Bycatch Reduction Devices for Effective Species Conservation: Towards the Indian

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Abstract

Bycatch, the incidental capture of non-target species during fishing activities, presents a significant threat to global marine biodiversity. This article investigates the effectiveness of Bycatch Reduction Devices (BRDs) in addressing this issue, with a specific focus on the Indian context. Bycatch reduction devices (BRDs) have emerged as a promising solution to mitigate this issue while ensuring sustainable fisheries management. This article explores the effectiveness of BRDs in reducing bycatch, particularly in the context of Indian fisheries. It provides an overview of various types of BRDs, their mechanisms, and their applicability in different fishing gears. Additionally, it examines the challenges and opportunities associated with the implementation of BRDs in Indian fisheries and suggests strategies for enhancing their adoption to promote species conservation and maintain ecological balance.

Keywords: Bycatch, Bycatch Reduction Devices, Fisheries Management, Conservation, Indian Fisheries

Introduction

Bycatch, the unintended capture of non-target species during fishing activities, has become a significant concern endangering marine biodiversity on a global scale (Kelleher and Steere, 2016). Given the crucial role of Indian fisheries in supporting livelihoods and ensuring food security, tackling the issue of bycatch is of utmost importance. Bycatch Reduction Devices (BRDs) present a hopeful avenue to address this challenge, aiming to minimize unintended catches while promoting sustainable fisheries management and the conservation of species. In Indian waters, the occurrence of bycatch is significant, encompassing a variety of marine species such as sea turtles, cetaceans, seabirds, and young fish, inadvertently trapped in fishing gear intended for specific targets (Lewison *et al.*, 2016). This unintended capture not only contributes to the depletion of biodiversity but also poses a threat to the sustainability of fisheries over time, impacting the welfare of coastal communities reliant on marine resources. In recent times, there has been a growing interest in using BRDs to tackle bycatch and lessen its negative effects on unintended species. BRDs include various new technologies and methods aimed at improving the selectivity of fishing gear. This helps in letting go or preventing the capture of non-target species while still catching the desired fish.

This article aims to delve deeply into the effectiveness of BRDs within the Indian context, providing a comprehensive examination informed by insights drawn from a variety of sources, including scientific research findings, ongoing fisheries management initiatives, and conservation endeavors. By thoroughly investigating the mechanisms underlying BRDs, their practical applications across different fishing scenarios, and the various challenges they encounter, this article seeks to illuminate opportunities for their broader adoption. Ultimately, the goal is to contribute significantly to the advancement of sustainable fisheries practices and the conservation of marine species in Indian waters by offering actionable insights and recommendations grounded in empirical evidence and expert analysis.

2. Bycatch in Indian Fisheries

2.1 Overview of Indian Fisheries

India ranks among the world's top fish producers, as per the most recent data from the Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. In the fiscal year 2020-2021, India's total fish production amounted to 14.90 million tonnes. India possesses an extensive coastline stretching approximately 8000 kilometers and boasts an Exclusive Economic Zone (EEZ) exceeding 2 million square kilometers. The marine fishing industry plays a pivotal role in India's overall fish yield. According to recent statistics, India's marine fish output for the fiscal year 2020-2021 amounted to approximately 5.92 million tonnes. Inland fisheries, which include production from rivers, reservoirs, ponds, and other freshwater bodies, also play a crucial role in India's fish production. The inland fish production in India during 2020-2021 was approximately 9.98 million tonnes. The fisheries industry offers employment to millions of individuals,

particularly in coastal and rural areas. As per the National Fisheries Development Board (NFDB), it provides livelihoods for over 14 million people, both directly and indirectly. India is a significant exporter of seafood products, and there has been a consistent rise in seafood exports from the country in recent times. As reported by the Marine Products Export Development Authority (MPEDA), India exported seafood valued at USD 6.73 billion in the fiscal year 2020-2021.

2.2 Bycatch Species in Indian Waters

The composition of bycatch species in Indian waters may differ based on the specific geographical area and fishing methods utilized. Nonetheless, typical reports highlight the accidental capture of marine mammals, sea turtles, sharks, and seabirds.

Marine Mammals: Species such as dolphins, porpoises, and whales often end up unintentionally caught in fishing nets. A study conducted by the Central Marine Fisheries Research Institute (CMFRI) in India found instances of these marine mammals, including dolphins, being incidentally trapped in gillnets used for fishing along the southwest coast of India (Rajagopalan, and Joshi, 2017).

Sea Turtles: Multiple types of sea turtles, such as the Olive Ridley, Green, and Hawksbill turtles, are commonly trapped unintentionally as bycatch during fishing activities, notably in trawl nets and gillnets. A study featured in the journal Biological Conservation underscored the consequences of shrimp trawling on the incidental capture of sea turtles in the Indian Ocean, including within Indian waters (Pandav *et al.*,2004).

Sharks: Sharks of various species are frequently unintentionally ensnared in fishing gear such as longlines, gillnets, and trawls. An article published in Biological Conservation scrutinized the incidental capture of sharks within the Indian Exclusive Economic Zone (EEZ) by the tuna longline fishery, highlighting the significance of this issue in Indian waters (Singh *et al.*,2007).

Seabirds: Seabirds, encompassing a variety of albatrosses, petrels, and shearwaters, face the risk of unintentional capture in longline fisheries. Research published in Biological Conservation investigated the consequences of longline fisheries on the incidental capture of seabirds in the Indian Ocean, encompassing areas adjacent to India.

2.3 Impact of Bycatch on Indian Biodiversity

The adverse impacts of bycatch on the biodiversity of marine ecosystems in India. The indiscriminate use of fishing gear frequently leads to the accidental trapping of species like sea turtles, cetaceans, sharks, and seabirds, many of which are already in peril. Bycatch not only causes immediate fatalities but also disturbs marine food chains and the balance of ecosystems, thereby exacerbating the loss of biodiversity (Silas, 2012). The extensive coastal waters of the Indian Ocean support a diverse array of marine life. Yet, fishing endeavors, ranging from traditional to large-scale industrial operations, frequently lead to

the accidental capture of species not intended for harvest, thus adding to the issue of bycatch (Qasim,1997). India is home to various sea turtle species, such as the Olive Ridley, Green, Hawksbill, Loggerhead, and Leatherback turtles. Among these, the Olive Ridley turtle is particularly vulnerable to threats arising from unintentional entanglement in fishing equipment, notably trawl nets employed in shrimp fishing activities along the eastern coastline (Shanker and Choudhury,2006). The coastal regions of India play vital roles as habitats and resting sites for migratory birds during their journeys. Nevertheless, specific fishing methods, like gillnetting, jeopardize these birds. Seabirds and shorebirds, in particular, face the danger of becoming entangled and perishing in fishing nets (Pain and Kati,2016).

3. Types of Bycatch Reduction Devices

3.1 Excluder Devices- Excluder devices are specially crafted tools aimed at reducing bycatch in fishing operations. They function by allowing non-target species to escape from fishing gear while retaining the desired catch (Kelleher, 2005). Excluder devices, including Turtle Excluder Devices (TEDs) and Fish Excluder Devices (FEDs), are specifically engineered to enable the escape of non-target species while retaining the intended catch. TEDs, for instance, have gained extensive application within shrimp trawl fisheries as a means to curtail incidental capture of sea turtles (Kelleher, 2018).

3.1.1 Turtle Excluder Devices (TEDs)

Turtle Excluder Devices (TEDs) are specialized tools engineered to minimize the unintentional entrapment of sea turtles in fishing nets, particularly in trawl fisheries or TEDs are grid-like configurations placed within the opening of trawl nets. Their purpose is to enable small marine creatures, like shrimp or fish, to navigate through the net while preventing larger animals such as sea turtles from entering. TEDs function by employing size-based selection, utilizing the variation in size between target and non-target species to enable the larger animals to escape. These tools have been extensively employed in shrimp trawl fisheries globally to alleviate the adverse effects of bycatch on sea turtle populations.

Effectiveness of TEDs:

Research has demonstrated that TEDs can notably decrease the accidental entrapment of sea turtles in trawl nets. With correct installation and upkeep, TEDs have proven effective in enabling a considerable proportion of sea turtles to evade capture while still retaining the desired catch. These mechanisms operate by integrating a grid-like design into the entrance of the trawl net, enabling smaller organisms to pass through while guiding larger animals like sea turtles toward an exit route. Research indicates that correctly deployed and adequately maintained TEDs can substantially reduce the incidental capture of sea turtles. However, the efficacy of TEDs may vary depending on factors such as the device's design, fishing location, and fishermen's compliance with usage regulations. Continuous research and monitoring are essential to optimize TED design and implementation, ensuring they effectively reduce bycatch and protect sea turtle populations (Watson *et al*., 2005).

Regulations and Implementation in India

In India, the implementation of TEDs has been made obligatory in specific fisheries to mitigate the incidental capture of sea turtles. Through joint efforts involving the Indian government, fisheries authorities, and conservation groups, the promotion of TED adoption among shrimp trawl fishermen along India's coastlines has been encouraged (Krishnan, 2002).

3.1.2 Fish Excluder Devices (FEDs)

Fish Excluder Devices (FEDs) are devices created to minimize the catch of fish species that are not the target of fishing activities, especially in trawl fisheries. Usually comprised of grids, screens, or similar structures, these devices selectively prevent fish below a specific size limit from being caught, enabling them to exit the net freely.

Effectiveness and Design

Studies have shown that FEDs are efficient in decreasing the capture of unintended fish species in trawl fisheries. Well-designed and correctly utilized FEDs can substantially reduce bycatch while preserving catch rates of target species. Research has investigated different designs and arrangements of FEDs to enhance their effectiveness in diverse fishing situations and surroundings (Broadhurst and Kennelly,1996).

Regulatory Framework and Adoption:

Certain nations have enforced regulations mandating the adoption of FEDs in particular fisheries

to reduce bycatch and advocate for sustainable fishing methods. These rules typically stipulate that fishermen must install and employ authorized FEDs to lessen their impact on unintended species. The uptake of FEDs could be impacted by various factors including governmental directives, incentives, and outreach initiatives designed to educate about the advantages of mitigating bycatch (Kelleher and Moore, 2001).

3.2 Escape Gaps

Escape gaps, alternatively termed as selective devices or size-selective openings, are components incorporated into fishing equipment to enable undersized or unintended organisms to exit while keeping the desired species. Escape gaps function based on size selectivity and behavioral principles, enabling smaller or undesired organisms to exit the gear while retaining larger or preferred catches.

Effectiveness and Design:

Studies have confirmed that escape gaps are effective in reducing bycatch and enhancing the selectivity of fishing gear. Well-designed and appropriately sized escape gaps can notably reduce the capture of undersized or unintended species. Research has investigated diverse arrangements and positions of escape gaps to enhance their efficacy in different fishing scenarios and species being targeted (Broadhurst, 2000).

3.3 Selective Fishing Gear

Selective fishing gear comprises tools and methods engineered to focus on particular species while minimizing the inadvertent capture of non-target species, commonly referred to as bycatch. These gears are designed to enhance the sustainability of fishing operations by minimizing wastage, safeguarding vulnerable species, and preserving the equilibrium of ecosystems. Here are some examples of selective fishing gear:

Turtle Excluder Devices (TEDs)

TEDs are incorporated into shrimp trawl nets to facilitate the release of sea turtles while preserving the shrimp catch. These devices are equipped with metal grids and an escape mechanism that prevents turtles from entering the net but allows them to exit safely.

Bycatch Reduction Devices (BRDs): BRDs are utilized across different fishing methods like trawls and longlines to mitigate the capture of unintended species. These devices typically incorporate features such as size-sorting grids, escape openings, or barriers to aid in the release of non-target species.

Grate Systems

Mesh structures are integrated into bottom trawl nets to filter out larger, unintended species while permitting smaller, economically valuable species to pass through. This effectively decreases the capture of undersized or non-commercial fish.

Circle Hooks

Circle hooks are frequently employed in longline fishing operations to selectively catch certain species like tuna and swordfish while minimizing unintended catches of sea turtles, sharks, and other non-target species. These hooks are designed to decrease the chances of deeply hooking the fish, thereby enhancing the survival prospects of those released back into the ocean.

Square Mesh Panels

Square mesh panels are added to gillnets to selectively enlarge the mesh size, enabling smaller fish to exit while retaining larger, desired species. This aids in minimizing the incidental capture of undersized or non-commercial fish.

Pingers

Pingers emit sound signals to discourage marine mammals like dolphins and porpoises from coming near fishing equipment such as gillnets and longlines. This serves to minimize interactions between marine mammals and fishing gear, thereby assisting in the reduction of bycatch.

Selective fishing equipment is vital for maintaining sustainable fisheries by reducing unintentional catches, safeguarding non-target species, and supporting the overall health of ecosystems. Ongoing exploration and advancement in selective gear technology are pivotal for further decreasing unintended catches and securing the lasting health of marine resources.

4. Challenges Adopting of BRDs in India (Bull, 2007)

Technological Challenges

Small-scale fishers often struggle to find BRD designs that are both affordable and suitable for their fishing practices. This lack of access to practical solutions limits their ability to reduce bycatch effectively.

Economic Constraints

Many fishers believe that using BRDs will reduce their catch and, consequently, their income. This fear creates resistance to adopting these devices.

Lack of Awareness and Training

A significant barrier is the lack of understanding among fishers about the ecological and economic benefits of BRDs. Without proper training or awareness programs, many are hesitant to use them.

Gaps in Policy and Enforcement

Although there are regulations aimed at reducing bycatch, enforcement is often inadequate. Weak monitoring systems and insufficient follow-through make it difficult to ensure compliance.

5. Recommendations for Effective Implementation (Lewison *et al.*, 2004)

Policy Interventions

- Gradually make the use of BRDs mandatory in all fishing activities, allowing time for fishers to adapt to the changes.
- Offer financial assistance, such as subsidies or incentives, to help small-scale fishers adopt BRDs without economic strain.

Awareness Campaigns

- Launch outreach programs to educate fishing communities about the environmental and economic advantages of using BRDs.
- Collaborate with local leaders and organizations to foster trust and encourage widespread adoption of these devices.

Capacity Building

- Organize regular training sessions to teach fishers how to install, use, and maintain BRDs effectively.
- Partner with research institutions and non-governmental organizations to support the development and distribution of appropriate technologies.

Global Collaboration

- Build partnerships with countries that have successfully implemented BRDs to exchange knowledge, experiences, and technologies.
- Focus on creating region-specific solutions that address the unique challenges faced by fisheries in India.

Conclusion

Reducing bycatch is crucial for protecting India's marine biodiversity and promoting sustainable fishing practices. Bycatch reduction devices (BRDs) provide a practical way to achieve a balance between conserving marine ecosystems and addressing economic needs. Despite the challenges, success can be achieved through a combination of policy reforms, active community participation, and innovative technologies. Proactively adopting BRDs will not only safeguard India's rich marine life but also ensure a stable future for the livelihoods of coastal fishing communities.

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