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Turtle Excluder Devices (TEDs) in Fisheries: Innovations and Impacts on Marine Ecosystem and Commercial Catches

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ARTICLE ID: 52

Abstract

Turtle Excluder Devices (TEDs) have emerged as a critical tool in reducing bycatch and promoting sustainable fishing practices globally. First introduced in the 1980s, TEDs were developed to address the unintended capture of sea turtles in trawl fisheries, particularly in shrimp trawls. The device, typically a grid-like structure, allows larger species, such as turtles, to escape through an exit while retaining target species like shrimp. Over the years, TED designs have evolved, incorporating innovations such as flexible grids and enhanced escape openings, improving their efficiency and adaptability across different fisheries. This study provides a comprehensive review of TED implementation across various regions, assessing their effectiveness in minimizing bycatch without significantly affecting the commercial catch. Research from the Mediterranean, Australia, the Gulf of Mexico, and other regions demonstrates that TEDs can reduce turtle bycatch by up to 97% while improving catch quality by reducing debris and large object interference. Despite initial resistance from the fishing industry, ongoing advancements and regulatory support have led to the broader adoption of TEDs worldwide. The findings underscore the importance of TEDs as a sustainable fisheries management tool that not only protects endangered sea turtles but also promotes eco-friendly fishing practices, enhancing the long-term viability of both marine ecosystems and the fishing industry.

Keywords: - Sea turtles, fishing gear innovations, Sustainable fishing, marine conservation, eco-friendly fishing practices

Introduction

TEDs were proposed in the early 1980s to reduce turtle submergence and mortality. A TED is a grid-like device that diverts large objects (including turtles) toward an exit positioned

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before the cod end (Mitchell et. al.,1995; Epperly, 2003 and Sala et. al., 2011). Sea turtles, some of the most ancient and intriguing creatures on our planet, are currently facing significant threats to their survival. These marine reptiles, which have been traversing the oceans for over 100 million years, now confront various human-induced challenges, including pollution, habitat destruction, and, notably, bycatch in fishing operations. Bycatch, the unintended capture of non-target species, significantly impacts the sea turtle population, often leading to injuries or fatalities. To combat this, a seemingly simple yet highly effective solution has been made. A TED is a specialized device integrated into shrimp trawl nets that allows captured sea turtles to escape while retaining the shrimp catch. This innovation has been a game-changer in marine conservation, providing a practical method to protect endangered sea turtles without compromising the livelihood of fishers. As highlighted by the National Oceanic and Atmospheric Administration (NOAA), TEDs have proven to reduce turtle bycatch by up to 97% when properly used. The development and implementation of TEDs were driven by both environmental concerns and regulatory mandates. In the 1980s, rising awareness of the plight of sea turtles led to legislative action in the United States. The Endangered Species Act (ESA) and subsequent regulations required the use of TEDs in shrimp trawling operations within U.S. waters, setting a precedent for conservation efforts worldwide. These regulations have not only aided in the recovery of turtle populations but also highlighted the need for international cooperation in marine conservation. Moreover, the design and efficiency of TEDs continue to evolve. Innovations such as the use of lightweight materials, improved escape openings, and the incorporation of turtle-friendly lighting systems have enhanced the performance of these devices. These advancements not only improve the efficacy of TEDs but also address specific challenges faced by different fishing communities around the world. Sea turtles, some of the most ancient and intriguing creatures on our planet, are currently facing significant threats to their survival. These marine reptiles, which have been traversing the oceans for over 100 million years, now confront various human-induced challenges, including pollution, habitat destruction, and notably, bycatch in fishing operations. Until recently, the primary management aim of harvest fisheries was to maximise sustainable yields of the target species. Relatively little attention was paid to minimising the effects of fishing on the broader ecosystem (Brewer et. al., 2006). One of the most effective ways to minimise the broader ecological impacts of harvest fisheries is to improve the selectivity of fishing gear (e.g. Robertson, 1984; Liu et. al., 1985; Alverson et. al., 1994; Briggs et. al., 1999).

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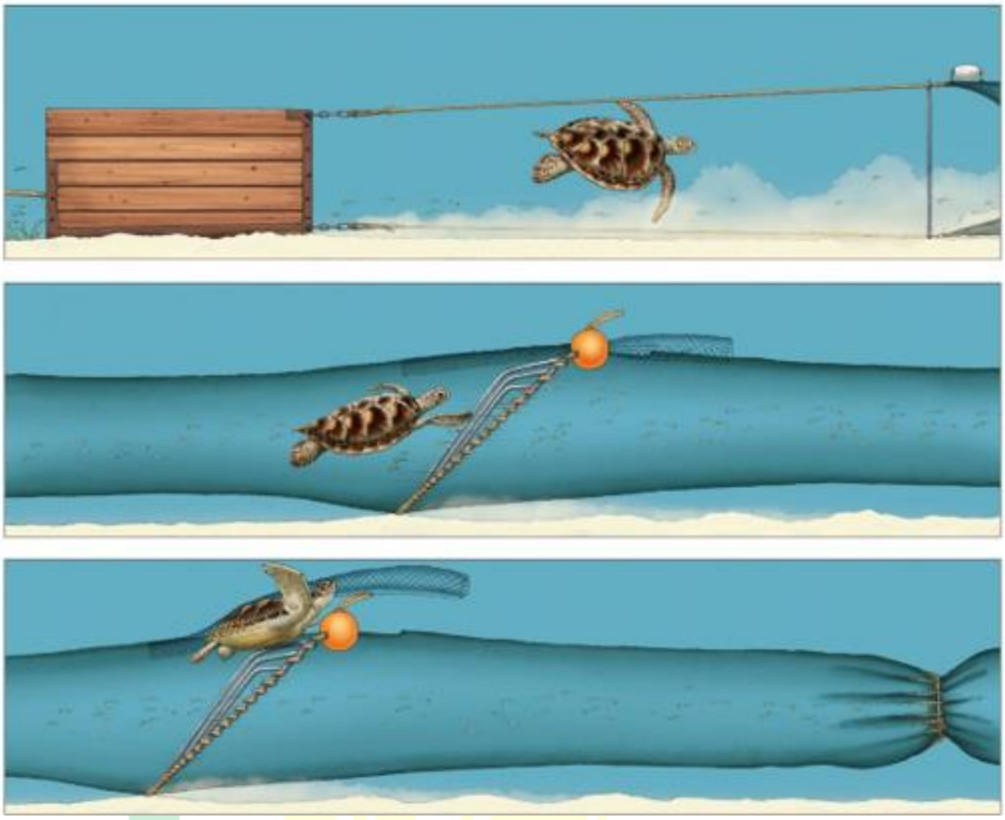

Fig 1: - A turtle excluder device (TED

How TEDs work:

These devices are designed based on the difference in size and mobility between target species, such as shrimp, and non-target species like sea turtles.

The mechanism of TEDs involves several scientific principles:

1. Mechanical grid design: A rigid or semi-rigid grid with bars spaced at specific intervals is installed at an angle within the trawl net. This grid acts as a selective barrier, allowing smaller target species to pass through while deflecting larger animals like turtles.
2. Escape hatch: Positioned either at the top or bottom of the net, an escape opening is strategically placed beyond the grid. When a sea turtle encounters the grid, its body size prevents it from passing through the bars, and it is directed toward the escape hatch, allowing it to swim out of the net.
3. Behavioural responses: TEDs take advantage of the distinct escape behavior exhibited by sea turtles when entrapped. Turtles typically respond to stress by swimming upwards or seeking exit points, which is why the positioning of the escape opening is critical for the device's success.

4. Size and hydrodynamics: TED designs are calibrated based on the average size of sea turtles and the hydrodynamic conditions within the trawl net. The flow of water inside the net helps guides the turtle toward the grid and the exit, while the grid itself minimizes drag, ensuring the net's fishing efficiency is maintained.

Fig 2: - Turtle excluder device

Success stories

The success stories of TEDs extend beyond the United States. In countries like Australia, Costa Rica, and Nigeria, the introduction of TEDs has contributed to significant reductions in turtle bycatch, showcasing the global applicability of this technology. For instance, in Australia's Northern Prawn Fishery, the use of TEDs has become standard practice, resulting in a notable decline in turtle mortalities and fostering a more sustainable fishing industry. Nets that incorporate both a turtle excluder device and a bycatch reduction device achieved significant reductions in turtle catches by 99%, while also decreasing sea snake captures by 5%, shark catches by 17.7%, ray catches by 36.3%, large sponge captures by 85.3%, and small bycatch by 8%. However, it is important to note that these outcomes were largely influenced by the effectiveness of the turtle excluder devices (Brewer et. al., 2006). The study conducted in the Mediterranean Sea found that the flexible turtle excluder device was highly effective, as it neither altered the total weight nor affected the species composition of the commercial catch. Furthermore, it substantially reduced the presence of debris and litter in the nets, enhancing the overall quality of the catch by excluding larger objects that could potentially cause damage to it (vasapollo et. al., 2019).

Challenges and criticisms

Despite their proven effectiveness, the adoption of TEDs has not been without challenges. Initial resistance from the fishing industry stemmed from concerns about potential catch loss and the costs associated with modifying nets. The prawn losses measured here appear to be largely due to TEDs, but some loss due to the Bigeye BRD was also measured. Prawn loss through TEDs is most likely to result from either (i) poor construction, installation, or tuning of the TED and/or BRD (Eayrs and Day, 2004a, b), (ii) blockages on the TED (usually by large animals), causing an unusually high number of animals to be diverted through the TED escape opening instead of passing back into the cod end, or (iii) poorly functioning escape flap. However, ongoing education and demonstration projects have illustrated that TEDs can be both economically viable and beneficial for long-term sustainability. Studies conducted in the Gulf of Mexico and the South Atlantic have shown that TEDs, when correctly installed and maintained, do not significantly impact shrimp yields.

Future outlook

As the global community grapples with the environmental impacts of human activities, the story of TEDs serves as a beacon of hope and ingenuity. It exemplifies how targeted technological solutions, supported by robust regulatory frameworks and international collaboration, can lead to meaningful conservation outcomes. While challenges remain, the ongoing commitment to refining and implementing TEDs reflects a broader shift towards sustainable practices that balance ecological preservation with economic needs. In conclusion, Turtle Excluder Devices represent a triumph of innovation and cooperation in the quest to protect our oceans and their inhabitants. By reducing bycatch and fostering more sustainable fishing practices, TEDs play a crucial role in ensuring the survival of sea turtles for future generations. In a future perspective, fishermen can be incentivised to adopt TED on a voluntary basis, by giving added market value to the fish caught with these “environmentally friendly” devices, through quality certification of fish products. As we look ahead, continued advancements and wider adoption of TEDs will be pivotal in the ongoing efforts to safeguard these remarkable marine creatures.

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