

Eco-Friendly Fishing Gear: Reducing Bycatch and Preserving Marine Ecosystems

Inab M. Bala*, Tasaduq H. Shah and Tabish Farooq

Faculty of Fisheries, Rangil, Ganderbal, SKUAST-Kashmir, J&K

*Corresponding Author: enabbalafrmfogy@skuastkashmir.ac.in

Abstract

Bycatch, the unintentional capture of non-target species, poses a significant threat to marine ecosystems and global biodiversity. Traditional fishing methods contribute to the decline of various species, including endangered marine mammals, seabirds, and sea turtles. Eco-friendly fishing gear has emerged as a critical solution to mitigate these impacts by reducing bycatch and preserving marine ecosystems. This article explores various types of eco-friendly fishing gear, including modified nets, hook-and-line systems, traps, and deterrent devices. Through case studies highlighting successful implementations, such as Turtle Excluder Devices (TEDs) in the Gulf of Mexico and seabird bycatch reduction measures in the Southern Ocean, the article demonstrates the effectiveness of these innovations. Despite challenges related to cost and adoption, the future of sustainable fishing lies in continued research, technological advancement, and collaborative efforts. Eco-friendly fishing gear not only enhances the sustainability of fisheries but also plays a crucial role in conserving marine biodiversity for future generations.

Introduction

The world's oceans are a vital source of food, livelihood, and ecological balance, supporting millions of people and a vast array of marine species (Thorne-Miller, 1999). Over the past few decades, the global demand for seafood has surged, driven by population growth, rising incomes, and an increasing awareness of the health benefits of fish consumption. This escalating demand has led to the expansion and intensification of commercial fishing activities across the globe. However, while the fishing industry plays a crucial role in meeting the world's food needs, it also faces significant challenges, particularly concerning the sustainability of marine resources and ecosystems. One of the most pressing issues arising from intensive fishing is bycatch the unintended capture of non-target species during commercial fishing operations. Bycatch can include a wide range of marine life, such as juvenile fish, seabirds, sea turtles, dolphins, sharks, and other marine mammals. These non-target species often suffer injuries or death, leading to substantial ecological consequences. Bycatch is not only a wasteful practice, leading to the unnecessary killing of

millions of animals annually, but it also poses a severe threat to biodiversity (Chaves, 2022). Species that are already vulnerable or endangered are particularly at risk, and the loss of these species can have cascading effects throughout marine ecosystems.

The ecological impact of bycatch extends beyond individual species. The removal of key species, particularly apex predators like sharks and large marine mammals, can disrupt food webs and alter the structure and function of entire ecosystems. Additionally, bycatch can negatively affect the livelihoods of coastal communities that depend on healthy marine environments for their economic well-being (de la Puente et al., 2022). For instance, the capture of juvenile fish that have not yet reached reproductive maturity can lead to declines in fish populations, ultimately threatening the sustainability of fish stocks and the long-term viability of fisheries. Recognizing the severe environmental and economic consequences of bycatch, there has been a growing global movement toward the development and adoption of eco-friendly fishing gear (Solomon and Ahmed, 2016). These innovations are designed to reduce bycatch by making fishing practices more selective, ensuring that only the intended target species are captured while allowing non-target species to escape unharmed. Eco-friendly fishing gear represents a critical component of sustainable fisheries management, as it helps to balance the needs of human populations with the imperative to protect marine biodiversity.

The shift toward eco-friendly fishing gear is part of a broader effort to minimize the environmental impact of fishing activities and promote sustainable practices that safeguard marine ecosystems for future generations (Oachis et al., 2023). This movement has gained momentum due to increasing awareness of the importance of biodiversity, the mounting evidence of the detrimental effects of bycatch, and the recognition that sustainable fishing practices are essential for the long-term health of the planet's oceans. Adoption of eco-friendly fishing gear is not just a technical solution to a specific problem but a vital step toward achieving a more sustainable and responsible relationship with our oceans. As the global community becomes increasingly aware of the need to protect marine biodiversity, the development and implementation of

these innovations will play a crucial role in ensuring that fishing activities contribute to, rather than detract from, the health and resilience of marine ecosystems.

This article delves into the significance of eco-friendly fishing gear, exploring the various types of innovations that have been developed to address the bycatch problem. It examines the different categories of eco-friendly gear, including modified nets, hook-and-line systems, traps, and deterrent devices, and highlights successful case studies where these tools have made a tangible difference in reducing bycatch and preserving marine ecosystems. Furthermore, the article discusses the challenges associated with the adoption of eco-friendly fishing gear, including financial barriers and resistance to change within the fishing industry, and emphasizes the importance of continued research, technological advancement, and collaborative efforts in promoting sustainable fishing practices.

The Problem of Bycatch

Bycatch is one of the most pressing issues in commercial fisheries. It is estimated that millions of tons of bycatch are discarded annually, leading to the unnecessary death of countless marine species. The consequences of bycatch are far-reaching, affecting not only the species caught but also the broader ecosystem. For example, the accidental capture of apex predators, such as sharks and dolphins, can disrupt food webs and lead to cascading ecological effects.

Bycatch also poses a significant challenge to fisheries management and conservation efforts. Many species affected by bycatch are already vulnerable or endangered. For example, sea turtles, several species of which are endangered, are frequently caught in fishing nets. The loss of these animals can have severe implications for their populations and the ecosystems they inhabit.

Eco-Friendly Fishing Gear: An Overview

Eco-friendly fishing gear is designed to reduce bycatch and minimize the impact of fishing on the marine environment. These gears are engineered to target specific species more effectively, allowing non-target species to escape. They can be classified into several categories, including modified fishing nets, hook-and-line systems, traps, and deterrent devices.

1. Modified Fishing Nets

One of the most common types of eco-friendly fishing gear is the modified fishing net. Traditional nets, such as gillnets and trawl nets, are often indiscriminate in what they catch, leading to high levels of bycatch. To address this, researchers and fishers have developed nets with modifications

designed to reduce bycatch. For example, bycatch reduction devices (BRDs) are incorporated into trawl nets to allow non-target species, such as juvenile fish and sea turtles, to escape. Another innovation is the use of Turtle Excluder Devices (TEDs), which are specifically designed to reduce the capture of sea turtles in shrimp trawl fisheries. These devices consist of a grid of bars that direct turtles toward an opening in the net, allowing them to escape while retaining the target catch.

2. Hook-and-Line Systems

Longline fishing is a method that can result in significant bycatch, particularly of seabirds, sharks, and turtles. To mitigate this, various modifications to hook-and-line systems have been developed. Circle hooks, for example, are designed to reduce the likelihood of hooking non-target species, as they are less likely to be swallowed by animals such as sea turtles and sharks (Sales et al., 2010). Additionally, bird-scaring lines, also known as tori lines, are deployed alongside longlines to deter seabirds from diving and getting caught on hooks. Another innovation in hook-and-line fishing is the use of weighted lines, which sink more quickly and reduce the exposure time during which seabirds are at risk. Combined with night setting (deploying lines at night when birds are less active), these measures have significantly reduced seabird bycatch in some fisheries.

3. Traps and Pots

Traps and pots are often considered more selective fishing methods compared to nets and longlines. However, they can still result in bycatch, particularly of species that are attracted to bait. To address this, researchers have developed various modifications to make traps and pots more species-specific. Escape vents are one such modification, allowing non-target species, particularly juvenile fish and crustaceans, to escape from traps (Zhang et al., 2016). Additionally, biodegradable panels can be incorporated into traps to prevent ghost fishing where lost or abandoned traps continue to catch marine life. These panels degrade over time, rendering the trap inoperative and reducing its impact on the environment.

4. Acoustic and Visual Deterrents

Acoustic and visual deterrents are increasingly being used to reduce bycatch, particularly of marine mammals and seabirds. Acoustic deterrents, also known as pingers, emit sounds that are designed to keep dolphins, porpoises, and other marine mammals away from fishing gear. These devices have been

effective in reducing bycatch in gillnet and trawl fisheries. Visual deterrents, such as colored ropes and flashing lights, are used to prevent seabirds from becoming entangled in fishing gear (Lucas and Berggren, 2023). For example, studies have shown that using brightly colored ropes in pot fisheries can reduce seabird bycatch, as the birds are less likely to dive near these ropes.

Case Studies: Success Stories in Bycatch Reduction

The adoption of eco-friendly fishing gear has led to significant reductions in bycatch in various fisheries worldwide. Several case studies highlight the effectiveness of these innovations.

1. Sea Turtle Conservation in the Gulf of Mexico

The introduction of Turtle Excluder Devices (TEDs) in shrimp trawl fisheries in the Gulf of Mexico has been a major success story in bycatch reduction (Nalovic, 2014). TEDs have dramatically reduced the bycatch of sea turtles, a group of species that are critically endangered. Since their mandatory implementation in the 1990s, TEDs have contributed to the recovery of sea turtle populations in the region.

2. Seabird Bycatch Reduction in the Southern Ocean

In the Southern Ocean, longline fisheries have historically had high bycatch rates of seabirds, particularly albatrosses and petrels. The use of bird-scaring lines, weighted hooks, and night setting has significantly reduced seabird bycatch (Jiménez et al., 2019). In some fisheries, bycatch rates have been reduced by over 90%, demonstrating the effectiveness of these measures.

3. Sustainable Crab Fisheries in Alaska

In Alaska, the use of escape vents in crab pots has reduced the bycatch of non-target species, such as juvenile crabs and fish. Additionally, the incorporation of biodegradable panels has minimized the impact of lost or abandoned pots on marine life. These measures have helped maintain healthy crab populations and contributed to the sustainability of the fishery.

Challenges and Future Directions

While eco-friendly fishing gear has made significant strides in reducing bycatch, challenges remain. One of the primary obstacles is the cost of adopting new gear. For many small-scale fishers, the initial investment in eco-friendly gear can be prohibitively expensive. Additionally, there is often resistance to change, as fishers may be reluctant to adopt new methods that they perceive as potentially reducing their catch or requiring significant adjustments to their fishing practices.

To overcome these challenges, it is essential to provide financial incentives and support for fishers to adopt eco-friendly gear. This could include subsidies, grants, or low-interest loans to offset the cost of new equipment. Education and outreach are also crucial, as fishers need to understand the benefits of eco-friendly gear not only for the environment but also for the long-term sustainability of their livelihoods.

Looking to the future, ongoing research and innovation will be critical in developing even more effective and accessible eco-friendly fishing gear. Advances in technology, such as the use of artificial intelligence and machine learning, could lead to the creation of smart fishing gear that can adapt in real-time to reduce bycatch. Collaborative efforts between scientists, fishers, and policymakers will be essential in driving these innovations and ensuring their widespread adoption.

Conclusion

The development and adoption of eco-friendly fishing gear represent a vital step toward more sustainable and responsible fishing practices. By reducing bycatch and minimizing the impact of fishing on marine ecosystems, these innovations contribute to the preservation of biodiversity and the health of our oceans. As the global demand for seafood continues to rise, the importance of sustainable fisheries management cannot be overstated. Eco-friendly fishing gear offers a promising path forward, helping to balance the needs of human communities with the imperative to protect the marine environment for future generations.

References

- Chaves, P. D. T. (2022). Bycatch: causes, impacts, and reduction of incidental captures. In *Life Below Water* (pp. 96-106). Cham: Springer International Publishing.
- de la Puente, S., de la Lama, R. L., Llerena-Cayo, C., Martínez, B. R., Rey-Cama, G., Christensen, V., ... & Valdés-Velasquez, A. (2022). Adoption of sustainable low-impact fishing practices is not enough to secure sustainable livelihoods and social wellbeing in small-scale fishing communities. *Marine Policy*, 146, 105321.
- Jiménez, S., Domingo, A., Forselledo, R., Sullivan, B. J., & Yates, O. (2019). Mitigating bycatch of threatened seabirds: the effectiveness of branch line weighting in pelagic longline fisheries. *Animal Conservation*, 22(4), 376-385.
- Lucas, S., & Berggren, P. (2023). A systematic review of sensory deterrents for bycatch mitigation of

- marine megafauna. *Reviews in Fish Biology and Fisheries*, 33(1), 1-33.
- Nalovic, M. A. (2014). An Evaluation of a Reduced Bar Spacing Turtle Excluder Device in the US Gulf of Mexico offshore Shrimp Trawl Fishery.
- OACHIȘ, A., ZOICAN, Ș., VORNICU, L., ȘMULEAC, L., & PAȘCALĂU, R. (2023). FISHERIES AND ENVIRONMENTAL ISSUES BALANCING RESOURCE UTILIZATION AND CONSERVATION. *Research Journal of Agricultural Science*, 55(4).
- Sales, G., Giffoni, B. B., Fiedler, F. N., Azevedo, V. G., Kotas, J. E., Swimmer, Y., & Bugoni, L. (2010). Circle hook effectiveness for the mitigation of sea turtle bycatch and capture of target species in a Brazilian pelagic longline fishery. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 20(4), 428-436.
- Solomon, O. O., & Ahmed, O. O. (2016). Fishing with light: ecological consequences for coastal habitats. *International Journal of Fisheries and Aquatic Studies*, 4(2), 474-483.
- Thorne-Miller, B. (1999). *The living ocean: understanding and protecting marine biodiversity*. Island Press.
- Zhang, P., Li, C., Li, W., & Zhang, X. (2016). Effect of an escape vent in accordion-shaped traps on the catch and size of Asian paddle crabs *Charybdis japonica* in an artificial reef area. *Chinese Journal of Oceanology and Limnology*, 34(6), 1238-1246.

* * * * *