

Bycatch Reduction Devices: A Selective Fishing Tool for Protecting Sea Turtles and Other Vulnerable Aquatic Animals

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Bycatch is the unintended capture of animals that are not the principal target of a fishing operation. In trawl fisheries, this can include sea turtles, sharks, rays, juvenile fishes, crabs and other non-target organisms. Bycatch Reduction Devices (BRDs) are selective gear components designed to provide an escape route for particular groups of non-target animals while retaining the desired catch. A specialised BRD, the Turtle Excluder Device (TED), uses a rigid or semi-rigid grid and an escape opening to guide large animals such as sea turtles out of a trawl. This article explains the major types of BRDs, the working principle of TEDs, their usefulness for endangered, threatened and protected aquatic animals, and their relevance to Indian fisheries. Properly designed and maintained devices can reduce unwanted capture, improve catch quality and support more sustainable fishing without requiring complete replacement of the fishing operation.

Keywords: bycatch, bycatch reduction device, BRD, turtle excluder device, TED, trawl fishery, sea turtles, selective fishing, sustainable fisheries

Introduction

Fishing gears are designed to catch particular species, sizes or groups of aquatic animals, but no fishing gear is perfectly selective. When non-target organisms are captured, they may be retained, discarded or released after injury. This unintended catch is known as bycatch. Trawling can generate substantial bycatch because the gear interacts with a broad section of the water column or seabed. For conservation-oriented fisheries management, the objective is therefore not only to catch the target species efficiently, but also to improve the selectivity of the gear. Bycatch reduction devices provide a practical technological approach. Rather than depending only on post-capture sorting, a BRD attempts to separate unwanted animals while they are still inside the fishing gear. FAO descriptions include square-mesh windows, fisheye openings, cones and rigid-grid separators among the approaches tested for reducing fish bycatch in shrimp trawls. For sea turtles, the best-known specialised device is the Turtle Excluder Device (TED). A TED is fitted into the trawl and uses differences in body size and behaviour to direct a turtle or another large animal toward an escape opening, while smaller target organisms can continue toward the cod-end. NOAA Fisheries describes TEDs as metal-bar grids fitted in the neck of shrimp trawls; when a turtle or other large animal encounters the grid, it is guided toward an opening and escapes.

What is a Bycatch Reduction Device?

A Bycatch Reduction Device is a selective component incorporated into fishing gear to reduce the capture or retention of non-target organisms. BRDs can be broadly grouped according to how they create selectivity: mesh-based devices, framed openings, rigid or semi-rigid grids,

and combinations of these approaches. Their performance depends on the species being targeted, the size and swimming behaviour of the animals, water flow through the gear, towing conditions, device position and dimensions, and correct maintenance. Indian fisheries literature has also described soft, hard and combination BRDs, with TEDs representing a specialised application for excluding turtles from trawls.

Major Types of Bycatch Reduction Devices

- 1. Square-mesh window** – A section of square mesh can remain more open during towing than diamond mesh, creating an escape pathway for appropriately sized and active fish. FAO material describes the square-mesh window as a simple BRD commonly positioned in the trawl extension ahead of the cod-end.
- 2. Fisheye BRD** – A framed opening, often positioned toward the upper part of the cod-end, provides an escape route for fish that respond by swimming forward or upward. Its dimensions and position must be matched to the target fishery.
- 3. Rigid-grid separator** – A grid separates animals mainly by body size and swimming behaviour. Larger animals can be guided toward an escape opening while smaller target organisms pass through the spaces in the grid. This principle forms the basis of TED technology.
- 4. Turtle Excluder Device (TED)** – TEDs are specialised trawl modifications intended primarily to reduce the capture and mortality of sea turtles. Depending on design, the escape opening can be positioned at the top or bottom of the trawl. NOAA reports that approved TED designs continue to be tested and modified to improve turtle exclusion while maintaining target catch retention.

How Does a TED Protect Sea Turtles?

Sea turtles must periodically reach the surface to breathe. When a turtle becomes trapped in a continuously towed trawl, prolonged retention can result in exhaustion, injury and drowning. A TED changes this outcome by creating an escape pathway. The turtle encounters the grid, is unable to pass through the bars with the smaller target catch, and is directed toward the escape opening. The target catch can continue toward the cod-end.

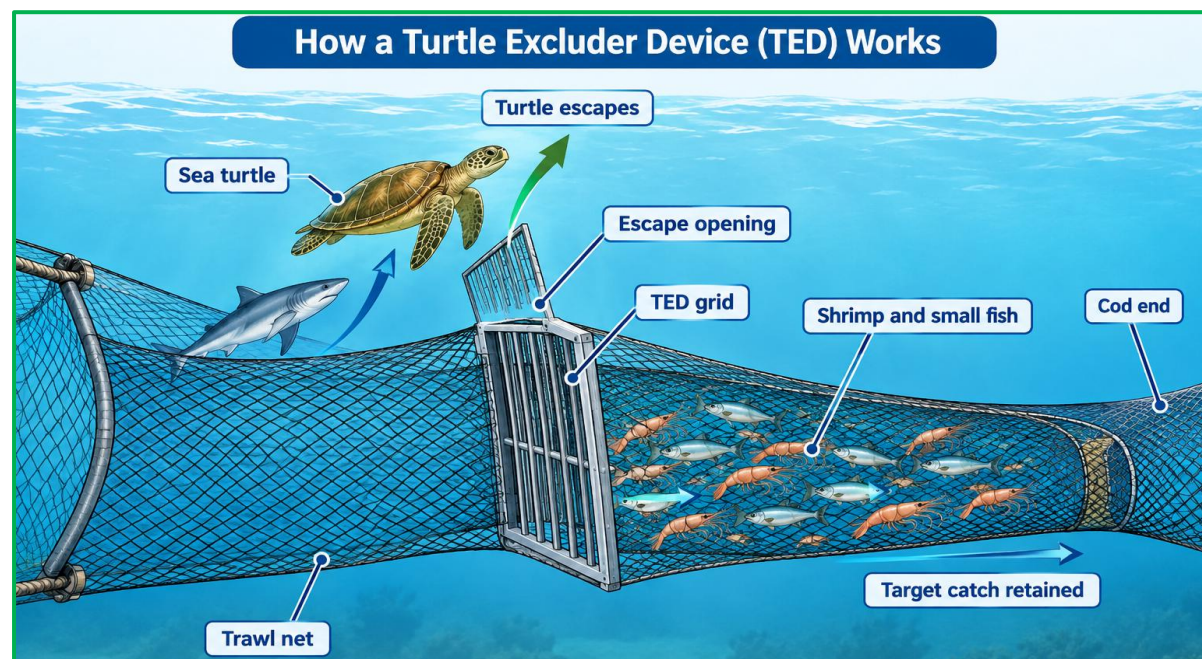


Figure 1. Schematic illustration of a Turtle Excluder Device (TED): the grid guides sea turtles and other large animals toward the escape opening while the target catch continues toward the cod end.

How the device works: As the trawl is towed, a turtle or other large animal encounters the TED grid. The animal is directed toward the escape opening and leaves the net, whereas smaller target organisms can pass through the grid and remain in the cod end. Correct grid spacing, opening size, orientation and maintenance are essential for effective selectivity.

The conservation value of this mechanism depends strongly on correct construction, installation, orientation and maintenance. NOAA Fisheries states that current TED designs are highly effective at excluding turtles from shrimp trawls when properly installed and maintained; it reports an exclusion performance of about 97% for current designs. This figure refers specifically to the evaluated TED applications described by NOAA and should not be assumed to apply to every fishery, gear design or operating condition.

Protection of Other Vulnerable Aquatic Animals

Although the TED was developed principally around sea-turtle exclusion, selective trawl devices can also reduce interactions with other large non-target organisms. NOAA notes that sea turtles, sharks and stingrays can be stopped by the grid and directed to the escape opening. Some TED modifications have also been investigated specifically for finfish bycatch reduction. The wider conservation value of BRDs is therefore linked to selectivity. Depending on the device and fishery, BRDs may allow juvenile or non-target fish to escape, reduce the retention of large animals, and decrease the quantity of unwanted material entering the cod-end. However, a device should be evaluated for the actual fishery in which it is used; a BRD that works well for one species, gear and towing condition may not give the same result elsewhere.

Importance for Indian Fisheries

The use of TEDs is particularly relevant to India because sea turtles occur along the Indian coastline and interactions with fishing gears have been documented. A CMFRI review reported that incidental mortality of turtles can occur through fishing activities including trawling and gillnetting and described field testing and development of TEDs for Indian trawl fisheries. The review also noted work involving CIFT, FSI and CIFNET and field trials of the CIFT-TED. Government policy has also moved toward wider TED implementation. In a July 2025 parliamentary reply, the Department of Fisheries stated that all nine coastal states had amended their Marine Fisheries Regulation Acts to mandate TED use and described benefits including turtle escape, reduced bycatch mortality, cleaner cod-ends and improved catch quality. The same release noted Kerala's programme for TED installation in trawlers. [cite turn1 search2](#) More recently, the Government of India has continued to support installation of TEDs in trawl nets, including through fisheries programmes and demonstrations. In March 2026, TEDs were distributed to fishers at a fisheries workshop in Kerala, illustrating continuing implementation efforts.

How BRDs Help the Fishing Community

A conservation device is more likely to be adopted when it also provides practical benefits to fishers. Selective devices can reduce the quantity of unwanted material entering the cod-end, make catch sorting easier and reduce damage caused by large debris or non-target animals. NOAA reports that TEDs can reduce bycatch of species such as stingrays and sharks and can also reduce marine debris entering the trawl. However, concerns about loss of target catch can affect acceptance. CMFRI's review of TED applicability in Indian trawl fisheries identified fisher concerns about shrimp escapement as an important implementation challenge. This highlights the need for locally appropriate designs, field demonstrations, fisher participation, gear-specific testing and routine inspection rather than assuming that one standard device will perform identically in all fisheries.

Factors Affecting BRD Performance

Device design: Grid spacing, mesh size, opening dimensions and shape must match the animals and target catch for which the device is intended.

Position in the gear: Small changes in placement and orientation can influence water flow and the ability of animals to find the escape route.

Animal behaviour: Swimming speed, body shape, escape response and size determine whether an animal interacts successfully with the device.

Towing conditions: Depth, speed, sea state, catch volume and net geometry can alter the performance of a BRD.

Maintenance: Bent bars, blocked openings, damaged netting or incorrect installation can reduce selectivity.

Fisher participation: Training, demonstrations and practical feedback are important for sustained adoption and correct use.

Broader Ecological Benefits

Reducing bycatch has ecological value beyond saving individual animals. When fewer juveniles and non-target species are removed from a fishery, more organisms remain available to contribute to future populations and ecosystem functions. Reduced capture of large predators and protected species can also decrease direct human–wildlife interactions. Cleaner trawl catches may reduce the time spent sorting and handling unwanted animals, while reducing debris in the gear can improve operational conditions. These benefits are fishery-specific and should be verified through field monitoring. For endangered, threatened and protected species, the principle is especially important: prevention is generally preferable to relying on survival after capture. Gear-based selectivity can act before an animal reaches the cod-end, reducing the duration of contact with the fishing gear.

Limitations and the Need for Monitoring

BRDs are not a universal solution. Their effectiveness can vary with species composition, animal size, gear type, season, depth, towing speed and fisher operation. A device may also create some loss of target catch if its dimensions or position are unsuitable. Therefore, BRD programmes should include experimental testing, onboard observation, catch-composition monitoring and periodic inspection. The most useful evaluation is not simply whether a device is present, but whether it produces measurable reductions in unwanted catch and mortality while maintaining an acceptable target catch. Such monitoring can guide modifications to grid spacing, escape-opening size, mesh configuration and device placement.

Conclusion

Bycatch Reduction Devices represent an important bridge between fishing production and aquatic biodiversity conservation. Among them, the Turtle Excluder Device is a clear example of how a relatively simple gear modification can create an escape route for large, vulnerable animals while allowing the target catch to continue into the cod-end. BRDs can also contribute to the release of unwanted fish, sharks, rays and other non-target organisms, depending on their design and application. In India, continuing government support and field implementation of TEDs provide an opportunity to strengthen selective fishing practices. The long-term success of BRDs will depend on scientifically tested designs, fisher participation, correct installation, regular maintenance and transparent monitoring of both conservation and fishery outcomes.

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