CONSULTING REPORT
STRATEGIC PLAN FOR REDUCING BY-CATCH OF SEA TURTLES, MARINE MAMMALS, SHARKS AND RAYS IN VIETNAM: A POLICY REVIEW

Center for Fisheries Community Development
Vietnam Institute of Fisheries Economics and Planning

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I. INTRODUCTION

The incidental capture of fish and other marine species, commonly known as bycatch, is a significant threat to both the profitability and sustainability of fisheries, as well as to marine biodiversity. While some perceive bycatch as an inevitable aspect of marine capture fisheries, its consequences are too substantial to ignore. Annually, at least 7.3 million tons of marine life are caught as bycatch, and in many regions, the volume of bycatch exceeds the catch of targeted species. Common bycatch species include sharks, sea turtles, and marine mammals like dolphins and whales. The Food and Agriculture Organization of the United Nations (FAO) estimates that over 300,000 whales and dolphins die each year from entanglement in fishing nets, and nearly 250,000 sea turtles are captured globally in longline fishing. Additionally, over 100,000 sharks and related species are caught annually, with 50% being bycatch. A notable concern is that these bycatch species are often not released back into the ocean but retained for commercial fishing, contributing to overfishing.

According to NOAA [1], Bycatch can negatively affect protected species such as sea turtles, whales, dolphins…) This unintentional capture not only harms individual animals but also exacerbates population declines and obstructs recovery efforts. Similarly, bycatch can contribute to overfishing and hinder efforts to regenerate fisheries resources, causing negative economic and social impacts on fishermen and fisheries community depends on aquatic resources. Bycatch can also have ecological impacts by altering food chains, and potentially impacting ecological balances.

Countries worldwide acknowledge the prevalence of bycatch in diverse fisheries, particularly in seine, gillnet, and longline operations, as identified by fisheries scientists. In response, there has been a concerted effort to minimize, and ultimately aim to prevent, bycatch. This is especially focused on safeguarding vulnerable species like sea turtles, marine mammals, and sharks and rays. Numerous nations have undertaken research and adopted measures to address this issue. In addition, the development of a legal framework with specific strategies and action plans has also been developed and implemented globally to minimize bycatch, such as: Marine Mammal Protection Act - MMPA, National Bycatch Reduction Strategy of the United States; Australia's Commonwealth Fisheries Bycatch Policy; National Plan of Action (NPOA) for the conservation and management of sharks and rays (2016 – 2020) of Indonesia…

Vietnam plays a proactive role in international nature conservation initiatives, particularly in the realms of marine preservation and the protection of endangered, precious and rare aquatic species. The country has committed to various international treaties and conventions that focus on marine conservation, safeguarding these species, and combating illegal fishing, includes: United Nations Convention on the Law of the

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[1] NOAA, National Bycatch Reduction Strategy, 2016 (U.S. National Oceanic and Atmospheric Administration , National Bycatch Reduction Strategy, 2016)

Sea 1982 (joined in 1994); Convention on Biological Diversity (Biological Diversity - joined in 1994) and the Protocols within the framework of the Convention; Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)...

Entering the new decade (2021-2030), amidst universal challenges of nature degradation, biodiversity loss, and climate change impacts, Vietnam is intensifying efforts to fulfill international commitments on nature conservation and biodiversity. This is evidenced by the development of industry-specific legal frameworks. In the marine capture fisheries sector, the focus is on marine conservation, habitat protection for aquatic species, and preserving endangered, precious and rare species. This commitment is reflected in numerous legal documents, such as the Law on Fisheries, which includes a dedicated chapter on the conservation and development of aquatic resources. This law stipulates the establishment of marine protected areas and the management and protection of endangered, precious, and rare aquatic species. Furthermore, the Vietnam Fisheries Development Strategy to 2030, with a vision to 2045 (approved in Prime Minister's Decision 339/QD-TTG dated March 11, 2021), aims for the establishment, expansion, and efficacy enhancement of marine protected areas, and the minimization and eventual cessation of destructive fishing gears of aquatic resources.

Although the policy framework for marine conservation and the protection of endangered, precious and rare aquatic species is relatively comprehensive, specific policies for managing bycatch are less developed and seldom mentioned in legal documents. As Vietnam's fisheries industry strives for sustainable and responsible development, there is a pressing need to review and formulate specific management policies. This is particularly crucial for managing bycatch, especially of vulnerable species like sea turtles, marine mammals, sharks, and rays.

II. METHODOLOGY

2.1. Desk review

- Collect and synthesize documents, policies and strategies relevant to bycatch from various sources, including management agencies (e.g., Department of Fisheries, Department of Fisheries Surveillance...); completed and ongoing projects by domestic and international organizations, and mass media publications.

- Examination of strategies and methods successfully implemented in other countries for reducing bycatch of endangered aquatic species.

2. 2. Experts consultation

- Consultations with selected experts or officials from relevant state management agencies at both central and provincial levels;

- Collaboration with the Department of Fisheries Surveillance (DFIRES) and Humane Society International in Vietnam for organizing and conducting a consultation conference. This conference aims to discuss the outcomes of the draft Policy Review Report before its final submission to the Fisheries Inspection Department in December 2023."

III. RESULTS

3.1. Research problem overview

The bycatch of legally protected endangered, precious, and rare aquatic species, including marine mammals, sea turtles, sharks, and rays, remains a complex and underaddressed issue in Vietnam. It has yet to receive substantial attention from the country's fishing community and fisheries science researchers.

Fisheries in Vietnam are small-scale, multi-gears (about 40 fisheries with different fishing gear), multi-species, with small-sized and small-capacity boats making up the majority. The Law on Fisheries 2017 does not distinctly categorize 'targeted species' and 'bycatch,' mirroring the reality of Vietnam's small-scale fisheries where a broad spectrum of species is commonly caught, and discarding at sea is rare. The current management framework does not employ quota-based management, leading to fishing practices aimed at maximizing catch without a definitive method to distinguish between 'intentional' and 'unintentional' catch. This general approach is prevalent, except in specific fisheries identified by their gear, like anchovy purse seine, squid falling net, or crab trapping.

The Food and Agriculture Organization (FAO) provides several definitions of bycatch, illustrating the diverse and complex nature of global fisheries. One definition describes bycatch as the "catch that is retained and sold but is not the target species of the fishery." Another definition, relevant in the Northeast and Western Pacific regions and in U.S. law, categorizes bycatch as "discarded species." This broader interpretation encompasses all non-target fish species, regardless of whether they are retained, sold, or discarded. The Organization for Economic Cooperation and Development (OECD), previously known as the Organization for European Economic Cooperation, defines bycatch more broadly as "Total fishing mortality excluding amounts directly accounted for by retained catches of target species." This definition includes all mortality resulting from interactions with fishing gear, even for species that are not removed from the water.

In multi-species fisheries, the task of identifying a 'key' or target species is complex due to the varied nature of the catch. The primary species, which is the main focus when setting Total Allowable Catches (TACs), becomes critical in this context. TACs, established by fisheries management agencies, are limits controlling the quantity of a particular species that can be harvested over a set period. While setting TACs for a primary species, 'secondary species' — those not specifically targeted but frequently caught with the primary species — must be considered. Including secondary species in management decisions is essential, especially if they constitute a significant portion of the primary species' catch. This inclusion ensures TACs accurately represent the dynamics of mixed-species fisheries and aids in sustainable management, taking into account both target species and those incidentally caught. Consequently, the global definitions of intentional, primary, and unintentional species in fisheries management vary, reflecting the diversity of fishing practices and regulatory approaches.

For this report, the definition of bycatch is adopted from NOAA Fisheries, which describes it as “discarded catch of marine species and unobserved mortality due to a direct encounter with fishing vessels and gear."

In Vietnam, sea turtle conservation efforts have been a focus since 2010, beginning with an action plan aimed at minimizing negative impacts, restoring sea turtle populations, and promoting conservation. Subsequently, the Vietnam National Plan of Action for Sea Turtle Conservation for 2016-2025 was implemented, as outlined in Decision No. 811/QD-BNN-TCTS dated March 14, 2016, by the Minister of Agriculture and Rural Development. According to the Department of Aquatic Resources Protection and Development (DFIRES) report, bycatch reduction has been a key component of the plan and put into motion through multiple projects, including surveys of sea turtle populations and habitats in various regions conducted by the IUCN and the Institute of Marine Resources and Environment; studies on the impact of offshore fishing on sea turtle populations and research on their biological and ecological characteristics led by the Research Institute for Marine Fisheries. Furthermore, nearly 50,000 circle hooks were distributed to tuna fishermen to mitigate bycatch. Other notable initiatives include the Fisheries Improvement Project (FIP), an observer program on fishing vessels in collaboration with WWF and the Vietnam Tuna Association, the design and installation of billboards at fishing ports, and the distribution of sea turtle conservation posters. Additional activities have included training for tuna fishermen on sea turtle conservation, development of educational materials on endangered species conservation for high school students, and the establishment of community-based models combining tourism and sea turtle protection in areas like Con Dao National Park. These efforts have significantly contributed to raising awareness and reducing the fishing pressure and bycatch of sea turtles, including their release when caught in nets. Most recently, the "Program to Conserve Vietnam's Endangered Turtle Species Until 2025, with a Vision to 2030," was issued under Decision No. 1176/QD-TTg dated September 12, 2019, by the Prime Minister. This program aims to protect and sustainably develop the habitats of endangered sea turtle populations in Vietnam, contributing to the preservation of the country's biodiversity.

For marine mammals, survey and research activities on marine mammals began to be carried out in Vietnam by the IUCN marine mammal expert group and Vietnamese scientists since 1995. This research was conducted in Khanh Hoa, Cuu Long estuary, Phu Quoc based on examination of skeletons in temples and shrines. The first list of Vietnam's marine mammals was published in 1995 with 17 species of marine mammals (1 species of whale, 15 species of dolphin and 1 species of dugong). Among them, the Pacific humpback dolphin *Sousa chinensis* (Osbeck, 1765) is the only species observed in Nha Trang Bay.

In October 1999, RIMF conducted additional investigations in the Gulf of Tonkin area. The results recorded many marine mammals belonging to 5 species including:

Sousa chinensis, Neophocaena phocaenoides, Stenella attenuata, Stenellla longirostris, Tursiops sp. [5]. In April 2000, during a follow-up survey by RIMF in the Gulf of Tonkin, the presence of five other species was also recorded: *Balaenoptera acutorostrata, B. edeni, Megaptera novaenglia, Pseudorca crasidens and Delphinus capensis.* [5]. As of 2005, studies indicate that Vietnamese waters are home to 25 species of marine mammals, spanning 7 distinct families, as documented by various authors. This diversity includes 15 species from the dolphin family (Delphinidae), 5 species from the whale family (Balaenopteridae), and 2 species of dolphin fish from the Kogiidae family. Additionally, other families such as Ziphiidae, Phocoenidae, and Dugongidae are each represented by 1 species[5].

As part of the project "Study on species and distribution status of marine mammals from Quang Ninh to Khanh Hoa for conservation and sustainable resource enhancement" conducted by IMER, a whale skull found at the Pho Thanh tomb in Pho Thanh commune, Duc Pho district, Quang Ngai province was identified by Pham Van Chien and colleagues as *Balaenoptera omurai* (Wada, Oishi, and Yamada, 2003), which belongs to the Balaenopteridae family, commonly known as the gray whale family[24]. In their efforts to standardize the fin whale specimen *Balaenoptera phusalus* (Linnaeus, 1758) at the Quang Ninh Provincial History Museum, Pham Van Chien and his team reclassified it as the gray whale *Eschrichtius robustus* (Lilljeborg, 1861) [23].

Most recently in 2021, RIMF conducted a study on "Developing technical guidance for rescuing marine mammals in Viet Nam" The primary outcome of this study was the formulation of rescue procedures for whales, dolphins, and dugongs. This study represents one of the few focused on marine mammals with the aim of reducing bycatch in purse seine, gillnet, and trawling in Vietnam. The Division of Aquatic Resources Protection and Development, under the Department of Fisheries Surveillance (previously the Department of Aquatic Resources Conservation and Development under the Directorate of Fisheries), is currently making efforts to develop an national action plan for the management and conservation of marine mammals in the near future.

The research, studies, and survey projects focusing on marine mammals in Vietnam are relatively few, primarily due to limited financial and professional capacities. The studies that have been published mainly address the classification and distribution of marine mammals. However, they lack in-depth research into population biology. As a result, critical details such as distribution areas, feeding grounds, stocks, fishing mortality of marine mammals caused by bycatch in marine capture fisheries remain undetermined. This scarcity of data and scientific information for species, species groups, and temporal changes poses challenges in proposing and enacting regulations.

Research and studies on sharks and rays in Vietnam began in the 1970s and 1980s, with more systematic documentation starting from 1973. In the late 1980s and 1990s,

these species were regarded as "fisheries resources" in the fishing industry, especially around Phu Quy island (Binh Thuan provinve). However, this industry has since declined due to a severe reduction in shark populations and the Vietnamese government's conservation policies. Post-1975, following the country's unification, several research programs, such as Thuan Hai - Minh Hai, contributed specimens and information about the distribution and stock status of cartilaginous fish. Yet, these surveys predominantly focused on open sea areas, leaving coastal areas, bays, and islands less explored. The results of these studies largely concentrated on describing the morphology of some species in taxonomic documents. During 2003-2004, RIMF carried out several surveys on sharks as part of a collaborative project with the Southeast Asia Fisheries Development Center (SEAFDEC) and other projects in subsequent years. Nguyen Long and Nguyen Khac Bat, using data from these surveys, identified 16 shark species in Vietnamese waters, with distribution across the Gulf of Tonkin, Southeast, and Southwest regions. This research also provided initial data on fishing seasons, catch volumes on fishing vessels, and trade and usage information in Binh Thuan and Ba Ria-Vung Tau during 2003-2004. Vietnam has also collaborated with the WCPFC and SEAFDEC on shark and ray identification programs in Ba Ria - Vung Tau from 2016 to 2020, aiming to record and discover new species. Despite these efforts, research on sharks in Vietnamese waters remains in its early stages and has not received substantial attention, particularly in terms of statistical data on their catch. Currently, the "National Action Plan on the Management and Conservation of Sharks and Rays" is under development by the Division of Aquatic Resources Protection and Development, and its promulgation is anticipated soon. This plan will provide a comprehensive framework for the protection, conservation, and development of these species.

In summary, bycatch of marine mammals, sea turtles, sharks and rays in Vietnam's fisheries is a complex issue that has not received much attention from the fishing and the domestic scientific community. Vietnam's fisheries are primarily small-scale, multi-gear and multi-species, with no clear distinction between "main catch" and "bycatch " species. This situation is further complicated by the lack of a quota-based management mechanism, making it difficult to classify species as target or non-target. However, recent efforts, such as the national plan for sea turtle conservation and research into marine mammal rescue procedures, show increasing attention to bycatch reduction. Studies on sharks and rays is still preliminary but a national action plan is being developed to protect and conserve these species. Above all, the application of quota-based fisheries management is also being researched and implemented. The above efforts demonstrate Vietnam's determination to improve its fisheries conservation and management strategy, and that Vietnam is seriously moving towards sustainable and responsible fisheries.

3.2. International legal framework

3.2.1. United Nations Convention on the Law of the Sea (1982)

The United Nations Convention on the Law of the Sea (UNCLOS) establishes guidelines for the utilization of the world's oceans. Vietnam, joining 168 other member countries, signed UNCLOS on December 10, 1982, and became an official member on July 25, 1994[31]. To align with UNCLOS 1982, Vietnam has enacted several national legal documents, including the Vietnam Law of the Sea 2012. While UNCLOS does not directly address bycatch reduction, it lays the groundwork for marine environment protection and sustainable marine resource management, indirectly aiding in bycatch reduction efforts.

Articles 192 and 194 of UNCLOS mandate state parties to protect and preserve the marine environment, encompassing control over various pollution sources. This includes the environmental impact of unintentional fishing. Additionally, Articles 65 and 120 focus on the conservation and management of marine mammals, aligning with the broader objective of bycatch reduction. UNCLOS principles provide a basis for member states, including Vietnam, to develop and implement innovative strategies for bycatch reduction, thereby supporting marine life conservation and the sustainability of marine resources.

3.2.2. Convention on the conservation and management of migratory offshore fish stocks in the Central and Western Pacific

The Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean is an international agreement aimed at long-term conservation and sustainable use of highly migratory fish stocks. These resources include species listed in Appendix I of UNCLOS, encompassing the tuna and mackerel family Scombridae, the bream family Bramidae, and various shark species.

The Convention established the Central and Western Pacific Fisheries Commission (WCPFC) which is tasked with managing and ensuring the long-term conservation and sustainable use of highly migratory fish stocks in the region[14]. Currently, Vietnam is one of eight countries (the remaining seven include Curacao, Ecuador, El Salvador, Liberia, Nicaragua, Panama, Thailand) that are cooperating non-members [14].

By the end of 2022, WCPFC has issued 4 Conservation and Management Measures (CMMs) related to marine mammals, sea turtles, sharks and rays, including:

- CMM 2011-03: Mentioning the impact of seine fishing activities on species of the cetacean suborder (Cetacean);
    + Prohibiting the setting of purse Purse seines on cetaceans if they are sighted before the start of the set;
    + Implementing requirements for the event of unintentional encircling of cetaceans in purse Purse seines, including mandates for incident reporting; Ensuring the safe release of cetaceans unintentionally caught in purse Purse seines;

+ Requiring an annual report on any instances where cetaceans have been encircled by purse Purse seines of flagged vessels.

- CMM 2018-04 on sea turtle conservation and management: Implementation of FAO Guidelines to reduce sea turtle mortality in fishing activities:

+ Mandates reporting on the implementation of sea turtle conservation measures and interactions with fishing vessels;
+ Requires fishermen to employ techniques to handle and minimize bycatch of sea turtles and mandates annual reporting of such incidents
+ Sets specific requirements for purse seine and longline fishing vessels to reduce bycatch, including the mandatory carrying and use of equipments like line cutters and dehooking devices for the safe handling and release of sea turtles;
+ Establishes reporting requirements for the operational definition of shallow-water swordfish fisheries and mitigation measures like the use of circle hooks in longlines.

- CMM 2019-05 was issued after the meeting from December 5 to 11, 2019 of the WCPFC, approving conservation and management measures for buzzard rays (Mobulidae) in the central and western Pacific region caught in fisheries based on the International Plan of Action for Sharks and Sharks issued by FAO (FAO IPOA Sharks). The main contents of CMM 2019-05 include:

+ Prohibition on retaining, transshipping, storing, or landing mobulid rays;
+ Prohibition on targeted fishing or intentional setting on mobulid rays;
+ Requirement to report on the implementation of CMM 2019-05 specifically for mobulid rays, as part of an annual report.

In addition, CMM 2019-05 includes a detailed Appendix on how to handle and re-release eagle rays for gillnet and longline fisheries (details in the Appendix).

- CMM 2022-04 for sharks:

+ Reporting alternative measures different from those in CMM 2022-04 applied by CCMs in national jurisdictions;
+ Implementing measures to minimize shark bycatch in longline fisheries; Special provisions for handling and protection of whale sharks.
+ Assessing the need for a National Plan of Action for shark conservation and management, and detailing such plans;
+ Ensuring all sharks retained on board are fully utilized and prohibiting finning;
+ Specific protection requirements for the oceanic whitetip shark *Carcharhinus longimanus* (Poey, 1861), the silky shark *Carcharhinus falciformis*

(JP Müller & Henle, 1839) and the whale shark *Rhincodon typus* (A. Smith, 1828) ;

+ Preventing fishing vessels from retaining, transshipping, and landing any fins harvested contrary to CMM 2022-04;
+ Ensuring carcasses and corresponding fins are landed or transshipped together for verification.

3.2.3. Convention on Biological Diversity (CBD)

Vietnam officially joined the Convention on Biological Diversity (CBD) on November 16, 1994 [6]. The CBD's primary goals include conserving biodiversity, promoting the sustainable use of its components, and ensuring equitable sharing of benefits from genetic resources. While CBD does not explicitly address fishing practices, its wider objectives encompass the conservation of marine and coastal biodiversity. This includes efforts to reduce bycatch of marine species like marine mammals, sea turtles, sharks, and rays. Reducing bycatch aligns with CBD's aims, as it contributes to ecosystem balance, protection of endangered species, and sustainable resource use.

3.2.4. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), commonly known as the Washington Convention, focuses on regulating the international trade of endangered plant and animal species to ensure their survival is not jeopardized. CITES does not directly address the reduction of bycatch in its mandate. It provides a framework for controlling and monitoring the international trade of species listed in its Appendices.

While CITES plays an important role in conserving marine species vulnerable to bycatch, such as certain sharks, manta rays, and sea turtles, it does so by regulating international trade in these species, rather than directly managing fisheries or specifying measures to reduce bycatch. The impact of CITES on bycatch is more indirect. For example, by regulating trade in endangered species commonly caught as bycatch, CITES can incentivize fisheries to adopt measures that reduce bycatch, thereby complying with the international trade regime.

3.2.5. Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), also known as the Bonn Convention, is an important international treaty operating under the auspices of the United Nations Environment Program (UNEP). Vietnam does not officially participate in CMS; instead, it participates in separate Agreements, Treaties, and Memorandums of Understanding within the CMS framework [9].

CMS pecifically focuses on the conservation and sustainable use of migratory

species and their habitats. This is distinct from CITES, which regulates international trade in endangered species at risk of extinction. CMS covers both terrestrial and aquatic animals, with a particular focus on vulnerable aquatic species groups such as cetaceans, sea turtles, sharks and rays. This focus is crucial for reducing bycatch, especially in migratory species often impacted by fishing activities.

For sharks and rays, the CMS 'Memorandum of Understanding (MoU) on the Conservation of Migratory Sharks' is a key tool for the protection of migratory shark and ray species. While the MoU is named for sharks, it actually includes all species in the Chondrichthyes class, encompassing both sharks and rays. Currently, 29 species are listed in Appendix I of the MoU, which can be amended through consensus at a signatory meeting. Signed in 2010, the MoU emphasizes international cooperation for conservation, as the majority of these species are intercontinental migrants, focusing on strategies like reducing bycatch, habitat protection, and collaborative research. Vietnam has not yet signed this MoU.

The whale suborder, including whales, dolphins, and porpoises, is protected under two Agreements and two Memorandums of Understanding within the CMS framework. The agreements are the 'Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area' (ACCOBAMS) and the 'Agreement on the Conservation of Small Cetaceans of the Baltic Sea, North East Atlantic, Irish and North Seas' (ASCOBANS). The Memorandums of Understanding are the 'Memorandum of Understanding on the Conservation of Cetaceans and Their Habitats in the Pacific Islands Region' and the 'Memorandum of Understanding concerning the Conservation of the Manatee and Small Cetaceans of Western Africa and Macaronesia.' To date, there are no Agreements or Memorandums of Understanding specifically for whale subspecies in Southeast Asian waters, possibly due to limited data on population stocks, migration routes, breeding, and feeding areas of these species.

For marine mammals like dugongs (Lacépède, 1799) found in Vietnam, CMS has established the "Memorandum of Understanding on the Conservation and Management of Dugongs and Their Habitats," effective from October 31, 2007 [7]. Although Vietnam is not a signatory to this Agreement, it is recognized as part of the "Range States" and is thus encouraged by CMS to adhere to the Memorandum's requirements.

For sea turtles, CMS developed the "Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia" (IOSEA Marine Turtle MoU). This MoU is dedicated to protecting, conserving, replenishing, and managing sea turtles and their habitats. It addresses key issues such as bycatch in fisheries, habitat conservation, and marine environmental pollution. Vietnam became a signatory to the IOSEA Marine Turtle MoU in 2001[8] A significant milestone in Vietnam's sea turtle conservation efforts was the recognition of Con Dao National Park by the United Nations Environment Program (UNEP) as a member of the Network of Important Sea Turtle Conservation Areas in the

Indian Ocean and Southeast Asia (IOSEA Site Network) in 2019[30].

3.2.6. Code of Conduct for Responsible Fisheries of the United Nations Food and Agriculture Organization (FAO)

The FAO Code of Conduct for Responsible Fisheries, issued by the Food and Agriculture Organization of the United Nations, serves as a comprehensive framework to promote sustainable fishing practices worldwide. A main objective of the Code is to reduce bycatch, crucial for maintaining biodiversity and ecological balance in marine ecosystems. The Code emphasizes minimizing bycatch of non-target, small, and endangered species, while also recognizing the adverse impacts of bycatch on marine biota.

To address bycatch, the Code advocates developing and implementing selective fishing methods and gear designed to be less harmful to non-target species and allow juvenile and endangered individuals to escape. An ecosystem approach to fisheries management is promoted, emphasizing consideration of the broader impacts of fishing activities, including those on bycatch species. This approach aims to ensure long-term sustainability of fisheries resources and the wider marine environment.

Accurate data collection and research are considered key components in understanding and minimizing bycatch impacts. This information is essential for developing targeted strategies to effectively reduce bycatch. Additionally, the Code recognizes the importance of training and educating fishers in sustainable fishing methods and the use of equipment and techniques that help reduce bycatch, fostering a sustainable fishing culture that promotes responsibility and conservation in fishing communities.

Furthermore, the Code calls for domestic and international cooperation in implementing effective bycatch reduction measures. This collaboration is important to harmonize efforts across different regions and fisheries, ensuring a cohesive and comprehensive approach to sustainable fisheries management.

Overall, the FAO Code of Conduct for Responsible Fisheries provides guidance to governments, fisheries management organizations, and fishers, supporting environmentally responsible and sustainable practices. By addressing bycatch as part of this broader strategy, the Code makes a significant contribution to global efforts to ensure the health and sustainability of marine ecosystems

3.3. Global Case Studies in Managing and Reducing Bycatch

3.3.1. USA

U.S. fisheries, among the world's largest and most diverse, operate in varied environments from Alaska's cold waters to Hawaii's tropical seas.

U.S. fisheries, renowned for their large-scale and technologically advanced operations, are dominated by single-species fisheries and governed by a combination of state and federal regulations. These fisheries prioritize sustainability and environmental conservation. This management strategy is supported by continuous scientific research

and monitoring, allowing for policy adjustments in response to new ecological data and assessments.

NOAA Fisheries defines bycatch as the unintentional capture of non-target marine species, which are either discarded or result in unrecorded species deaths, emphasizing the need for responsible fishing practices. [20].

The United States has implemented quota-based fisheries management. This system makes the adoption of devices aimed at mitigating bycatch more straightforward. By setting explicit catch ceilings for each type of vessel and fisheries, bycatch increases operational costs and decreases profits. This economic impact encourages businesses and fishermen to actively participate in programs designed to reduce bycatch.

Furthermore, the U.S. employs a Penalty-Reward System, functioning as an indirect tax subsidy. This system applies penalties and rewards to incentivize practices that reduce unintentional fish catches.

NOAA Fisheries' Bycatch Reduction Engineering Program (BREP), authorized under Section 316 of the Magnuson-Stevens Fisheries Conservation and Management Act (MSA), supports these initiatives. The program operates with an annual budget of approximately $2.3 million, furthering efforts to minimize bycatch in U.S. fisheries. [22]

Minimizing bycatch of marine mammals, sea turtles, sharks and rays has been mentioned very early in the U.S legal documents, specifically:

- Marine Mammal Protection Act (MMPA), 1972

This act prohibits the taking of marine mammals in U.S. waters and aims to maintain sustainable marine mammal populations. The MMPA addresses bycatch through its incidental take provisions and requires the development of a Bycatch Reduction Plan for species commonly caught as bycatch in fisheries, such as cetaceans, sea turtles, sharks, rays, and seabirds. These plans involve stakeholders, including fishermen, research institutes, and government agencies, in developing strategies to reduce bycatch, which may entail equipment modifications, timed area closures, and changes in fishing methods. MMPA has been effective in reducing marine mammal bycatch and mortality in U.S. fisheries, contributing to the recovery of some species.

- Endangered Species Act (ESA), 1973

In the context of fisheries, the ESA plays a critical role in reducing bycatch by listing endangered or threatened marine species and implementing recovery plans. When a species listed under the ESA is at risk from bycatch, the Act mandates implementing measures to minimize this impact. These measures may include modifying fishing gears, changing fishing practices, or closing fishing areas temporarily or indefinitely. The ESA has been pivotal in protecting and restoring numerous marine species affected by bycatch, though its enforcement sometimes creates conflicts with commercial fishing interests.

- Magnuson-Stevens Fishery Conservation and Management Act (MSA), 1976

This primary law governs marine fisheries management in U.S. federal waters,

aiming to prevent overfishing, restore fish stocks, and ensure sustainable fisheries. The MSA mandates the development of a Fisheries Management Plan (FMP) for each fishery, which must incorporate measures to reduce bycatch and bycatch mortality within practicable limits. These measures can include gear modifications or restrictions, bycatch quotas, observer programs to monitor bycatch, and temporal area closures to protect vulnerable species. The MSA has effectively reduced bycatch in many U.S. fisheries through its science-based management approach and stringent accountability in fisheries management

- National Bycatch Report from 2011:

This initiative by NOAA Fisheries provides up-to-date bycatch estimates in U.S. fisheries. The report is publicly available on NOAA's website (fisheries.noaa.gov), offering open access to all. Detailed data from 2011 to 2015 is accessible, including bycatch estimates by species and fishery for marine mammals, sea turtles, and seabirds. The overview report has editions from 2011, 2014, 2016, and 2019

Typical U.S. national programs and strategies for bycatch reduction issued by NOAA include:

- Turtle Excluder Devices (TEDs):

The installation of TEDs has been mandatory in shrimp trawling since the late 1980s. TEDs are systems installed near cod end that allow sea turtles and other large animals like sharks, marine mammals to escape when entangled (Figure 1). Since their implementation, TEDs have significantly reduced turtle bycatch. A study from 2007 indicated an efficiency rate of up to 97% in reducing turtle bycatch[11]while maintaining the loss rate for the target species below 2%.

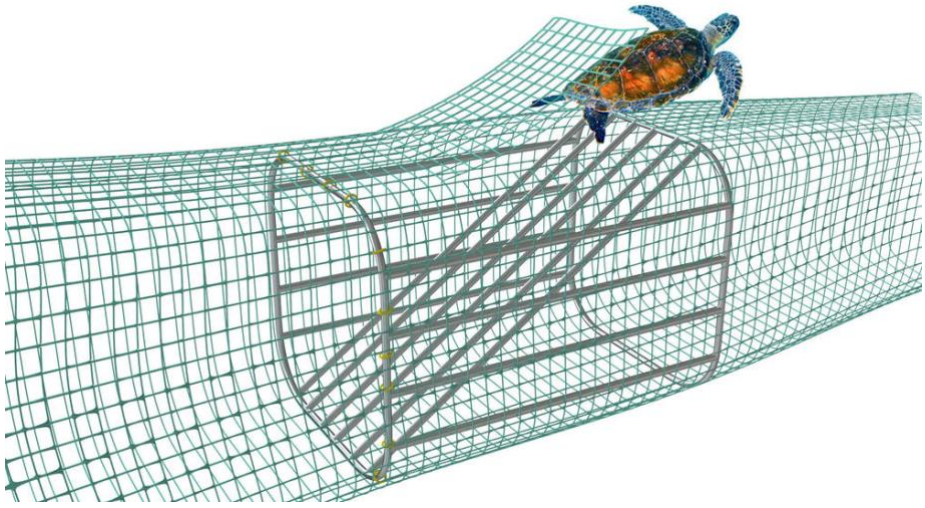

Figure 1. Turtle Escape Devices (TEDs)

- Weak links, pingers and illuminated net

In some fisheries, like those using gillnets and Purse seines, the mesh designs have been altered to maintain effective fishing while reducing mesh strength. This ensures protection for marine mammals, sea turtles, sharks, and large rays, providing them with

a greater chance to escape when caught.

Pingers, acoustic devices attached to fishing nets, are employed to reduce bycatch, particularly of marine mammals. These devices emit sounds ranging from 10 kHz to 160 kHz.

The effectiveness of pingers varies based on the fishery type, targeted species, location, and fishing grounds. Additionally, light warning devices like green flashing lights are attached directly to gillnets (Figure 2). Initially designed to reduce sea turtle entanglement, their benefits also extend to marine mammals, sharks, and rays. Studies have shown that these light devices can reduce bycatch of rays, sawfish, and sharks by up to 95% [27]

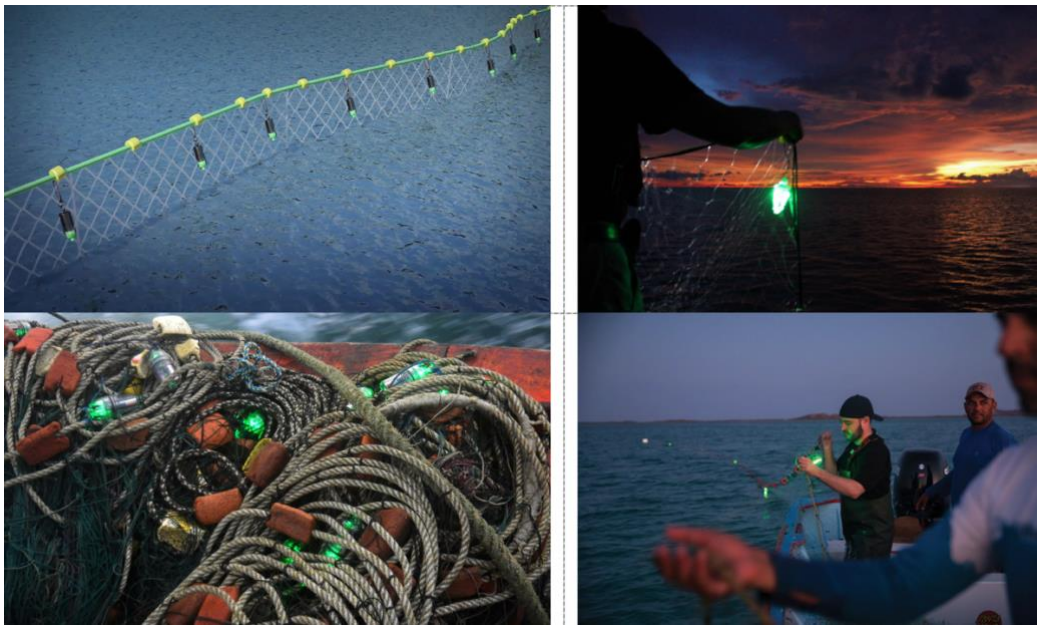

Figure 2. Illuminated net in the United States

- Circle hooks

In the United States, circle hooks are widely used in longline fishing to reduce bycatch rates of sea turtles. These hooks are effective because their size is larger than a sea turtle's mouth, reducing the likelihood of accidental capture [12]. Studies have shown that using circle hooks with squid baits can reduce the bycatch rate of *Caretta caretta* (Linnaeus, 1758) and *Dermochelys coriacea* (Vandelli, 1761) by 86% and 57%, respectively. When paired with fish bait, the bycatch rates decrease even further, to 90% for loggerheads and 65% for leatherbacks.[12].

- National Observer Program (NOP)

The profession of Fishing Vessel Observer, or "Observer," in the United States, originated in the 1970s alongside the formation of NOAA Fisheries. The role gained prominence following the reintroduction of the Magnuson-Stevens Act (MSA) in the 1990s, which aimed to enhance the use of scientific data in fisheries management. NOAA Fisheries oversees the implementation of this program, coordinating fisheries monitoring across various targets and regions. Observers are either employed by private companies contracted by the government or certified by NOAA Fisheries. They receive

extensive training and are issued a practicing certificate before embarking on a vessel. The annual salary of these observers is around $52,663, aligning with the average U.S. income in 2023[15]. Observers will be trained for 2-3 weeks on professional knowledge and survival skills at sea, and will be issued a practicing certificate before boarding the ship. Harassment or obstruction of these observers by crew members can lead to severe penalties, including fines up to $130,000 or imprisonment.

Observers on fishing vessels play a crucial role in collecting essential data on catches, including both target and bycatch species, fishing effort, and interactions with protected species. This information is vital for assessing fish stocks, monitoring the impact of fisheries on ecosystems, and evaluating the effectiveness of management measures.

Summary: The reduction of bycatch in U.S. fisheries is achieved through a comprehensive approach, encompassing regulatory frameworks under laws like the MSA and MMPA. These laws provide clear guidelines for fisheries management. The adoption of innovative technologies, such as Turtle Excluder Devices (TEDs) and Pingers, alongside monitoring programs supported by initiatives like the Bycatch Reduction Engineering Program (BREP), is crucial. Economic incentives and credit systems further encourage sustainable practices among fishermen. Collaborative efforts with a variety of stakeholders and ongoing research and development contribute to adaptive and responsive management, continuously enhancing bycatch reduction strategies.

3.3.2. Indonesia

Indonesia is a country with diverse fisheries, including large-scale fisheries and traditional, small-scale coastal fisheries.

Currently, Indonesia has been actively making efforts to reduce bycatch, especially for vulnerable species such as marine mammals, sea turtles, sharks and rays.

In small-scale fisheries and those not targeting tuna, Indonesia focuses on bycatch reduction through time- and area-based closures, reduced fishing effort, gear conversion, and changes in gear specifications like mesh size, hook type, and exclusion devices. The country also emphasizes community-based fisheries management, involving local fishing communities in the management process. This approach has been relatively effective, though there's room for improvement. Additionally, incentive-based measures like tax benefits, credit programs, or insurance are recognized as potentially effective in reducing bycatch. However, there appears to be a lack of significant interest from the Indonesian government in these incentive-based solutions.[10].

For tuna fishing, as a member of four RFMOs related to tuna, including the Indian Ocean Tuna Commission (IOTC), the Fish Conservation Commission Commission for the Conservation of Southern Bluefin Tuna (CCSBT), WCPFC), Indonesia applies a quota-based fisheries management approach.

In Indonesia, fishermen perceive bycatch of marine mammals, sea turtles, sharks,

and manta rays more as a risk than a benefit. Consequently, they are generally in favor of methods that reduce bycatch of these species [10].

Legally, minimizing bycatch of marine mammals, sea turtles, sharks and rays has been mentioned very early, specifically:

- **Fisheries Law No. 45/2009:** Indonesia's Law No. 45/2009, which amends Fisheries Law No. 31/2004, addresses a wide range of issues related to the development, management, and conservation of fisheries. This amendment includes changes to existing provisions and the introduction of new regulations. Key aspects of the law focus on the management and conservation of fish resources, the utilization of fishing gear and methods, and general fishing regulations.

- Minister's Regulation (MR) No. 56/Permen-KP/2014: The regulation temporarily suspends fishing licenses for vessels constructed abroad in all Indonesian fishing management areas. Its objective is to safeguard fisheries productivity and minimize the bycatch of non-target species, including tuna and sea turtles. Additionally, it aims to address the issue of foreign fishing vessels that enter Indonesian waters illegally, using prohibited fishing gear.

- Minister's Regulation (MR) No. 18/Permen-KP/2021: Indonesia has reinstated the ban on the use of destructive purse seines and trawls, known locally as cantrang, to protect protect the ocean ecosystem. These devices have low selectivity, causing nearly half of all fish caught to be bycatch or discarded. The initial ban was imposed in 2015 and was later amended and supplemented by a new decree from the Ministry of Fisheries in 2020, completely banning purse seines and trawls in Indonesia [2]

- Law No. 45/2009 on fisheries

The law addresses fisheries conservation to support fisheries resource management policies, protected species (including marine mammals) and marine protected areas to be established [25]

- Law No. 32/2014 on Sea

Refers to the protection of the marine environment through conservation of the marine environment, including migratory species, especially marine mammals (Article 50) [25]

- Other related regulations

Other regulations directly related to fisheries management in Indonesia include: Regulation No. 12/2012 of the Ministry of Fisheries and Marine Affairs (MMAF), which pertains to offshore fisheries. This regulation mandates that all fishing vessels operating offshore and catching marine animals as bycatch must ensure their safe release and report these incidents to the competent authority; Regulation No. 30/2012 of MMAF focuses on capture fisheries within Indonesian fishing grounds. It requires fishing vessels with licenses to implement measures for conserving certain marine species, including marine mammals. (Article 73) [25]

Indonesia has implemented various bycatch reduction strategies through MMAF,

in collaboration with international and local partners. These strategies are essential to manage the country's important marine biodiversity and to maintain its position as the world's second largest fish producer. Strategies include:

- **National Plan of Action (NPOA) for the conservation and management of sharks and rays (2016 – 2020)**

As one of the five countries with the world's highest sharks catching [18], Indonesia first issued the NPOA in 2010, then developed a revised NPOA for sharks and fish. drowning in the period 2016-2020. Indonesia has also issued a "National Action Plan on Whale Sharks from 2021-2025" through Ministerial Regulation (MR) No. 16 of 2021 [18]. However, the country faces challenges in effectively managing and limiting the fishing of sharks and rays. There is a lack of comprehensive data on shark and ray stocks, and sustainable management practices for these fisheries are not fully developed. Small-scale inshore fisheries frequently report catches of small sharks and rays.

National Plan of Action (NPOA) for sea turtle management and conservation

In Indonesia, sightings of sea turtles are relatively frequent, particularly species like the Hawksbill *Eretmochelys imbricata* (Linnaeus, 1766) and the Green Turtle *Chelonia mydas* (Linnaeus, 1758). Sea turtles in Indonesia quite common, and products are openly sold in many places [16]. Indonesia launched its National Plan of Action (NPOA) for sea turtles in 2022 and is implementing Ministerial Regulations No. 12/2012 and No. 30/2012 to reduce sea turtle bycatch in fisheries. Additionally, Indonesia collaborates with Coral Triangle countries (Malaysia, Philippines, Solomon Islands, Papua New Guinea, and Timor Leste) through the Coral Triangle Initiative on Coral Reefs, Fish, and Food Security (CTI CFF). This initiative aims to protect threatened migratory species, including sea turtles, and is developing a Regional Plan of Action (RPOA) for 2020-2030. Critical habitats like migration corridors, calving grounds, and nursery and foraging areas have been identified under this program. [17].

- National Plan of Action (NPOA) for marine mammal conservation and management

Marine mammals, including cetacean whales and dugongs, are commonly found in Indonesian waters, which serve as both a crucial habitat and a vital migration route for various species of whales and dolphins [2]. Marine mammal strandings and rescues are relatively frequent in Indonesia. To address this, Indonesia issued a National Plan of Action (NPOA) for the conservation and management of marine mammals for 2016-2020, developed by the Ministry of Marine Affairs and Fisheries (MMAF). The NPOA tackles various unsustainable human activities that affect marine mammals, including bycatch, dynamite fishing, direct capture, tourism-related impacts, captivity, marine dumping, vessel collisions, and interactions with fisheries. It also addresses habitat disturbances from coastal and riverine development, acoustic pollution from commercial and military activities, chemical pollution, biotoxins, and climate change impacts.

Fisheries monitoring program

ndonesia currently operates two tuna fishery monitoring programs in the Indian Ocean: the National Observer Program (NOP) and the Scientific Observer Program (SOP). The NOP, established through MMAF Decree No. 01/2013 since 2013, is aligned with RMFOs standards, coordinated by MMAF, and backed by the Indonesian Pole & Line and Handline Fisheries Association (AP2HI) and its members. This program gathers and provides data on the fishing capacity and output of large fishing vessels, focusing particularly on purse seining and longline fisheries. Furthermore, since 2016, NOP has been supported by the USAID SNAPPER program, which enhances marine data collection activities across Indonesia's 11 fisheries management zones. This support has been crucial in managing Indonesia's vital fish stocks, particularly red snapper and grouper fisheries. The program has trained over 900 individuals in data collection methods, significantly improving stock monitoring for these species. This collaboration has led to the development of a national fisheries management plan and harvest strategy for the deepwater snapper fishery, aimed at preventing overfishing and reinforcing regulations and fisheries control. [32].

The Scientific Observer Program (SOP) was initiated in mid-2005 through a collaboration between RCCF-MMAF and Australia's CSIRO, with funding from ACIAR. Post-2009, the program transitioned to the Indonesian government and the Research Institute for Tuna Fisheries (RITF). Currently, RITF employs six trained observers. However, the SOP's monitoring capacity has seen reductions in the number of trips, coverage capacity, types of monitored occupations, and lacks repetition in data collection. [4].

- Other programs

MMAF has collaborated with NOAA-PIFSC, WWF-Indonesia, and Bogor University to study sea turtle bycatch in Indonesia's small-scale coastal fisheries. This partnership aims to gain a comprehensive understanding of fisheries bycatch across Indonesian waters and to develop effective mitigation strategies. [21].

- Ocean Accounting System

MMAF is developing an ocean accounting system, set to commence from 2021, as part of its commitment to sustainable ocean management. This system will enable the Indonesian government to evaluate the value of marine resources and ecosystem services, as well as track degradation trends. It will serve as a vital index for policy formulation and zoning decisions relating to fisheries, protected areas, and key marine ecosystems like seagrass beds, mangroves, and coral reefs. This initiative is a component of the Global Ocean Accounting Partnership (GOAP) and involves collaboration with statistical agencies, geospatial information bodies, financial and monetary policymakers, and the national development planning ministry [3].

- Cooperate with the Marine Stewardship Council (MSC)

MMAF has renewed its Memorandum of Understanding (MoU) with MSC in

2022, focusing on national Fisheries Improvement Projects (FIPs) for sustainable fishing. This collaboration involves pre-assessing 11 fisheries against the MSC Fisheries Standard and supporting the development of action plans to achieve sustainable certification. The MoU aims to enhance marine fisheries management by 2025, emphasizing improved data collection and monitoring systems to lessen human impact on marine and coastal ecosystems. Minimizing bycatch is a key component of this initiative. [19].

Summary : Indonesian fisheries management combines Individual Transferable Quotas (ITQ) with traditional methods like co-management, Marine Protected Areas (MPAs), and temporary spatial and temporal fishing bans. The country has also issued NPOAs for marine mammals, sea turtles, sharks and rays. The effectiveness of bycatch mitigation efforts varies across different target species, and there is an ongoing need for improvement through domestic research and international collaboration..

3.3.3. Malaysia

In Malaysia, fisheries management employs a comprehensive approach involving input, technical, and output controls. Input controls aim to manage catches and reduce species mortality by zoning fishing areas, limiting fishing efforts, regulating vessel size and power, and strictly manage new fishing licenses. Technical controls include seasonal closures and designated area fishing bans to protect fish populations, alongside establishing marine protected areas and artificial reefs. Output controls or quota systems set total allowable catches and allocate quotas to fishermen. While Malaysia has trialed quota systems, their effective implementation remains challenging due to the multi-species, multi-gear nature of its fisheries. These strategies collectively seek to balance sustainable marine resource use with the fishing industry's economic viability.

Bycatch of marine mammals, sea turtles, sharks and rays in Malaysia primarily occurs in purse sein, and offshore trawling.

Legally, minimizing bycatch of marine mammals, sea turtles, sharks and rays has been addressed early in the Malaysian legal framework, specifically:

- Fisheries Act 1985

This Act deals with fisheries management, including the conservation and development of inland, estuarine and marine capture fisheries in Malaysian waters. It specifically focuses on the protection of marine mammals and sea turtles and includes provisions for establishing marine protected areas. This Act grants the Malaysian Directorate of Fisheries the authority to set licensing conditions related to fishery resources. Additionally, the legal framework incorporates the Fisheries Act 1985 and its regulations, outlining various offenses and penalties, including those related to bycatch in fishing activities.

- Wildlife Conservation Act 2010

This Act is pivotal in regulating, protecting, conserving, and managing wildlife in Malaysia. While its jurisdiction covers Peninsular Malaysia and the Federal Territory of

Labuan, it is an integral part of a more extensive legal framework dedicated to wildlife conservation. This includes species impacted by fishing activities, such as cetaceans, sea turtles, sharks and rays, reflecting Malaysia's commitment to preserving its diverse marine life.

- Malaysia, through its Ministry of Fisheries and Marine Affairs (MMAF), in collaboration with international and local partners, has implemented a range of bycatch reduction strategies and policies, includes:

- **National Plan of Action (NPOA) for sharks conservation and management**

- Sharks are commonly caught as bycatch in Malaysia, prompting the adoption of the National Plan of Action for Sharks (NPOA-Shark) in 2006, which was later revised in 2014[26]. This NPOA, aligned with the FAO's IPOA-Sharks, aims to ensure the conservation, management, and long-term sustainable use of shark populations in Malaysian waters..

- National Plan of Action (NPOA) on sea turtle management and conservation

Malaysia actively participates in turtle conservation programs, exemplified by the issuance of the National Plan of Action for Marine Turtles (NPOA-Marine Turtle) in 2008. This plan serves as the foundation for sea turtle conservation and management efforts. To minimize interactions between turtles and fishing gear, particularly trawl nets, Malaysia developed and promoted the use of the "Juvenile Turtle Escape Device." Additionally, the use of circle hooks in longline and handline fishing is encouraged among fishermen to further reduce turtle bycatch.

Ecosystem approach to fisheries management (EAFM)

Ecosystem Approach to Fisheries Management (EAFM) is an established tool in the Philippines and is gaining adoption in other countries, including Malaysia. This approach involves active participation from fishing communities, government bodies, and academia, aiming to incorporate sustainable practices into both national and local policies. A critical aspect of EAFM is reducing bycatch, which aids in maintaining the marine environment's ecological balance and biodiversity. EAFM takes a holistic view, encompassing the broader marine ecosystem and the socio-economic dimensions of fishing communities. It seeks to balance ecological, economic, and social objectives, ensuring sustainable operations across the entire ecosystem.

In addition to the strategies and policies mentioned, Malaysia also applies other technical policies such as 1) Regulations on areas and ban periods for certain types of fishing gear; 2) Improve fishing gear and fishing techniques; 3) Change the type of fishing gear.

Summary: In Malaysia, the complexity of multi-gear, multi-species fisheries, particularly small-scale operations, presents challenges in reducing bycatch of species like sea turtles, sharks and rays. While diverse fishing methods offer adaptability in bycatch reduction techniques, standardizing regulations and enforcement is difficult. Often, small-scale fisheries lack strict adherence to bycatch reduction targets due to

limited enforcement and data collection. To enhance effectiveness, stronger measures such as mandatory catch logging and a comprehensive fisheries observation program are necessary. These steps would improve data accuracy, ensure compliance, and protect sensitive marine species more effectively.

3.3.4. Thailand

Thai fisheries, characterized as multi-species and multi-gear, include small-scale operations in near-shore waters and large-scale, industrial activities in offshore regions. These fisheries bear notable similarities to those in Vietnam. A significant portion of Thailand's fishing occurs in the Gulf of Thailand, which contributes up to 68.4% of the country's total fishing output.

In Thailand, bycatch of marine mammals, sea turtles, sharks and rays primarily occurs in key fisheries like gill nets, longlines, and trawls. Studies indicate that most of these species, with the exception of sharks and rays, are often released after being caught in the nets. [28].

As a member of the Indian Ocean Tuna Commission (IOTC) and a cooperating non-member with the Western and Central Pacific Fisheries Commission (WCPFC), Thailand is obligated to implement the Conservation and Management Measures (CMMs) proposed by these organizations.

Thailand manages its marine capture fisheries through a combination of input controls, technical measures, and ecosystem protection. Input controls involve limiting high-performance vessel numbers through licensing, based on Total Allowable Effort (TAE). Each vessel is also allocated a specific number of fishing days, with fishing ceasing upon reaching this limit. Restrictions on fishing gear quantity and size are in place. Thailand's fishery resources are categorized into three main groups: pelagic fishes, anchovies, and demersal fish, focusing on two primary fishing grounds: the Gulf of Thailand and the Andaman Sea. [13]. TAE is is specifically allocated for each marine resources group within each type of fishing ground. Additionally, TAE is differentiated based on the efficiency of the fishing gear, distinguishing between high-efficiency and low-efficiency.

Legally, minimizing bycatch of marine mammals, sea turtles, sharks and rays has been addressed early in the Thai legal framework, specifically:

- Fisheries Act BE 2490 (1947)

The Fisheries Act in Thailand, encompassing both fisheries and aquaculture, categorizes fisheries into four distinct types. The Act empowers the Minister of Agriculture and Cooperatives or the Provincial Governor to enact regulations. While it doesn't specifically focus on bycatch reduction or protecting specific marine species, its broad regulatory framework for fisheries management may indirectly influence these aspects.

- The Wildlife Reservation and Protection Act, BE 2535 (1992)

The Act in Thailand enforces stringent controls on hunting, breeding, possession,

and trade of conserved or protected wildlife, including marine mammals and sea turtles. Activities in Wildlife Sanctuaries are heavily regulated, permitting only certain actions like hunting or endangering wildlife for educational or scientific research with official approval. The import and export of wild animals, particularly conserved and protected species, are also closely monitored. These measures aim to protect marine wildlife and their habitats, indirectly aiding in bycatch reduction and promoting sustainable management of marine ecosystems.

- Royal Ordinance on Fisheries (Royal Ordinance on Fisheries) BE 2560 2017

The decree amending the Royal Decree on Fisheries, 2015, focuses on sustainable fisheries based on catchability and maximum sustainable yield (MSY) of aquatic species. It includes regulations for port in – port out controls for fishing vessels, mandating the use of Vessel Monitoring Systems (VMS) and authorized transit with observers for vessels operating outside Thai waters. This Executive Order aids in reducing bycatch and protecting marine species by managing fishing and transshipment activities to ensure adherence to sustainable practices. [1].

- National Plan of Action (NPOA) for sharks conservation and management (2010 – 2024)

NPOA is designed to address the increasing bycatch of sharks in marine fisheries employing methods like trawls, purse seines, gill nets, and longline fishing. Despite a decline in shark catches in both the Gulf of Thailand and the Andaman Sea from 2002 to 2014, and global demand for shark products increasing. According to the Government, intentional shark fishing in Thailand is often unreported. Sharks are mainly caught as bycatch, making up about 0.72% of the total catch. However, shark fin soup is notably popular in Thailand, present in approximately 72% of weddings, 61% of family gatherings, and 47% of business events..

- National Plan of Action (NPOA) for sea turtle conservation and management

In its Country Report to the IOTC, Thailand has reported advancements in applying FAO guidelines for sea turtle conservation. Regulations for Thai fishing vessels in IOTC areas include specific sea turtle conservation measures: Article 14 prohibits using Purse seines around marine mammals, sea turtles, or whale sharks; Article 18 mandates releasing and recording bycatch of sensitive species, like sea turtles; and Article 19 requires any caught sea turtles that are unwell to be nurtured back to health before release.

In addition to the Thai government's efforts, the private sector's role in developing sustainable fisheries and minimizing bycatch is significant. Thai Union Group, a global seafood leader, has committed to becoming a Sustainable Fisheries Partner with the NGO Conservation Protecting Ocean Wildlife. This involves identifying high-risk bycatch fisheries and implementing measures to minimize risks to endangered, threatened, and protected species. Key initiatives include 100% observer coverage on fishing vessels, support for scientific methods to reduce bycatch, improving supply

chains for sustainability, and maintaining transparency through public reporting. Thai Union's leadership sets industry standards and encourages other companies to contribute to marine biodiversity protection. [29]

Summary: The Thai government has taken significant steps to improve fisheries management and regulation, contributing to fish population recovery and better working conditions in the industry. These actions position Thailand as a regional leader in fisheries restoration and enhance its international standing. Key measures include decommissioning commercial vessels and revoking licenses for illegal fishing, resulting in fewer commercial vessels. The private sector, exemplified by Thai Union's commitment to the Ocean Wildlife Protection Sustainable Fisheries Partnership, demonstrates the industry's potential to reduce bycatch, with more companies encouraged to join this conservation effort.

3.3.5. Insights

Vietnam's fisheries, characterized by their diversity in species, gear types, and predominantly small-scale fisheries, demand a management approach that carefully balances ecological considerations with the economic realities faced by local fishermen.

From the United States, Vietnam can learn about using advanced technology to reduce bycatch. The U.S. has successfully reduced bycatch of non-target species in longline fisheries and trawl nets by implementing circle hooks and Turtle Excluder Devices (TEDs). Adapting such technologies to Vietnam's context, particularly in small-scale fisheries, involves ensuring affordability, ease of use, and minimal disruption to traditional fishing practices. The U.S. model also highlights the importance of strict enforcement and ongoing research to continually improve bycatch mitigation technologies.

In Southeast Asia, Vietnam could benefit from adopting Malaysia's community-based management and Indonesia's spatio-temporal management strategies. Malaysia's approach of involving local communities in fisheries management could be particularly effective for Vietnam's small-scale fisheries. Training fishermen to identify and report bycatch, and involving them in decision-making, can enhance management and compliance. Similarly, Indonesia's seasonal closures and habitat protection for marine mammals, sea turtles, sharks and rays could serve as a model. Implementing such measures in Vietnam could significantly reduce bycatch by identifying and safeguarding critical habitats.

Finally, Thailand's advanced monitoring, control, and surveillance systems offer a model for Vietnam, especially in ensuring compliance with fishing regulations and reducing bycatch. Implementing robust monitoring, including electronic methods, is crucial for Vietnam. This would not only ensure adherence to national laws but also aid in meeting WCPFC’s CMMs. As Vietnam considers introducing Individual Transferable Quotas (ITQs) for certain species, integrating bycatch considerations could incentivize fishermen to engage in more selective and sustainable practices, potentially structuring

ITQs to reward lower bycatch rates.

By integrating diverse international approaches with its unique fisheries dynamics, Vietnam can formulate an effective bycatch reduction strategy. This plan should be adaptable and responsive to the changing marine ecosystems and fishing practices. Utilizing a mix of technological innovation, community involvement, strategic spatial management, thorough monitoring, and a cohesive policy framework, Vietnam has the opportunity to establish a more sustainable and responsible seafood industry.

3.4. National legal framework

3.4.1. Laws

- Penal Code 2015 (amended and supplemented in 2017), Article 244 regulates the acts of illegally hunting, capturing, transporting, trading, keeping, and storing species on the list of endangered, precious and rare species . Those who protect or transport, trade, or store products/parts thereof (regardless of quantity, volume, value of exhibits) will be criminally prosecuted with a maximum penalty of up to 15 years in prison. prison.

Regulations on criminal penalties for illegal hunting, capturing, transporting, trading, captivity, and storage of species on the list of endangered precious and rare species contribute to reducing the retention of non-native species. target species but are unintentionally catch (such as sea turtles, sharks/shrimps...) for consumption or commercial purposes.

- Fisheries Law No. 18/2017/QH14 dated November 21, 2017. This Law has a chapter (chapter II) with articles and clauses regulating issues related to the protection and development of aquatic resources, including the establishment of marine protected areas. This law also regulates the management and protection of endangered, precious and rare aquatic products.

- Vietnam's Law on Biodiversity No. 20/2008/QH12, dated November 13, 2008, includes critical provisions for wildlife protection. Article 7 strictly prohibits activities such as hunting, capturing, killing, transporting, and trading endangered, precious, and rare species prioritized for protection. It also forbids advertising, marketing, and consuming products derived from these species. Article 44 mandates that certain wild species are not to be fished, with the Ministry of Agriculture and Rural Development coordinating with the Ministry of Natural Resources and Environment on regulations. It requires periodic publication of lists detailing which wild species are banned from fishing and those allowed under special conditions.

3.4.2. Decrees

- Decree No. 26/2019/ND-CP dated March 8, 2019 of the Government detailing a number of articles and measures to implement the Law on Fisheries, which has full regulations for endangered, precious and rare aquatic species.

Under Decree 26/2019/ND-CP, endangered, precious, and rare aquatic species in Vietnam are categorized into two groups: Group I and Group II. The specific list of these

species is detailed in Appendix II, accompanying the Decree. Notably, marine mammals, sea turtles, sharks and rays are classified under Group I, indicating their high conservation priority.

- Decree No. 42/2019/ND-CP, issued by the Vietnamese government on May 16, 2019, outlines penalties for administrative violations in fisheries. Articles 7, 8, and 9 of the Decree specify fines for violations in prohibited fishing areas, management of endangered, precious, and rare aquatic species, and marine protected areas. This Decree supersedes Decree 103/2013/ND-CP regarding sanctions for administrative violations related to these aquatic species. However, it addresses the previous lack of stipulations for handling related administrative violations, providing authorities with a clear basis for management and enforcement.

- Decree No. 160/2013/ND-CP, dated November 12, 2013 of the Government on criteria for determining species and management regime for species in the list of endangered, precious and rare species prioritized for protection .

- Decree No. 179/2013/ND-CP dated November 14, 2013 of the Government regulating penalties for administrative violations in the field of environment, Article 42: Violations of regulations on wild plant species and breeds plants, mushrooms, microorganisms or body parts, products of wild animals, and livestock breeds on the List of Endangered, Precious and Rare Species prioritized for protection.

3.4.3. Circulars

- Circular 19/2018/TT-BNNPTNT dated November 15, 2018 of the Minister of Agriculture and Rural Development on guidelines for protection and development of aquatic resources;

- Circular No. 01/2022/TT-BNNPTNT, issued by Vietnam's Ministry of Agriculture and Rural Development on January 18, 2022, amends and supplements existing circulars in the field of fisheries. Notably, in Appendix VII, issued with the Circular, it introduces form No. 01 for the fishing logbook. This form includes a section for declaring information about endangered, precious, and dangerous aquatic species (like whales, dolphins, dugongs, manta rays, sea turtles, leatherback turtles, and other species) that are encountered or unintentionally caught during marine fisheries operations.

3.4.4. Decisions

- Decision No. 339/QD-TTg, dated March 11, 2021, by the Prime Minister, outlines Vietnam's Fisheries Development Strategy to 2030, with a vision to 2045. It includes a directive to "...Establish new, expand and improve the operational efficiency of marine protected areas. Pay attention to protecting spawning grounds, nurturing areas where young aquatic species live and migratory routes of aquatic species..." and an orientation for marine capture fisheries that aims to "... Minimize and ultimately cease the use of destructive fishing gear that damages aquatic resources. Transition from gear that significantly harms aquatic resources and consumes high amounts of fuel to

alternatives that are environmentally friendly and aquatic resources...".

- Decision No. 1176/QD-TTg, dated September 12, 2019, by the Prime Minister, approves the "Vietnam's Endangered Sea Turtle Species Conservation Program to 2025, with a vision to 2030." This program aims to achieve the government's goals of preserving endangered, precious, and rare species, and enhancing biodiversity conservation. It focuses on specific actions to protect turtle species, particularly those endangered and prioritized for protection, and aims to increase awareness among agencies, organizations, individuals, and communities about the importance of conserving Vietnam's turtle species. The program's objectives include completing the legal documentation to establish a basis for conserving endangered turtle species, enhancing investigation, evaluation, and research of such species, especially those considered endangered, precious, and rare. It aims to build and efficiently manage protected areas, including rescue operations, and to ensure effective breeding and conservation of prioritized turtle species. Additionally, the program seeks to strengthen management and law enforcement in conserving endangered turtles, and to increase awareness and community involvement in their conservation.

- Decision No. 208/QD-TTg On March 10, 2023, the Prime Minister issued and approved a project aimed at transforming certain marine capture fisheries that are negatively impacting both resources and the ecological environment.

The goal of the project is to transition from fishing gear that significantly impacts resources, the environment, and ecosystems, to alternatives with lesser effects. It also aims to relocate capture fisheries with considerable impacts to other sectors such as aquaculture. This approach is intended to gradually balance fishing efforts in line with the capacity for aquatic resource recovery and regeneration.

This decision also provides specific regulations for trawling and tuna fishing:

Reducing trawl fishing vessels with the maximum length of 15m or more, fishing vessels aged 15 years or more in the period up to 2025 and gradually reducing in the period 2026 - 2030.

The policy stipulates that licenses will not be re-issued for renting or purchasing fishing vessels from other regions for local trawling and tuna fishing activities. The approval to lease or buy fishing vessels will only be granted if the buyer commits to switching to alternative fishing gears or fisheries.

For fishing vessels that register to change their fishing gear, written approval for conversion is only granted if they switch to fisheries methods other than trawling and tuna gillnet fisheries.

- Decision No. 1090/QD-TTg dated September 19, 2022 of the Prime Minister: On approving the National Program to develop effective and sustainable marine capture fisheries in the period 2022 - 2025, orientation to 2030 .

One of the specific goals of this decision by 2025 is "to monitor 100% of marine capture fisheries products and imported seafood materials". Monitoring marine catches

will be one of the solutions to ensure compliance with fishing regulations and measures to reduce bycatch.

- Decision No. 811/QD-BNN dated March 14, 2016 of the Ministry of Agriculture and Rural Development approving the Vietnam sea turtle conservation action plan for the period 2016-2025 with the general goal of: conservation , effectively and sustainably protect sea turtle populations and their habitats in Vietnam.

3.5. Summary

Vietnam's national legal framework related to bycatch is comprehensive, with clear directives including the expansion of marine protected areas, minimizing and eventually ceasing destructive fishing gears, and enhancing monitoring of aquatic products and fishing vessels. However, specific regulations directly addressing bycatch are either non-existent or seldom mentioned in legal documents. This suggests a need for more targeted regulations in this area.

Detail:

- There are no specific regulations on bycatch for distinct capture fisheries (including capture fisheries groups); There are only regulations on the mesh size of fishing gear to protect juvenile (Circular 01/2022/TT-BNNPTNT);

+ There are no specific regulations for trawling, which has a high risk of bycatch;

+ There are currently no mandatory requirements for using equipment designed to repel marine mammals on purse seine fishing gear (an endangered aquatic species prioritized for protection according to UNCLOS 1982);

- The current framework lacks a mechanism to monitor bycatch. While there are regulations for supervisors on fishing vessels, specific regulations or mechanisms for implementation are absent, with monitoring efforts only being tested within the scope of certain projects;

- Sharks and rays: there are no regulations and technical mitigation measures such as using magnetic field generating devices, hydroacoustics, and special chemicals;

- There are no regulations or measures to minimize lost, abandoned, or discarded fishing gear (ALDFG) at sea;

- No national strategy/action plan has been issued on the conservation of marine mammals, sharks and rays (there is only an action plan on sea turtle conservation).

IV. SUGGESTED STRATEGIES FOR DEVELOPING A PLAN TO MINIMIZE BYCATCH OF SEA TURTLES, MARINE MAMMALS, SHARKS, AND RAYS IN VIETNAM

Establishing a National Plan of Action (NPOA) to reduce bycatch in Vietnam, particularly for marine mammals, sharks, rays, and sea turtles, is crucial both ecologically and for meeting international regulations. This is underscored by the U.S. Marine Mammal Protection Act (MMPA), which requires countries exporting fish and fish products to the U.S. to demonstrate that their fishing practices minimize bycatch of marine animals. For Vietnam, a significant seafood exporter to the U.S., adhering to

these standards is not only an environmental responsibility but also a vital economic strategy.

Marine mammals like dolphins and whales are crucial for marine ecosystem health and stability, often serving as indicators of ocean health. Their decline can signify broader ecological issues. Due to their size and migration patterns overlapping with fishing areas, these species are highly susceptible to bycatch. A decrease in marine mammal populations due to bycatch can disrupt marine ecosystems, potentially leading to cascading effects throughout the ocean's food web.

Sharks and rays, each playing unique roles in marine ecosystems, are significantly impacted by bycatch. Sharks, as an apex predators, help maintain species diversity and population health in the ocean. Manta rays are vital to seafloor ecosystems. Declines in these species can cause imbalances, affecting marine biodiversity and habitat health. In Vietnam, while sharks and rays are not the main targets in marine capture fisheries, they are not usually discarded due to their economic value. Developing an NPOA for their conservation and management is more complex than for sea turtles and cetaceans, necessitating specific research and evaluation.

For Vietnam, implementing an NPOA is not just an environmental initiative but also a crucial economic strategy. Given the significance of the U.S. as a major market for Vietnamese seafood exports, adhering to MMPA standards is vital for maintaining this trade relationship. Non-compliance could lead to restrictions or bans on Vietnamese seafood imports, impacting the country's economy significantly. Fisheries are a key sector in Vietnam, providing livelihoods for millions and contributing to national food security. Thus, aligning with MMPA standards is essential for the continued prosperity of Vietnam's fisheries industry.

Implementing an NPOA not only aligns Vietnam with global conservation efforts but also underscores its commitment to sustainable fisheries and environmental stewardship. This effort enhances Vietnam's international reputation as a responsible global environmental contributor. Effective bycatch reduction strategies will protect marine biodiversity and support sustainable fishing industry development, fulfilling Vietnam's international conservation and trade obligations. This approach is essential for the long-term health of Vietnam's marine ecosystem, the viability of its fishing industry, and its standing in the global community.

4.1. Technical solutions

To minimize bycatch of rare species in general and marine mammals in particular in Vietnamese waters, it is necessary to consider implementing the following technical solutions:

- Conducting comprehensive surveys to determine the current status of bycatch in marine mammal populations, sea turtles, sharks and rays;

- Investigating and improving fishing technologies and techniques that are safe, effective, environmentally friendly, and specifically aimed at minimizing bycatch of

these species;

- Researching and implementing dolphin repelling devices in purse seines, capture nets, gillnets, and tuna fisheries to reduce marine mammal bycatch;

- Developing and refining Marine Mammal Exclusion Devices (MEDs) for use in offshore fishing to allow the safe release of marine mammals;

- Enhancing gillnet fishing methods to lower the bycatch risk for marine mammals, including the application of visual deterrents like altering rope colors, brightness, or shapes;

- Modifying fishing hooks to reduce bycatch of marine mammals;

- Developing technical protocols for fisheries that use dolphin chasing devices, MEDs, and improved gear, aimed at reducing bycatch in Vietnam's marine mammal populations.

4.2. Solutions for management and conservation

4.2.1. International

Vietnam's adherence to the regulations of RFMOs like WCPFC is essential, particularly in implementing CMMs such as CMM 2022-04 for sharks and rays, CMM 2018-04 for sea turtles, and CMM 2019-05 for Mobulid rays. As a Cooperating non-member, maintaining international standards is crucial for Vietnam's global market reputation. Non-compliance could lead to sanctions or trade restrictions, impacting access to key markets with strict seafood sustainability standards. Conforming to RFMO regulations is vital for Vietnam's continued market access and participation in the international seafood trade.

In addition to RFMO regulations, seafood import markets like the United States have their own criteria, particularly for the protection, conservation, and management of marine mammals. Compliance with these criteria is crucial, especially considering challenges like the EU's yellow card on IUU fishing. Promptly implementing necessary CMMs to demonstrate proactive steps in marine mammal conservation is essential for Vietnam to prevent potential barriers or export bans, particularly into the U.S. market.

International and regional collaboration is crucial in tackling marine bycatch and conserving vulnerable species like cetaceans, sharks, rays, and sea turtles, which often migrate through multiple countries' waters. This cooperation ensures uniformity in fishing regulations across different regions, promoting a cohesive approach to preserving marine biodiversity. Sharing knowledge and resources is vital, enabling countries to leverage each other's expertise, particularly in technology and sustainable fishing methods. Such collaborative efforts are key to effective management and protection of these migratory species.

Sustainable fisheries management, supported by international cooperation, is vital for the long-term health of fish stocks, crucial for global food security and the economies of many nations. Such collaboration also enables countries to meet their international conservation commitments under various treaties. Ultimately, international and regional

cooperation is both strategic and essential for effective marine conservation, promoting ecological balance, economic sustainability, and global responsibility.

4.2.2. Vietnam

a) Develop policies and regulations to protect and rescue marine mammals, sea turtles, sharks and rays

- Regulations for licensing the hunting, capturing, and importing of marine mammals, sea turtles, sharks, and rays for scientific research, educational exhibits, or conservation enhancement should be included in the amendment of Decree 26/2019/ND-CP.

- Policy development is needed to encourage participation in marine mammal conservation by organizations and individuals through Associations, Fisheries Organizations, and Coastal Fisheries Community Groups. This should include collaboration for joint protection and calls for support from NGOs in terms of financial and technical resources for marine mammal conservation.

b) Establishing an observation program for fisheries with regular bycatch of marine mammals, sea turtles, sharks, and rays

A fisheries monitor program in marine fisheries management is crucial for ecological conservation and adherence to international standards. Serving as a vital tool for data collection and monitoring, it enables detailed observation and documentation of marine mammal interactions with fishing activities. This data is essential for shaping policy and conservation strategies aimed at reducing bycatch and protecting marine species.

Additionally, such a program is key in ensuring compliance with international regulations, including the US Marine Mammal Protection Act (MMPA). By systematically recording marine mammal bycatch, the program provides crucial evidence of monitoring and mitigation efforts, a requirement for exporting seafood to the United States.

The fisheries monitoring program is crucial for promoting sustainable fishing by identifying bycatch hotspots and high-risk activities, guiding the industry towards more responsible practices, and safeguarding marine ecosystems and fishing community sustainability.

Moreover, the program significantly raises awareness among fishermen and communities about the impact of fishing on marine mammals. Its educational and capacity-building aspects empower local communities in conservation efforts, fostering active participation in protecting marine life and ecosystems.

The dynamic nature of marine ecosystems calls for adaptive management strategies. The observer program, providing continuous, current information, facilitates timely adjustments to management in response to changes in marine mammal populations or fishing practices. Fundamentally, this program is more than a monitoring tool; it's foundational for comprehensive marine conservation, sustainable fisheries

management, and fulfilling international environmental commitments.

Deploying fisheries observers for marine mammals, sea turtles, and sharks in Vietnam has advantages due to the few fisheries group and the typically short duration of fishing trips. Additionally, limited fishing in international waters simplifies the process, making the supervision task easier and more convenient compared to other countries with larger-scale operations or extensive international fishing activities.

Disadvantages, As highlighted in the previous report, Vietnam currently lacks regulations specific to the profession of "Fisheries observer". Typically, individuals in this role are researchers from institutes, driven by the needs of ongoing projects and topics. Moreover, identifying marine mammals presents unique challenges compared to other species, as it often requires distant observation, unlike species identification of captured individuals in nets. Such differences pose additional monitoring challenges. Furthermore, species identification demands extensive professional training, and specialized human resources are usually confined to certain institutes, limiting large-scale implementation. Challenges such as the willingness of fishermen to cooperate with observers, safety concerns, sea-related risks, and the absence of both professional regulations and protective measures for observers are significant and require resolution.

c) Implementing a career transition program for fisheries with high incidence of bycatch including marine mammals, sea turtles, sharks, and rays

To effectively tackle the issue of bycatch in fisheries, particularly concerning marine mammals, sea turtles, sharks and rays, the development of a comprehensive and targeted career transition program is proposed. This program will focus on sustainable fishing alternatives and active community involvement. The initial phase will involve an in-depth analysis to gauge the prevalence of bycatch and the economic reliance of local communities on fishing practices. This stage will also encompass collaborations with various stakeholders, such as fishermen, community leaders, and marine conservation specialists. These collaborations are crucial to ensure that the program is both appropriate and well-received by the community.

The subsequent phase of the program will concentrate on skill enhancement and educational initiatives, aimed at preparing fishermen for diverse alternative careers. These alternatives will encompass a variety of sectors including aquaculture, marine tourism, coastal agriculture, and participation in marine conservation initiatives. Furthermore, a critical component of this phase will be business development and entrepreneurship training. This training is essential to empower fishermen to explore and establish new business ventures, thereby facilitating a smooth transition to these alternative livelihoods and contributing to the sustainability of their local communities.

The program will further incorporate collaborations with local businesses and industries to aid in job placements, ensuring a seamless transition for fishermen to new career paths. To support this transition, financial assistance and incentives will be offered, particularly aimed at covering the initial setup costs for new ventures.

Additionally, the establishment of mentoring programs and support networks will play a crucial role. These elements will provide continuous guidance and support, fostering a nurturing environment for participants as they navigate their new career trajectories.

A central element of the program is the inclusion of environmental education, with a strong emphasis on the significance of marine conservation and the adoption of sustainable practices. This educational aspect is designed to foster a culture of long-term ecological responsibility and heightened awareness. To ensure the effectiveness of the program, regular monitoring and evaluation will be integral, enabling timely adjustments as needed.

In its final stages, the program will actively support community development initiatives and advocate for policy reforms that favor sustainable livelihoods and fishing practices. This holistic approach aims not just to mitigate bycatch issues but also to enhance the well-being of fishermen and their communities. By doing so, the program seeks to establish a harmonious balance between the economic necessities of the fishing communities and the imperative of environmental conservation.

d) Expanding the list of no-take and temporarily restricted zones in areas frequently inhabited by marine mammals, sea turtles, sharks and rays

Given the scarcity of specific research on marine mammals, sea turtles, sharks and rays in Vietnam, formulating a strategy for creating no-fishing zones and implementing temporary fishing restrictions demands a thoughtfully tailored approach. In the face of limited detailed data on cetaceans, sharks and rays, Vietnam will have to leverage a blend of broader regional studies, expert consultations, and initial exploratory research efforts. This combined approach is essential to accurately identify and designate critical habitats and migration corridors for these species, ensuring effective conservation measures.

In response to the need for comprehensive data on marine species, Vietnam has the opportunity to engage in collaborative efforts with international marine conservation organizations and neighboring countries. By tapping into their extensive research and data, Vietnam can gain valuable insights into the regional behavioral patterns of marine mammals, sea turtles, sharks, and rays. This information can then be effectively applied to understand and protect Vietnam's own marine ecosystem. Such cross-border cooperation is crucial for developing a more complete understanding of these species' habits and habitats, thereby facilitating more informed and effective conservation strategies within Vietnam's maritime domain.

Furthermore, Vietnam could initiate pilot research projects aimed at gathering fundamental data on the presence and behavioral patterns of marine mammals, sea turtles, sharks, and rays within its territorial waters. These projects might include tagging and tracking programs, aerial or boat-based surveys, and leveraging reports from local communities. Involving fishermen and local communities in these research efforts is particularly valuable. Their firsthand knowledge and observations can offer critical

insights into the movements and habits of marine life. This grassroots-level involvement not only enriches the data collected but also fosters a sense of stewardship and engagement within the community, contributing to more effective and sustainable marine conservation practices.

In the meantime, Vietnam could set up temporary protected areas in regions known to be common habitats for these marine species. As an initial step, safeguarding zones around coral reefs, seagrass beds, and estuaries would be strategic, considering these environments are favored habitats and breeding grounds for numerous dolphin species, among others. These provisional conservation areas can then be dynamically adjusted and refined as more specific and detailed data becomes available. This approach allows for immediate conservation actions while laying the groundwork for more tailored and effective measures in the future based on evolving research findings.

Moreover, adopting a preventative approach to fisheries management can yield significant benefits. This strategy would encompass setting conservative fishing limits to prevent overfishing of marine resources. Additionally, the use of fishing gear specifically designed to minimize bycatch should be encouraged. Implementing temporary closures in areas where bycatch incidents are frequently reported is also crucial, even if comprehensive data on these incidents is not yet available. Such preemptive measures are essential for safeguarding vulnerable marine species and ecosystems, ensuring sustainable fisheries management while more detailed research is underway.

Ultimately, the objective is to progressively develop a robust, data-informed understanding of Vietnam's marine ecosystems. This knowledge will enable the implementation of more effective and precisely targeted conservation measures. Such an approach goes beyond just safeguarding marine mammals, sharks, and rays; it also promotes sustainable fishing practices that harmonize ecological preservation with the economic requirements of local communities. This balanced direction is crucial for ensuring the health and sustainability of marine environments while supporting the livelihoods that depend on them, thereby achieving a cohesive and sustainable approach to marine resource management**.**

4.3. Strategies to Strengthen Human Resource Capabilities

- Enhance staffing levels in **the MPA** and wildlife care and rescue facilities**;**

- Prioritize the rescue of marine mammals and sea turtles, utilizing funds from the Aquatic Resources Protection and Development Fund**;**

- Develop sustainable financial mechanisms and policies to facilitate resource mobilization for marine mammal conservation**;**

- Conduct research and invest in establishing rescue stations in **the MPAs** frequently visited by marine mammals and sea turtles, catering to the operational needs of the Patrol and Control Team**;**

- The Patrol and Control Team should focus on patrolling and enforcing

regulations in **the MPAs**, engage in communication and tourist guidance activities, and distribute informational leaflets outlining permitted and prohibited behaviors for tourists on the islands**;**

- Allocate funds for specialized equipment to enhance patrol and control operations at sea**;**

- Invest in the renovation and improvement of management station facilities in **the MPAs**, upgrading stations, workplaces, and living areas to support patrol, control, and ecotourism management on the islands**;**

- Establish a zoning buoy system to clearly demarcate functional areas, especially the core and development recovery zones, to facilitate monitoring, patrolling, and biodiversity protection in **the MPAs;**

- Proactively seek funding from domestic and international non-governmental organizations for biodiversity conservation, and marine ecosystem management and protection. Increase collaboration with international organizations for biodiversity conservation, climate change adaptation, and environmental quality monitoring, like the United Nations Environmental Program (UNEP), UNESCO, and the Marine Conservation Program Fund (FEW). Develop projects and initiatives funded by donors or through sponsorships, using counterpart funds that can be combined with state budget allocations.

4.4. Strategies for Effective Communication

- Train a network of local human resources to participate in programs focused on the identification and rescue of marine mammals, sea turtles, sharks, and rays.

- Conduct an annual training workshop titled "Improving Identification and Rescue Skills" for staff of marine protected areas, volunteers, and others involved in marine mammal and sea turtle rescue, with specific objectives like:

  + Enhancing awareness of conservation and skills needed for the rescue of marine mammals and sea turtles.

  + Developing strategies for the proper handling of large marine mammal carcasses, like whales, crucial for local epidemiological hygiene and environmental safety.

- Increase awareness and responsibility among management staff and fishermen in fishing areas regarding marine conservation and the rescue of marine mammals and sea turtles by:

  + Implementing diverse and audience-appropriate information and propaganda activities, such as broadcasting messages about the importance of marine conservation and rescue on local radio, legal regulations on marine conservation, and protection of aquatic resources; Coordinating the production of reports and documentaries on marine mammals, sea turtles, sharks, and rays with domestic and foreign organizations;Organizing community activities like learning competitions, painting contests, and sports tournaments aimed at

promoting the preservation of these species.

V. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The issue of bycatch involving marine mammals, sea turtles, sharks, and rays in Vietnam's fisheries is complex and has historically lacked significant attention from domestic scientists, researchers, and management authorities. Nevertheless, managing bycatch is a critical aspect that must be addressed to foster responsible and sustainable fisheries. This is particularly vital given Vietnam's current efforts to fulfill international commitments on nature conservation, biodiversity, marine conservation, and the preservation of precious and endangered aquatic species.

Globally, and specifically in some Southeast Asian countries, there are valuable lessons and practices that Vietnam can adapt in its bycatch management. For instance, Vietnam could consider the United States' advanced design technology for reducing bycatch or emulate Thailand's use of robust monitoring, control, and surveillance systems to ensure adherence to fishing regulations and bycatch reduction measures. Despite the unique characteristics of Vietnam's multi-species fisheries, selectively researching and adapting these experiences can aid in developing an appropriate and effective bycatch management strategy.

A review of the legal framework concerning bycatch management reveals that while the general legal structure addressing bycatch is relatively comprehensive, specific regulations on unintentional catches have been scarcely or only superficially mentioned in legal documents. This represents a significant 'gap' that needs addressing in the formulation and implementation of policies for fisheries management, particularly concerning the protection of rare and endangered aquatic species like sea turtles, cetaceans, sharks, and rays.

5.2 Recommendations

Based on the conclusions drawn, our research team proposes the following recommendations to the relevant authorities, particularly the Department of Fisheries Surveillance:

Develop and enact a comprehensive national action plan dedicated to the conservation of marine mammals, sharks, and rays.

Actively pursue the execution of the “Action Plan for the Conservation of Vietnam's Sea Turtles for 2016-2025”. Conduct an interim review and assessment of this plan to extract valuable insights and lessons that can be applied to the implementation of the “National Plan of Action on Conservation of Marine Mammals, Sharks and Rays”.

- Develop a mechanism to monitor bycatch, including regulations and measures to minimize lost, abandoned and discarded fishing gear at sea;
- Develop communication programs to raise awareness about bycatch for different audiences, focusing on fishermen and coastal communities;
- Develop a mechanism to encourage organizations and individuals to research

and apply measures to reduce bycatch.

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Appendix I

METHODS FOR HANDLING AND SAFE RELEASE OF MOBILIDAE FAMILIES

(ISSUED TO ACCOMPANY WCPFC's CMM 2019-05)

Profession	Recommendations	Not recommended
Purse seine	• Release eagle rays whenever possible while they are still swimming freely (using appropriate measures, e.g. reversing the net process, submerging buoys, cutting the net). • For stingray species larger than 60 kg that may be difficult to catch and release manually, nets, canvas ropes or similar specially designed equipment can be used as recommended. in document SC08-EB-IP-12 (Poisson et al. 2012, Good practices to reduce bycatch mortality of sharks and rays in tuna seine fisheries tropical [2]) to lure stingrays out of the net. • For medium-sized rays (30-60kg) and rays smaller than 30kg, when re-released, they must be handled by 2 or 3 people and carried by both fins or it is best to use a specialized stretcher to carry them. Ensuring safety for rays and crew members.	• Do not leave stingrays on the deck until the net is collected before releasing the fish into the sea; • Do not make holes in the fish's fins or body (e.g. to pass cables or lines through to lift the fish). • Do not hook, pull, gill, lift or pull the ray by the fish's head or tail or use a hook or hand into the gill slit or spiracle.

[2]https://www.researchgate.net/publication/259772574_Good_practices_to_reduce_the_mortality_of_sharks_and_rays_caught_incidentally_by_tropical_tuna_purse_seiners

Profession	Recommendations	Not recommended
	• When a fish is caught in a net, it is necessary to quickly and carefully cut the net from the fish and release it into the sea as quickly as possible, while still ensuring the safety of the crew.	
Golden sentence	• For small rays, gently bring them to the boat and remove as many hooks as possible. Use pliers to cut the hook or cut the wire at the hook and gently release the animal back into the sea. • For medium to large stingrays (>30 kg), lower the animal into the water and, using a hook remover or long-handled line cutter, cut as close to the hook as possible (ideal). is fishing line <0.5 meter)	• Do not hit or bang the ray against any surface to shake it off the hook; • Do not attempt to remove deeply embedded or ingrained hooks by pulling on the branch line or using a hook remover; • Do not attempt to lift stingrays with an estimated weight of more than 30kg onto the boat; • Do not cut the tail; • Do not hook, pull, gill, lift the ray by its “head lobe” or tail, or use hooks or hands to hook into the ray's gill slit or breathing hole;

Appendix II

WCPFC CONSERVATION AND MANAGEMENT MEASURES ISSUED REGARDING MARINE MAMALS, SEA TURTLES, SHARKS AND STRAIGHTS

Year of application	Name of management and conservation measures	Techniques/measures to minimize bycatch	Species group	Fishing gear
2004	CMM-2004-04: Resolution on management and conservation measures	Spatial and temporal measures	Sea turtle; Sharks and rays; marine mammals; seagull	Purse seine, longline
2012	CMM 2011-03: Management and conservation measures to protect Cetacean whales from seine fishing	Safe handling and release methods	Sea animals	Purse seine
2017	CMM 2017-01: Management and conservation measures for bigeye, yellowfin and skipjack tuna in the Central and Western Pacific	FAD design and management	Sea turtles, Sharks and rays	Purse seine
2017	CMM-2017-04: Measures for management and conservation of marine pollution	ALDFG - management of abandoned, lost and discarded fishing gear	Sea turtle; Sharks and rays; marine mammals; seagull	Purse seine, longline
2018	CMM 2018-04: Sea turtle conservation and management	Circle hooks, FAD design and management, non-squid fishing lures,	Sea turtle	Purse seine, longline

Year of application	Name of management and conservation measures	Techniques/measures to minimize bycatch	Species group	Fishing gear
		Safe handling and release methods		
2019	CMM 2019-05: for Mobulid rays caught in the WCPFC Convention Area	Safe handling and release methods; Space and time management measures	Sharks and rays	Purse seine, longline
2021	CMM 2021-01: Conservation and management measures for bigeye, yellowfin and skipjack tuna in the Western and Central Pacific	ALDFG - abandoned, lost, discarded fishing gear management, FAD design and management	Sea turtle; Sharks and rays; marine mammals; seagull	Purse seine
2022	CMM 2022-04: Management and conservation measures for sharks	Monofilament / Conductor , Safe handling and release , Space and time measurement	Sharks and rays	Purse seine, longline

Appendix III

Propose a number of policies and programs to reduce bycatch of marine mammals, sea turtles, sharks and rays

Policy /Program name	Describe	Budget source	Time _
Minimize bycatch and practice sustainable fisheries	Legal framework for sustainable practices and reduced output.	Government budget, international grants	1-2 years
Local fisheries co-management council	Collaboration between communities, NGOs and agencies.	Local government budget, environmental non-governmental organizations.	one year
Local Fishing Community Based Monitoring & Reporting Project	Engage fishermen in monitoring and reporting activities.	Government funding, community contributions.	6 months to 1 year
Environmentally friendly fishing gear subsidy program	Incentives and subsidies for the use of equipment that reduces bycatch .	Government subsidies, environmental foundations.	1-2 years
Training program for fishermen about bycatch	Training on sustainable fishing and minimizing bycatch for some occupations	Government educational funds, non-governmental organizations, private sector.	one year
Pilot project to reduce bycatch for whales, dolphins, sea turtles and sharks and rays	bycatch reduction technologies and methods .	Research funding, private sector, international cooperation.	1-2 years
Campaign to raise social awareness about bycatch	Public awareness campaign on sustainable fishing and reducing bycatch of marine mammals, sharks and sea turtles	Government outreach funds, corporate sponsorship, non-governmental organizations.	6 months to 1 year