plankton and small invertebrate species consume them at the initial lowest trophic level. Through the process of predation, these particles move through multiple trophic levels which leads to bioaccumulation and biomagnification. Microplastics and their associated toxins build up in substantial amounts within higher trophic organisms, which include commercially valuable fish and marine mammals. The presence of microplastics in marine life threatens their health and survival while also creating potential health dangers for humans who consume seafood. The distribution of microplastics demonstrates that ghost fishing generates extensive effects which extend beyond its immediate damage to the environment.

Mitigation Measures

The protection of marine biodiversity from ghost fishing requires a complete solution

which unites technological progress with regulatory systems and active stakeholder participation. Biodegradable fishing gear provides an effective solution because it naturally disintegrates over time which helps reduce the environmental effects of lost fishing equipment in oceans. The use of escape mechanisms, which include biodegradable panels and weak links designed for traps and pots, enables organisms that get trapped to break free after the gear becomes lost, which helps reduce ongoing death rates. Fishing gear retrieval operations gain substantial improvements through technological innovations which include GPS gear marking systems and radio-frequency identification (RFID) and satellite-based fishing gear tracking systems. The systems enable fishers to take responsibility for their actions while they support efficient retrieval operations which can start immediately. The process of mitigation depends on regulatory measures to establish its fundamental framework. Governments and fisheries management bodies have introduced policies that require fishermen to report lost gear and follow proper disposal methods while banning specific dangerous gear types. The introduction of gear marking guidelines, which were created by the Food and Agriculture Organization (FAO), enables organizations to identify gear ownership while decreasing the practice of illegal gear discarding. The process of retrieving ghost gear from oceans requires organized retrieval programs and cleanup campaigns which work together with local communities and non-governmental organizations and government bodies.

Global Initiatives for Control of Ghost Fishing

The expanding issue of ghost fishing which harms marine biodiversity now receives attention from multiple global initiatives established to fight against this problem. The Food and Agriculture Organization (FAO)

established the Voluntary Guidelines on the Marking of Fishing Gear which enables better gear tracking while reducing gear losses and promoting sustainable fisheries management practices. The guidelines establish a framework through which countries can create monitoring and reporting systems that their organizations must achieve. The Global Ghost Gear Initiative stands as another important initiative which creates a multi-stakeholder alliance that unites governments, industry, academia, and civil society to fight against ghost gear throughout the world. GGGI builds evidence-based research while it promotes best practices and runs projects that recover and recycle lost fishing gear. The organization conducts awareness programs while it develops policy standards which protect against fishing gear loss. The UN Environment Programme addresses ghost fishing within the broader context of marine litter and plastic pollution. UNEP establishes international partnerships to create policies and regional waste management strategies which target marine debris removal including ghost gear. Organizations like the National Oceanic and Atmospheric Administration (NOAA) execute extensive derelict gear removal operations while they study how ghost fishing affects ecosystems and economies. The international programs deliver their single message which demonstrates that worldwide collaboration combined with technological advancement and policy creation efforts brings resolution to the ghost fishing problem.

CONCLUSION

Ghost fishing operates as a constant invisible menace which damages marine biodiversity and ecosystem health through its destructive activities. The situation creates multiple problems because it kills organisms while destroying their habitats and interrupting natural ecological systems and causing microplastic pollution which accumulates in marine environments. The problem has grown

into complicated challenges which need urgent solutions despite growing knowledge about it and the development of various methods to reduce its effects. The effective elimination of ghost fishing demands that all parties need to work together through technological advancements and policy implementation and stakeholder participation and global partnerships. The continuous existence of marine ecosystems and fishery resources depends on immediate long-term methods which tackle ghost fishing problems.

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