

SEA TURTLE BYCATCH AND MITIGATION IN THE INDIAN OCEAN AND SOUTH-EAST ASIA REGION: RESULTS FROM THE IOSEA SEA TURTLE BYCATCH QUESTIONNAIRE CONSULTATION, 2025

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Purpose, expectation and action intended (select one or more and include corresponding text)

Conclusion (to record a concluded position or summary)

The paper is to seek confirmation of the results of the IOSEA Sea Turtle Bycatch Questionnaire, deployed across the Indian Ocean South-East Asia region in 2025, which documents the marine turtle species and fisheries reported by stakeholders in the region, the reported magnitude of bycatch by species and by fishery, the degree to which bycatch mitigation measures are currently used in gillnet, trawl, purse seine, longline, bottom longline, hook & line, trap and beach seine fisheries, the engagement of different stakeholder groups, and the challenges and priority requirements identified by respondents, as set out in Section III (Results and Discussion) and Section IV (Summary of Findings). Importantly, the review found that there was insufficient uptake of mitigation measures across both commercial and artisanal fisheries, and importantly, a general lack of knowledge of what mitigation measures were in place. This suggests that what mitigation measures are un use are not being reported, and information on bycatch (where it occurs) is not made publicly available. This hinders the design and deployment of mitigation measures at a greater spatial scale and endangered sea turtle populations in coastal waters and on the high seas.

Recommendation (to ask the meeting to endorse a recommendation)

The paper is to seek endorsement of the following recommendations, as set out in Section V (Priority Recommendations) and supported by Section III (Results and Discussion) and Section IV (Summary of Findings):

- Improve reporting and understanding of the bycatch challenge, through standardised data collection and reporting formats and better dissemination to all relevant stakeholders (5.1).
- Act on bycatch now, regardless of remaining knowledge gaps, applying proven solutions while research continues in parallel, and prioritising high-impact fisheries and at-risk species, whether by abundance (green, olive ridley) or extinction risk (hawksbill, leatherback, loggerhead) (5.2).
- Promote greater implementation of mitigation measures put forth in IOTC Resolution 12/04 to safeguard sea turtles stocks from impacts by commercial fisheries.
- Strengthen monitoring and knowledge acquisition, including support for States to build capacity and to explore low-cost electronic monitoring with AI detection, and repeat this or a similar survey in three to five years to track progress (5.3).
- Strengthen policy support, with governments introducing or reinforcing legal requirements for bycatch mitigation and ensuring these are properly enacted and enforced (5.4).
- Strengthen engagement with fishing communities, through community-led initiatives, awareness-raising, fisher exchanges and incentives for good practice (5.5).



- Coordinate funding programmes, including regional project proposals developed on behalf of Signatories through mechanisms such as the GEF, with national government buy-in (5.6).
- Ensure continued technical support from the IOSEA Advisory Committee, including guidance on mitigation measures and emerging technologies, technical toolkits and training materials (5.7).

Applying these recommendations to Resolution 12/04 On the Conservation of Marine Turtles, the following changes are proposed:

- Treat gillnet fisheries as a priority for action, being the most widely used and least regulated gear across the region and the one for which the Resolution currently requires no mitigation at all (Section 3.5a).
- Reporting (para. 4): replace narrative reporting of successful measures with structured annual reporting of the mitigation measures actually deployed, by gear type and fleet segment, in a standardised format. Over 40 per cent of respondents had no knowledge of what mitigation was in place in any fishery in their country.
- Monitoring (para. 3): specify minimum observer coverage levels by gear type and provide for electronic monitoring, coupled with AI detection software, as an alternative or supplement where observer placement is impractical.
- Training (paras 6 and 9): require crew and skipper training in safe handling, release and resuscitation, identified as an underused measure with direct effect on post-release survival.
- Make reporting of sea turtle bycatch by CPCs mandatory and within a specific time framework, including condition of turtle at release, species, size, location, and fishing gear involved.

Abstract

Bycatch in commercial and artisanal fisheries is considered the greatest threat to sea turtles in the Indian Ocean and South-East Asia (IOSEA) region, a region which hosts six of the world's seven species of marine turtles. In response to Activity 8 of the Work Programme adopted at the 9th Meeting of the Signatory States (MOS9) and CMS Decision 14.33, the Steering Group on Bycatch of the IOSEA Marine Turtle MOU Advisory Committee developed a questionnaire to elicit feedback on people's knowledge of sea turtle bycatch in their respective countries and the current use of mitigation measures to safeguard sea turtles. The questionnaire, comprising 39 questions over nine sections, was deployed online in April 2025 to 354 conservation practitioners, academics and government officials across the region, and garnered 135 responses (a 40.7% response rate) from 30 countries.

Green and hawksbill turtles were the most frequently reported species, comprising 59.7% of reported bycatch in commercial fisheries and 63.5% in artisanal fisheries, followed by olive ridley, leatherback and loggerhead turtles. Trawls, longlines and gillnets together comprised 52.8% of commercial fishing effort, and gillnets a further 20% of artisanal fisheries; given the widespread use of gillnets and the difficulties in enforcing regulatory measures, it is likely gillnets present the largest challenge in addressing bycatch of sea turtles. Turtle Excluder Devices were the best-known mitigation measure but were reportedly barely used across the region, with the highest levels of uptake in Australia. Of particular concern was the prevalence of *Do not know* responses: over 40% of respondents indicated having no knowledge of what mitigation measures were in place in any of the fisheries, commercial or artisanal. A lack of technical know-how and skills, a lack of funding, and a lack of prioritisation by governments were ranked as the key challenges, while national and international policy support and funding were ranked as the highest priority requirements for moving forward. The magnitude of bycatch is likely very high, in the tens of thousands of sea turtles per year, and turtles will continue to be taken at an alarming rate unless proactive measures are taken to address the particular impacts of different fisheries and the threats these pose to turtle species in the region.



SEA TURTLE BYCATCH & MITIGATION IN THE INDIAN OCEAN AND SOUTH-EAST ASIA REGION

In partnership with



Sea Turtle Bycatch and Mitigation in the Indian Ocean and South-East Asia Region

Results from the IOSEA Sea Turtle Bycatch Questionnaire Consultation, 2025

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This report is accompanied by a review of technical and operational bycatch mitigation measures for marine turtles. The 2026 paper, *A review of technical and operational measures to mitigate bycatch of marine turtles in commercial fisheries*, by Breimann and Baker ([UNEP/CMS/COP15/Inf.25.1.1](https://www.unep.org/press/2026/01/2026-01-20-01)) provides the broader technical context and evidence base that supports interpretation of the questionnaire findings presented here.

LAYOUT

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Green turtle in fishing net: © Adobe Stock Images

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I. Introduction

1.1 Call for Action - MOS9

Activity 8 of the Work Programme adopted by the 9th meeting of the Signatory States (MOS9) in Dar es Salaam, United Republic of Tanzania (June 2024) calls for collaboration with the CMS Scientific Council in addressing CMS Decision 14.33:

- a) identify regions for which carrying out a review of relative levels of bycatch of CMS-listed marine mammals and marine turtles in commercial and artisanal fisheries would be a priority and/or beneficial as a foundation document; collaborate with all relevant organizations including fisheries management bodies to develop regional reviews with a view to reducing the levels of bycatch of all CMS-listed marine mammals and turtles in commercial and artisanal fisheries; identify and prioritize fisheries and areas in which adverse impacts of bycatch are highest for CMS-listed marine mammals and turtles and cooperate with the relevant organizations, including fisheries bodies to develop the most appropriate bycatch mitigation measures for fisheries of highest priority; and develop appropriate bycatch mitigation measures with associated timebound action plans; and

- b) in collaboration with the IOSEA Marine Turtle MOU and, if possible, the Inter-American Convention for the Protection and Conservation of Sea Turtles and the Caribbean Environment Programme, review current knowledge about existing measures to reduce and mitigate bycatch of marine turtles for both commercial fisheries and artisanal fisheries, and make recommendations to Parties and the Signatory States of the IOSEA Marine Turtle MOU on the most effective and appropriate measures to reduce and mitigate bycatch, while ensuring that recommended measures do not act to the disadvantage of other CMS-listed marine species.

In response to this mandate, this report presents the results of the IOSEA Sea Turtle MOU Bycatch Questionnaire deployed in 2025 to stakeholders across the IOSEA region, and the subsequent analyses of the data that were collected as part of this process are presented in the results.

The survey helped in identifying current uses of bycatch mitigation measures to safeguard sea turtle species, and the current state of knowledge among stakeholders in regards to bycatch of sea turtles in the IOSEA region. While it does not prioritise high-impact fisheries, or provide time-bound action plans as required by the mandate, it identifies critical barriers



Picture 1. Green sea turtle surfacing to breathe (Photo © Nicolas Pilcher)

and priority needs that can inform subsequent phases of implementation.

This report is complemented by a technical companion document: Breimann & Baker (2026), *A review of technical and operational measures to mitigate bycatch of marine turtles in commercial fisheries* ([UNEP/CMS/COP15/Inf.25.1.1](#)). The review provides relevant scientific and operational background on bycatch mitigation approaches and can be used as the primary literature reference in support of the findings presented here.

1.2 Purpose of the Questionnaire

The purpose of the questionnaire was to elicit feedback on people's knowledge of sea turtle bycatch in their respective countries and the current use of bycatch mitigation measures to safeguard sea turtles. The overarching goals of the questionnaire were to understand the greatest challenges to implementation of bycatch mitigation measures and potential opportunities for advancing conservation approaches that address bycatch of sea turtles.

1.3 Project Team

The development of the questionnaire was led by Dr Nicolas Pilcher (Malaysia), the Lead of the Steering Group on Bycatch and a member of the Advisory Committee to the IOSEA Marine Turtle MOU, and benefitted from the collective wisdom of all the members of the Steering Group as well as a number of external advisors:

Sali Bache, Australia*
 Christine Madden, Australia
 Zahirul Islam, Bangladesh
 Andrea Phillott, India*
 Dipani Sutaria, India
 Jarina Moh'd Jani, Malaysia*
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 Mathieu Barret, Réunion
 Manjula Tiwari, United States*
 Summer Martin, United States
 Yonat Swimmer, United States
 Bryan Wallace, United States
 Michael Liles, United States

Assistance with data analysis and reporting was provided by Damien Jahan, an intern at the CMS Secretariat in 2025.

(*Denotes members of the IOSEA Marine Turtle MOU Advisory Committee).

II. Methods

2.1 Design and Development of the Questionnaire

The Sea Turtle Bycatch Questionnaire was developed by the Steering Group on Bycatch of the Advisory Committee of the IOSEA Marine Turtle MOU and CMS Scientific Council. Following extensive consultation among members of the Steering Group and the wider Advisory Committee, it was decided that a widely-distributed online questionnaire would be an adequate, cost- and time-efficient measure to gauge the current adoption of bycatch mitigation measures, and to get an understanding of the levels of knowledge and capacity related to bycatch of sea turtles in the IOSEA region.

The questionnaire was developed into an online tool using the commercial SurveyMonkey® platform (www.surveymonkey.com) after multiple rounds of consultation among all Steering Group members. The questionnaire consisted of 39 questions, provided as a combination of open- and close-ended questions over nine sections. The use of an *I don't know* response was a common feature in the questionnaire, given that not all respondents would be expected to have a response to every question.

The content of the questionnaire was developed based on the Steering Group's knowledge of the diverse fishery types and bycatch mitigation approaches, but also enabled participants to identify *Other* responses, providing a degree of flexibility and acknowledgement of variability across the region. A copy of the questionnaire is provided as Annex 1.

2.2 Field Testing and Trial Runs

The questionnaire was deployed among a small group of volunteers to gauge the clarity of the language and instructions, and to ascertain that the content was thorough while not overly time-consuming.

2.3 FPIC Commitment

The questionnaire adopted the principles of Free, Prior, Informed Consent (FPIC) in its approach, providing respondents with the opportunity to withdraw from the survey should they wish to at any point. The questionnaire design benefitted from input from several social science practitioners and experts, and feedback from a number of university ethics boards to ensure that the participation of the respondents was clearly voluntary and anonymous. The online version of the questionnaire was prefaced with the following text:

Your participation in this survey is voluntary and confidential. We will not use your name or any personal information you share with us unless this is ok with

you, and ONLY if you provide these at the end of the questionnaire. Individual answers will be collated and reported on as a group to provide a general idea of current status in different countries / regions, and we will absolutely not share your individual answers to anyone outside of the IOSEA Bycatch Working Group. You can stop answering questions at any time by clicking on the Exit button on the top right of your screen.

If you have any concerns or complaints about the conduct of the project, please contact npilcher@mrf-asia.org

Please note, by continuing the survey you consent to take part in this research and agree to the information provided in this Explanatory Statement.

Only 11 (3%) respondents provided their names and contact details, and these were stored via a separate response form and are not provided or discussed in this report. The authors will contact these respondents for additional feedback and to provide them with a copy of these findings.

The data have been stored securely at the CMS/IOSEA Marine Turtle MOU headquarters and with Dr Nicolas Pilcher, who led the survey efforts. No other copies of the data, and no names or contact details are available for the responses, providing a high degree of confidentiality.

2.4 Development of Participant List

The questionnaire was aimed primarily at conservation practitioners, academics and government officials who were identified following an extensive search among contacts known to members of the Steering Group, the Secretariat, and contacts in the region.

After several rounds of communication, the process identified 354 individuals across the region as target recipients of the questionnaire. The introduction to the questionnaire also encouraged participants to forward the link to additional potential respondents. Consequently, it is possible that the questionnaire reached a larger number of individuals.

The questionnaire was not specifically aimed at MOU Focal Points as their input had already been provided in National Reports submitted in 2024, but the survey did receive responses from 17 Focal Points (of 36 country Focal Points in total).

2.5 Deployment and Reminders

Emails inviting respondents to complete the questionnaire were sent out on 9 April 2025. Friendly reminders were then sent out on 23 April (two weeks later) and on 20 May (nearly one month later). The initial request for participation resulted in 64 responses (a 19.3% response rate). The first friendly reminder resulted in an additional 58 responses (a 36.9% overall response rate). The second friendly reminder garnered a further 13 responses. Altogether, a total of 135 responses were received (a 40.7% overall response rate). Response rates to email surveys such as these can be highly variable but are normally in the range of 25%–30%.

2.6 Data Collection (SurveyMonkey)

Data were automatically collated by the SurveyMonkey® platform and were accessible as downloads in the form of raw data and as charts and tables. Many of these formats were not deemed appropriate or useful and thus the analyses presented herein are all by the authors.

2.7 Data Analysis

With 39 questions, many of which had multiple parts, sub-sections and response options, the questionnaire had a total of 737 possible responses per respondent. The analyses of this large data set attempt to provide region-wide and sub-region-specific (as appropriate and where data permitted regional analyses) glimpses of the current use of bycatch mitigation options, and the levels of understanding of sea turtle bycatch amongst respondents in the IOSEA region. Several questions received insufficient responses to enable an analysis by sub-region. Given the limited number of respondents per country in all but two cases, no analyses were possible at the country-level.

We acknowledge that these data do not provide the full picture of turtle bycatch in the region, and that there may be efforts that were not captured by the process, particularly where specific knowledge-holders did not participate in the survey. There was also great variability in the response rates by country, further biasing the results. We are hopeful that future efforts will reach a greater audience, and that those who did not participate in this survey can be encouraged to join the mailing list for follow-up, making it as comprehensive as possible.

III. Results and Discussion

There were variable response rates by country, with just over half of the countries being represented by only one or two respondents (Figure 1; Table 1). There was a disproportionate number of responses from Malaysia and Saudi Arabia, possibly as a result of the senior author's personal contacts with people in these countries – or it could indeed point to higher engagement of practitioners and a greater interest in addressing bycatch in these countries. The high proportion of countries with only one or two respondents may indicate that less effort is invested in addressing sea turtle bycatch in those locations, as it is likely that major efforts to address bycatch would be known to the Steering Group members. Similarly, this may be a reflection of limited communication with individuals in those countries. Interestingly, there was one response from Gabon, outside of the IOSEA region.

several undescribed professions (indicated by selection of *Other* as a response). These backgrounds were reflected in the current workplace of the respondents: 58 were from NGOs – and are therefore likely to be directly engaged with bycatch mitigation efforts and have first-hand information on the issue; 30 from academia and 22 from government (Figure 2, top right). Nearly 84% of respondents indicated they had more than five years of experience in their field and nearly 40% had over 15 years of experience, suggesting they would be sufficiently experienced and knowledgeable, and be in a good position to respond to the questionnaire. Experience by employment was highly variable, but government agents and NGO respondents – who likely have the greatest exposure to bycatch policy or efforts on the ground – had substantial experience, lending credibility to the results presented herein. Both fishers who responded to this survey also had 10-15 years of experience, suggesting a good understanding of their specific industry.

3.1 Respondents' Backgrounds

By far the largest proportion of respondents had a conservation background; academics and government officials were also well represented (Figure 2, top left). Additional respondents included fishers or students and

3.2 Turtles and Fisheries in the IOSEA Region

The IOSEA region is home to six of the seven species of the world's sea turtles. Bycatch in both small-scale/artisanal and commercial fisheries impacts hundreds of thousands of turtles each year globally, and it is likely

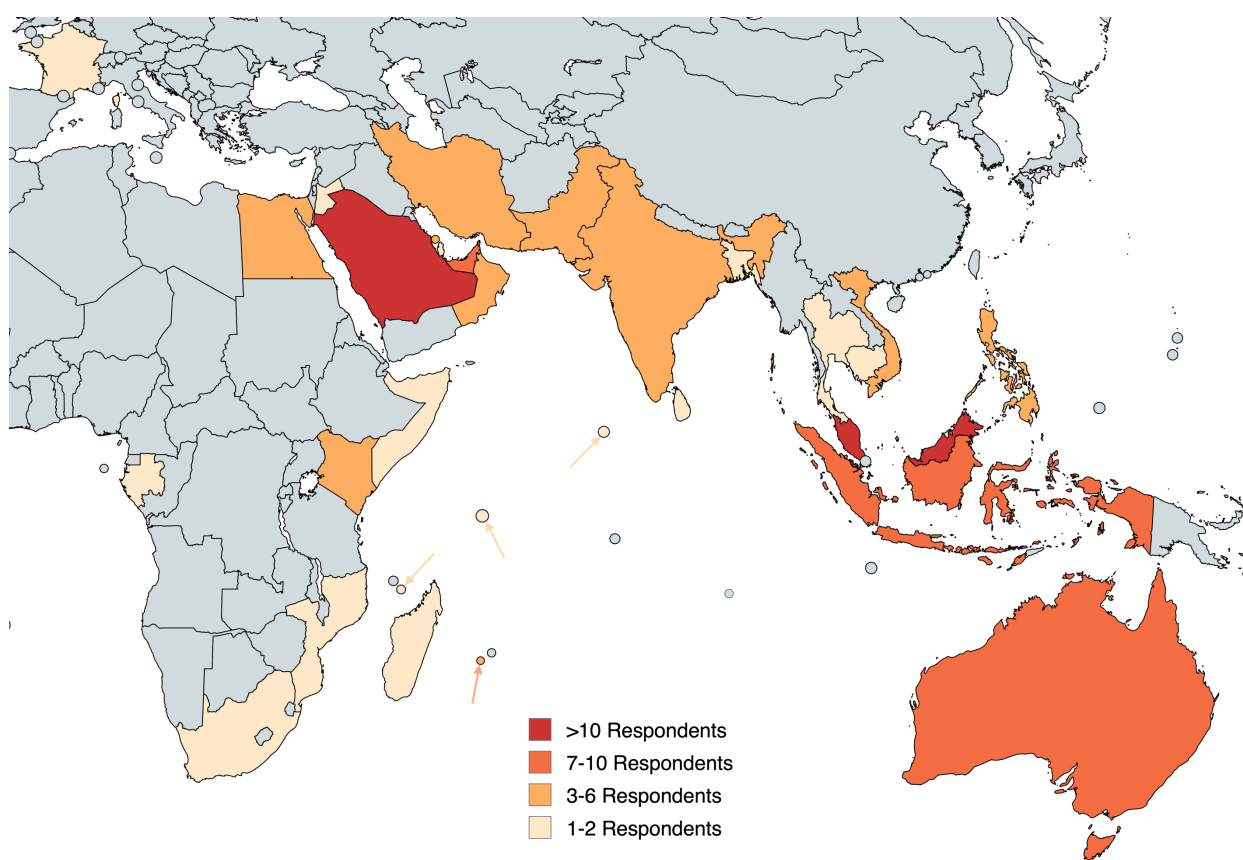


Figure 1. Distribution and relative number of responses to the bycatch questionnaire. (Note: Responses from the Maldives, Mayotte and Réunion are highlighted with arrows due to their small size.)

Table 1: Number of respondents per country.

Malaysia	20	Pakistan	5	Somalia	2
Saudi Arabia	14	Oman	4	Sri Lanka	2
Indonesia	9	Vietnam	4	Thailand	2
Australia	8	Egypt	3	Brunei Darussalam	1
United Arab Emirates	7	Réunion (France)	3	Cambodia	1
India	6	Bangladesh	2	France	1
Kenya	6	Madagascar	2	Gabon	1
Philippines	6	Mayotte (France)	2	Jordan	1
Bahrain	5	Qatar	2	Maldives	1
Iran	5	Seychelles	2	South Africa	1

that impacts from fisheries are the greatest threat to sea turtles in the IOSEA region. The IUCN Red List status of sea turtles (<https://www.iucnredlist.org>) has been assessed by the IUCN Marine Turtle Specialist Group at global levels for all species, and at regional management level (RMU) for some species and some regions. The IOSEA region encompasses four sub-regions (the Western Indian Ocean, North-Western Indian Ocean,

Northern Indian Ocean, and South-East Asia+), and the RMU-level Red List assessments are broadly coincident with these. The six species of turtles found in the IOSEA region are currently classified as follows:

- Hawksbill – Critically Endangered (Globally)
- Green – Least Concern (Globally); North Indian Ocean Subpopulation – Vulnerable

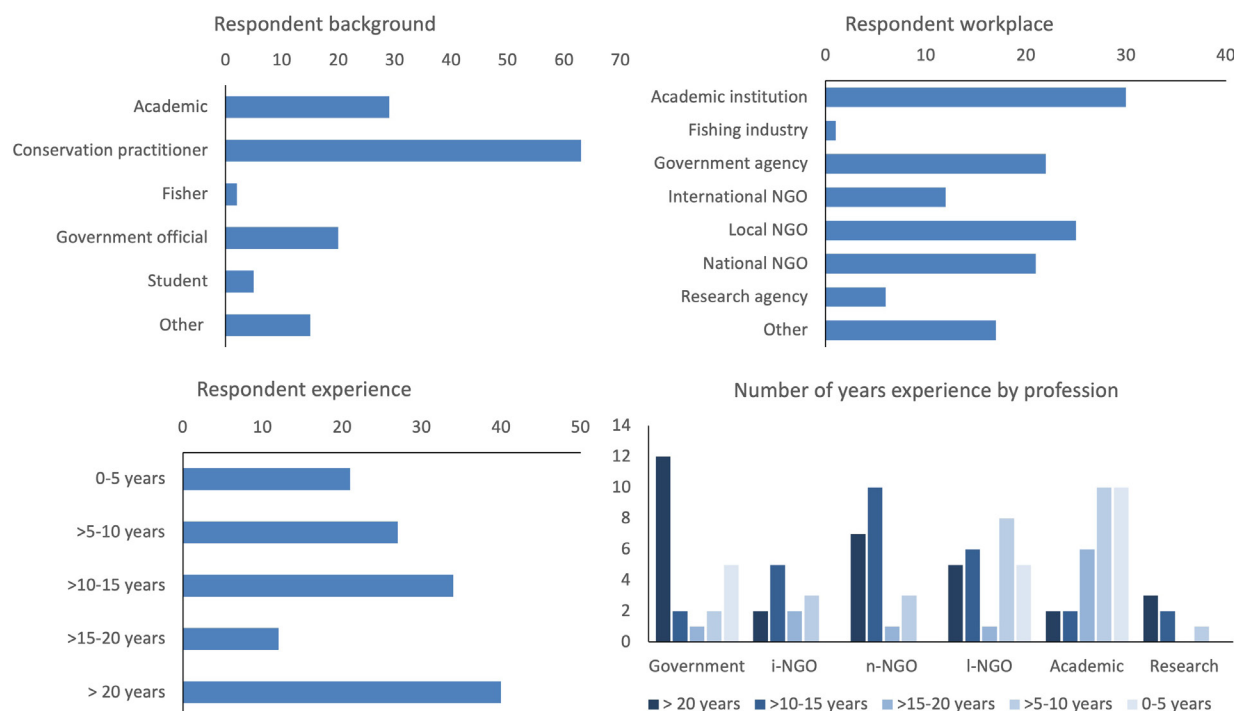


Figure 2. Background and expertise of respondents to the bycatch questionnaire for the IOSEA region. (Note: As Other professions were not specified, they have been omitted from the bottom right graphic. Both fishers indicated 10-15 years of experience; for the sake of clarity, this is not shown in the bottom right graphic.)

- Leatherback – Vulnerable (Globally); Northeast Indian Ocean Subpopulation – Data Deficient; Southwest Indian Ocean Subpopulation – Critically Endangered
- Loggerhead – Vulnerable (Globally); Northeast Indian Ocean Subpopulation – Critically Endangered; Northwest Indian Ocean Subpopulation – Critically Endangered
- Olive Ridley – Vulnerable (Globally)
- Flatback – Data deficient (Globally); Note: the status of the flatback turtle, which is restricted in distribution to Australia and some parts of southern Indonesia and Papua New Guinea, has been recently assessed and submitted to the IUCN Red List for review

data were analysed by sub-region (See Annex 2 for a map of IOSEA sub-regions). Unsurprisingly, olive ridley turtles were more frequently reported in the Northern Indian Ocean (NIO), given the large arribadas that occur in India, and their subsequent dispersal in the Bay of Bengal and the northern waters of the Indian Ocean. But it was surprising to see that olive ridley turtles were also frequently reported in the Northwest Indian Ocean (NWIO), given the limited records of this species in the Arabian Gulf and Red Sea (although we acknowledge that the at-sea distribution of olive ridley turtle extends across to Pakistan and the Gulf of Oman, and occasionally to Iran). There is also a nesting rookery on Masirah Island in the Arabian Sea. The limited reporting of flatbacks is linked to their restricted spatial distribution.

3.2.1 Reported turtle frequency at IOSEA and sub-regional levels

At an IOSEA region-wide level, green turtles and hawksbill turtles were the most frequently reported species (Figure 3), and this was also the case when the

3.2.2 Fishery use in the IOSEA region

This section describes the types of fisheries reported in the IOSEA region (Figure 4). However, there are varying definitions for artisanal / local / small-scale

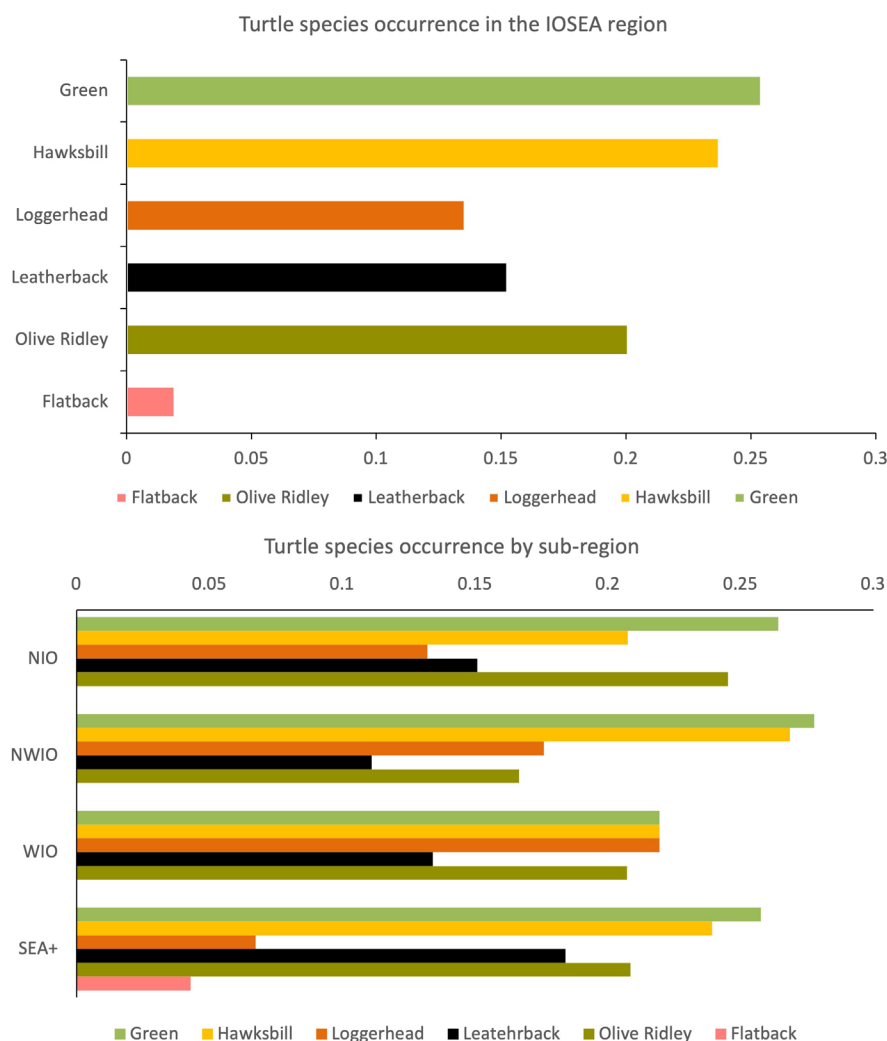


Figure 3. Proportional species distribution as reported by respondents for (top) the entire IOSEA region and (bottom) by IOSEA sub-region.

fisheries, and there is no universal distinction between these and larger commercial fisheries. Reference to artisanal fishing in this report is used to denote smaller fishing operations, typically with one or only a small number of fishers per vessel, often unmotorised, landing their catch for personal use, barter or for sale to middlemen who transport fish products to larger markets. Some respondents indicated that in their country the distinction was based on the size of the vessels, with 5 gross tonnes being listed as the transitional weight limit in some cases, and 10 tonnes in others. Other respondents referred to engine size (horsepower), while some provided slightly more ambiguous definitions related to ‘how commercial the sale of the catch was’ and whether the fishing was inshore or offshore, mechanised or unmechanised. Some

respondents indicated that their countries had adopted the definitions of the Indian Ocean Tuna Commission (IOTC), which defines artisanal fisheries ‘as those conducted by vessels or fishing crafts with a length overall (LOA) of less than 24 meters, operating primarily within the Exclusive Economic Zone (EEZ) of their flag states. These fisheries often involve small-scale fishing households using traditional methods and gear, typically for local consumption or small-scale trade.’

Commercial fisheries were well represented, with trawl, longline, gillnet, purse seine, hook & line, traps and beach seines in decreasing order of use (Figure 4, top). Very few respondents (7) indicated there were no commercial fisheries in their country (three in the UAE;

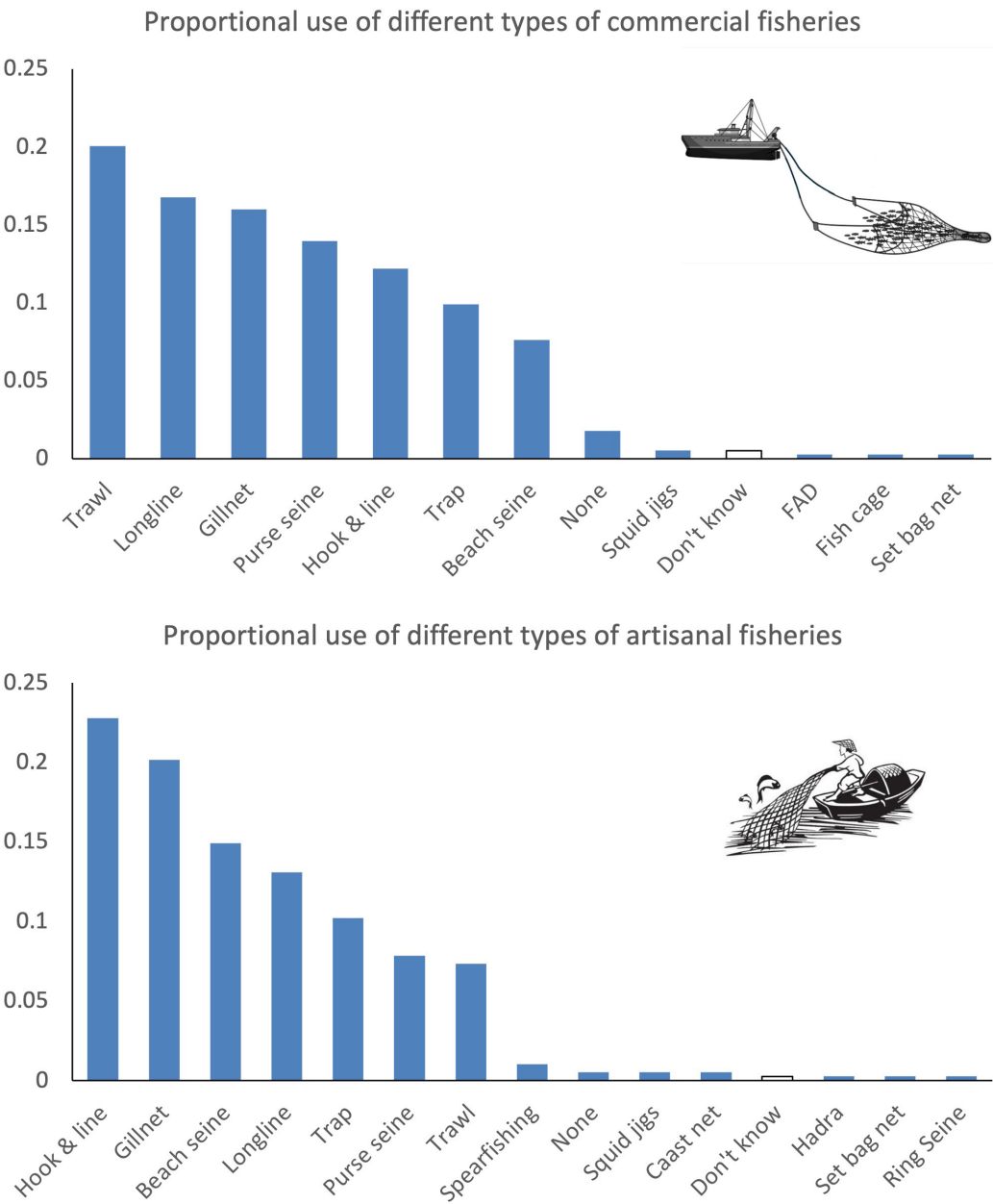


Figure 4. Proportional use of different fisheries and gears in the IOSEA region. Top: Commercial fisheries; Bottom: Artisanal fisheries.

and one each from Bahrain, Indonesia, Mozambique and Saudi Arabia). Given there are commercial fisheries in all of these countries, it is possible that this is linked to varying definitions of commercial vs. artisanal fisheries. An even smaller number reported not knowing what types of commercial fisheries operated in their country (2), which was an encouraging indication of the degree of familiarity with the fishing industry.

Combined, trawls, longlines and gillnets comprised 52.8% of commercial fishing effort, which is of concern because all three of these fisheries are known to impact sea turtles, often with fatal consequences. Trawls usually drag nets for several hours during which sea turtles drown. Similarly, gillnets left unattended for multiple hours can drown entangled turtles, and longlines cause direct injuries through hooks and entanglement in the lines, and often lead to mortality if the lines are not retrieved frequently and with care.

Purse seines and hook & line fisheries generally do not cause substantial direct mortality to sea turtles as they are able to surface and breathe, and are usually only entrapped for a short time (in both cases). An unintended consequence of captures in artisanal hook & line fisheries is the opportunistic retention of the turtles for consumption. This is of particular concern because hook & line fisheries were reported as the most common artisanal fishery in the IOSEA region.

Of similar concern is the high use of gillnets in the region, comprising 20% of all artisanal fisheries (Figure 4, bottom). As in the case of commercial fisheries, gillnets left unattended can drown sea turtles, and this is frequently the case in these less-regulated fisheries. Combined with the opportunistic retention of turtles for consumption or trade – similar to hook & line fisheries – the extensive use of gillnets in artisanal fisheries is a grave concern.

There was a substantial regional bias in these responses (Figure 5), with commercial and artisanal fisheries represented less in the NIO than elsewhere. It is unclear why both of these groups were reported as less-frequently used in the NIO where fisheries are abundant. SEA+ had the highest reporting rate for nearly all fisheries with hook & line, gillnet and trawl fishing dominating the commercial fisheries, and hook & line, gillnets and traps dominating the artisanal fisheries. Only two respondents indicated there were no artisanal fisheries in their country (one in Australia and one in Malaysia, possibly a result of individuals' perceptions of artisanal vs. commercial fisheries), with one additional respondent indicating they were unsure if this was the case.

These results indicate the ubiquitous use of both artisanal, small-scale, inshore fisheries and commercial offshore fisheries across the IOSEA region. This means that sea turtles in shallow coastal feeding and development waters and turtles in deeper offshore feeding and migration pathways may all be impacted, suggesting turtles are at risk at all phases of their life cycle in the IOSEA region, in all types of inshore and offshore habitats.

3.3 Bycatch Impacts on Different Turtle Species in the IOSEA Region

Among the turtle species impacted by artisanal and commercial fisheries in the IOSEA region, green and hawksbill turtles were the most frequently reported, followed by leatherbacks (Figures 6 and 7, top panels). Green and hawksbill turtles combined comprised 59.7% of reported bycatch in commercial fisheries and 63.5% in artisanal fisheries; olive ridley turtles comprised 16.5% in commercial fisheries and 14.0% in artisanal fisheries; leatherbacks, 9.3% in commercial and 10.3% in artisanal fisheries; and loggerheads, 9.3% in both commercial and artisanal fisheries. Unsurprisingly, given

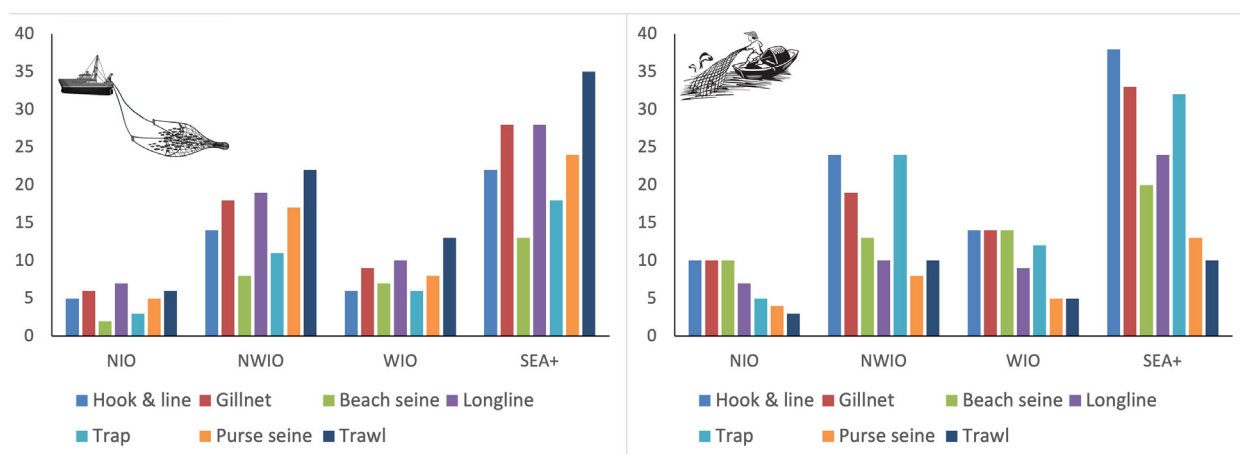


Figure 5. Proportional use of different gears by sub-region in (left) commercial and (right) artisanal fisheries. (Note: For the sake of clarity, gears with minor contributions to the trends are not included.)

their limited spatial distribution, flatback turtles were very infrequently reported as bycaught species (3.6% and 2.8%, respectively), but bycatch remains a concern in their limited range, as multiple respondents from Australia reported interactions with several fisheries.

Importantly, while a number of respondents were able to indicate which species were being caught and provided estimates of the numbers of turtles that may be impacted, over 45% and more than 50% of respondents indicated they did not know the species affected and the scale of impact in commercial and artisanal fisheries respectively (inset pie chart; Figures 6 & 7). This provides a clear indication of the widescale lack of clarity of the impacts of these fisheries on sea turtles. It also

highlights a major research gap for sea turtle bycatch and the need for standardised region-wide assessments by onboard or electronic observer programmes. Not knowing which species of sea turtles and how many of each species are being removed from the population each year, limits the ability of managers to design and implement targeted conservation practices.

At the subregional level, there were substantial differences in bycatch of different species (Figure 8). Green, hawksbill, leatherback and olive ridley turtles were all reportedly the most frequently caught species in both commercial and artisanal SEA+ fisheries, with only a few reports of bycaught loggerheads. Almost all bycatch of flatback turtles was in this region, although

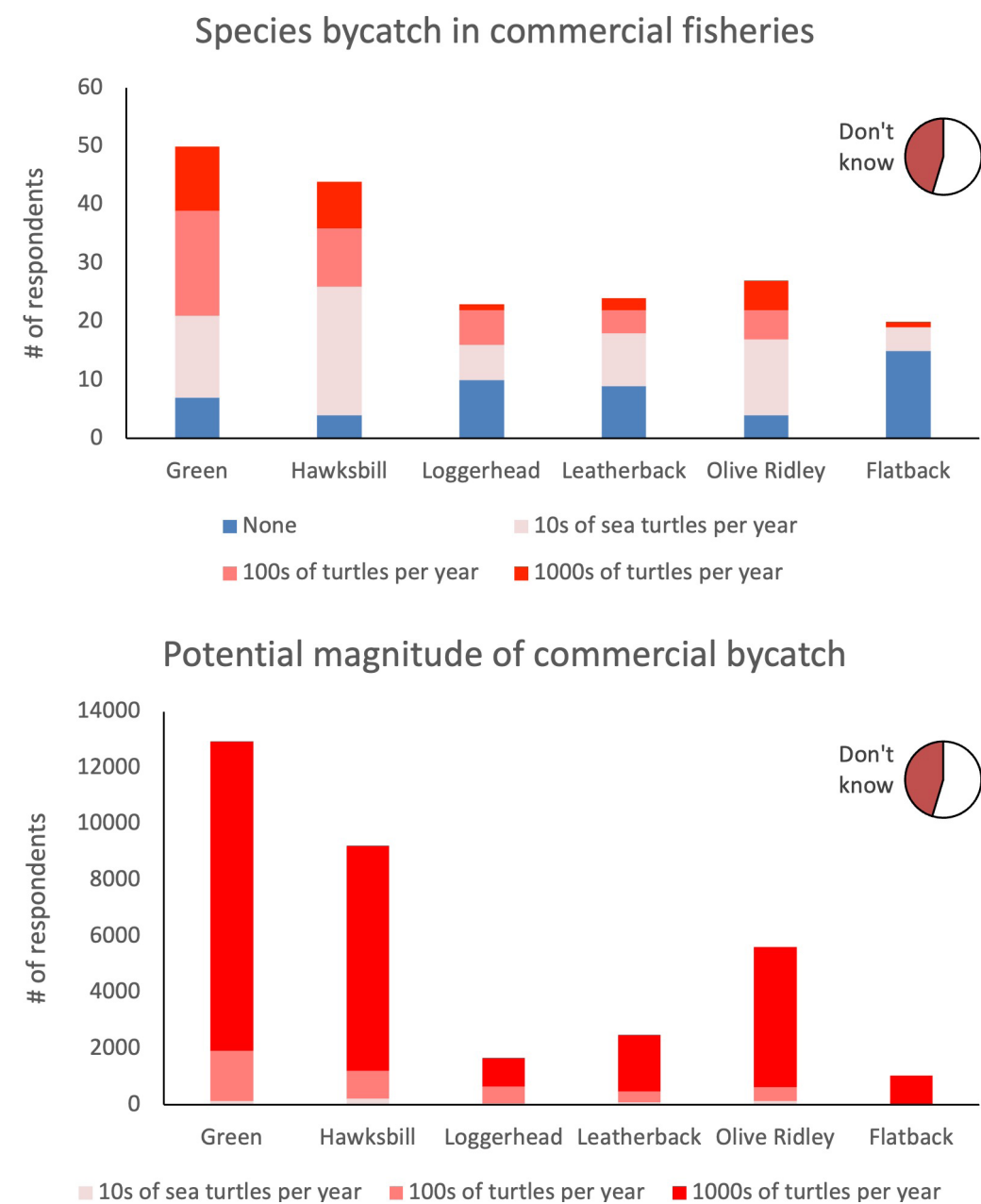


Figure 6. Top: Estimated magnitude of turtles bycaught annually in commercial fisheries by species. Bottom: Potential (minimum) numbers of turtle bycaught in commercial fisheries.

there was one erroneous recording of the species in the NIO. This highlights the importance of tackling bycatch of sea turtles in the SEA+ region, which reportedly has the highest levels of bycatch for most of the species. High levels of green and hawksbill bycatch were also reported in the NWIO, where bycatch of the other species was substantially lower. While these species are rare or not abundant in the Red Sea and the Persian/Arabian Gulf, the loggerhead turtle has been listed as Critically Endangered in the NWIO given significant declines in the population nesting in Oman, and bycatch of this species is of grave concern. Given the slightly higher bycatch of loggerheads in the WIO, it is possible that these fisheries impact the Oman stock, and this needs urgent attention. Olive ridley bycatch was high in the NIO and

the WIO. The WIO also had moderate levels of green and hawksbill bycatch. Respondents in the NIO indicated they were more familiar with both the species and magnitude of bycatch, compared with the significant uncertainty among respondents from other areas, especially SEA+ (Figure 9).

3.3.1 Magnitude of impacts on different species by fishery type

Respondents were asked to provide estimates of the numbers of bycaught turtles by species, categorised in bins of *10s of sea turtles*, *100s of sea turtles*, and *1,000s of sea turtles*. These categories were only meant to be indicative, recognising that this information is not only

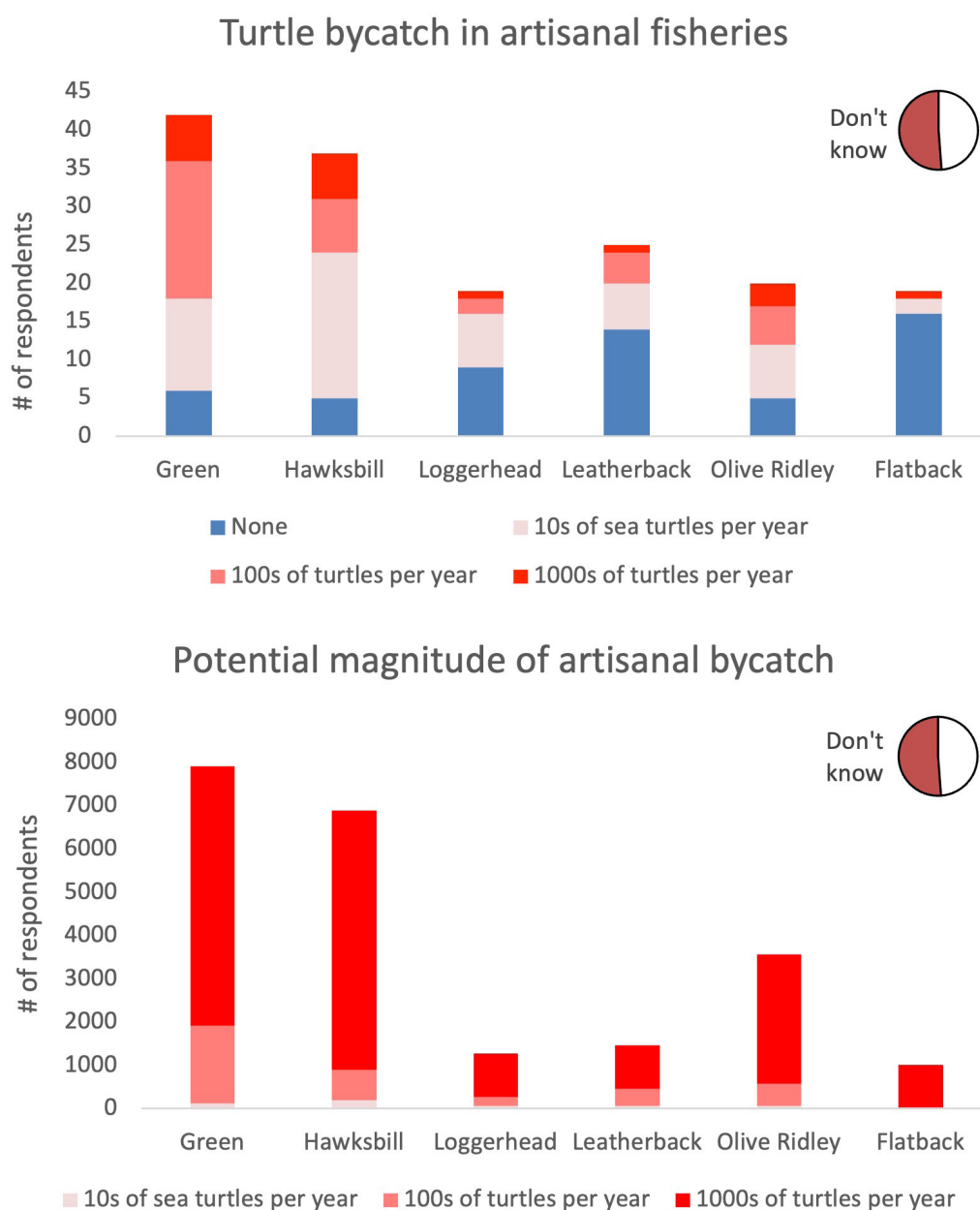


Figure 7. Top: Estimated magnitude of turtles bycaught annually in artisanal fisheries. Bottom: Potential (minimum) numbers of turtle bycaught in artisanal fisheries.

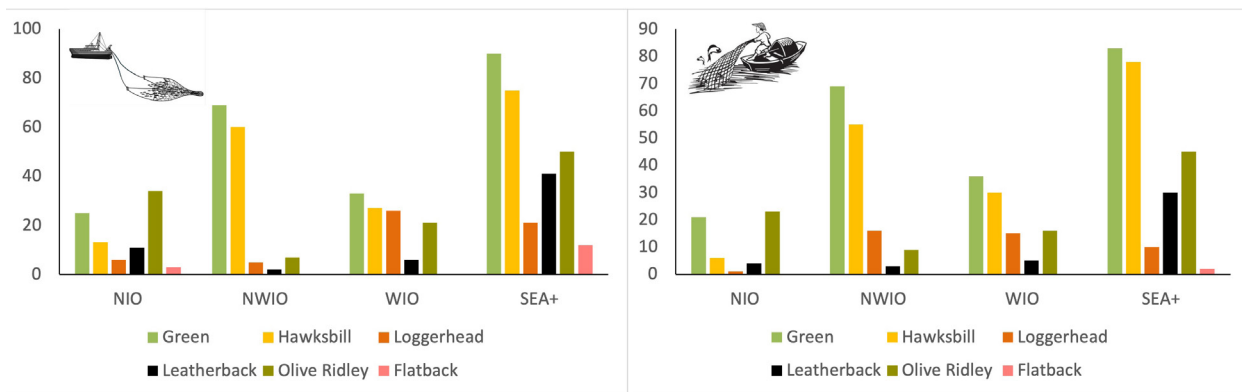


Figure 8. Overall proportion of turtles caught as bycatch by sub-region in (left) commercial and (right) artisanal fisheries.

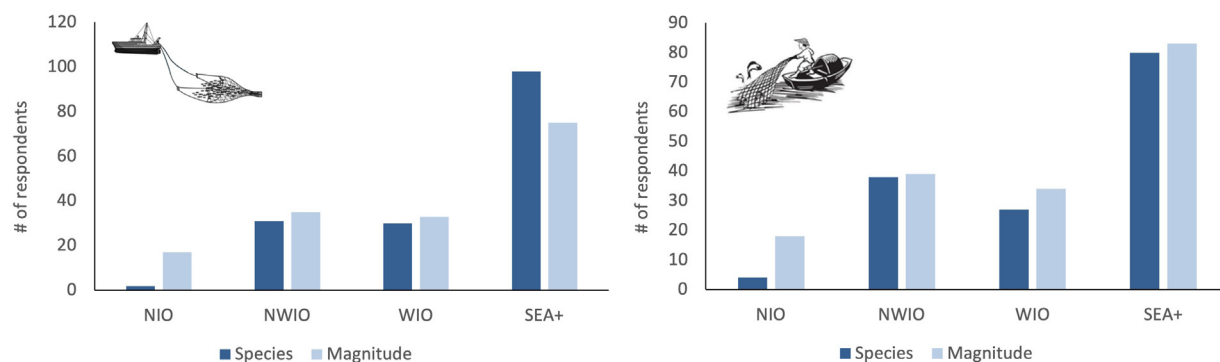


Figure 9. Proportion of respondents by sub-region who listed a *Do not know* response to species and magnitude of impacts in (left) commercial and (right) artisanal fisheries.

based on quantitative data, but also on respondents' perceptions and subjective assessments. Thus, no overall estimate of turtle bycatch can be derived from the responses provided by the participants (when a respondent indicated turtles may be taken by the *100s*, this could be anything from 100 to 900; *1,000s* could mean 1,276 or 7,432). Nonetheless, the results provide some value in assessing the potential relative impact these fisheries might have on sea turtles.

A simple mathematical extrapolation using the lowest values in each bin provides a worrying glimpse of the possible numbers of turtles being taken by both commercial and artisanal fisheries (Figures 6 & 7, bottom). For instance, if 11 respondents suggested *1,000s* of turtles were being taken, the magnitude would be at least 11,000 turtles. Similarly, if 16 respondents suggested *100s* of turtles were being taken, the magnitude would be 1,600 at a minimum. The values provided in Figures 5 and 6 are a gross underestimate of the overall impact of both commercial and artisanal fisheries. The impacts of some commercial fisheries are staggering: it has been estimated that over 4 million cetaceans were killed in gillnets of the Indian Ocean tuna fishery between 1950 and 2018, peaking at ~100,000 cetaceans per year from 2004 to 2006. The bycatch numbers for sea turtles are only provided to highlight

the magnitude of the bycatch problem, which indicates that across the IOSEA region sea turtles are being lost to fisheries by the *1,000s*, and more likely in the tens to hundreds of thousands.

Future iterations of the questionnaire could benefit from clearer guidance or more defined categories for quantity estimates. However, it is still informative to reflect on the responses provided by participants. A subset of 28 participants responded that green and hawksbill turtles were being taken by the *1,000s* in commercial fisheries and another 18 respondents also indicated artisanal fisheries were impacting *1,000s* of turtles (top, Figures 6 & 7). There were also a substantial number of responses suggesting that *100s* of green turtles were taken by both types of fishery (43 and 36, respectively). A large proportion of respondents felt that the numbers were in the *10s* (68 and 53, respectively). Combined, these results suggest the magnitude of sea turtle bycatch remains high in the IOSEA region.

3.3.2 Other bycatch species

The questionnaire took the opportunity to briefly assess bycatch of other species in commercial and artisanal fisheries, based on known interactions between these fisheries and other marine species. Unsurprisingly

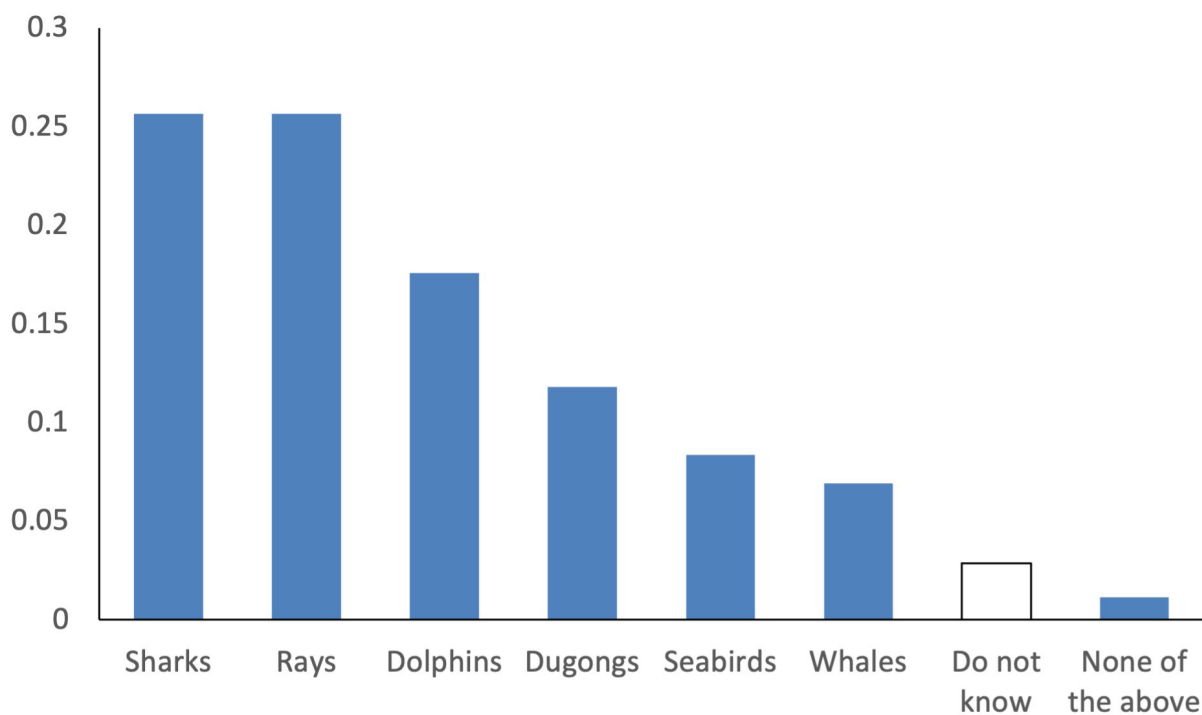


Figure 10. Proportional bycatch of non-sea turtle species in the IOSEA region.

sharks and rays were the two most cited non-turtle bycatch species (Figure 10), although in many countries these are also target species, so it is unclear if this catch refers to bycatch that is discarded or targeted catch alongside other species. Dolphins were also commonly reported, with the largest proportion being taken in bottom set and mid-level trawls (29%) followed by longlines (27%) and gillnets (24%).

Dugongs were reported as bycatch in all sub-regions, with greater numbers being caught in the NWIO and SEA+ (Figure 11). The higher bycatch in the NWIO is unsurprising given the second largest population of dugongs globally occurs in the Arabian/Persian Gulf. However, the high rates of dugong bycatch in SEA+ is of equal, if not greater, concern given the relatively small population sizes of dugongs reported in Southeast Asian countries. Seabirds are also frequently caught as bycatch in longline fisheries, and this was also documented by the respondents. Of note, several respondents also indicated whales were caught as bycatch (Figures 10 & 11); gillnets are particularly problematic, with other gear like traps with vertical ropes also causing entanglement.

At a sub-regional level, there were few differences, except for dugongs (as noted above) and for whales for which there were a disproportionate number of cases of bycatch reported in the NIO sub-region: ~40% of the respondents (Figure 11). This may reflect species distribution relative to fisheries effort but further insights into this are challenging without further contextual information. There is a well-documented and genetically

distinct population of humpback whales (*Megaptera novaeangliae*) resident off the coast of Oman, and it is known that bycatch impacts this endangered population, which is of serious concern as this population is among the smallest and most endangered populations of baleen whales globally, with a population size of less than 100 individuals (and declining) based on estimates from Oman. Sharks and rays remained at higher risk of bycatch across all four sub-regions, comprising between 25% and 30% of all responses.

3.3.3 Foreign vessel incursions

In addition to exploring bycatch of other species, the questionnaire investigated respondents' knowledge of (illegal) foreign vessel incursions and their impacts on bycatch of sea turtle species. There was a slightly higher proportion of respondents indicating they knew that this occurred (Figure 12) with roughly two thirds of Yes respondents indicating they could provide details of these activities (shaded red portion, Figure 12). However, slightly more than 40% of respondents indicated they were unaware of whether foreign vessels encroached into their national waters, suggesting that this might still occur but remains unaccounted for – a form of Illegal, Unreported and Unregulated (IUU) fishing. IUU fishing violates national and international laws, and can deplete fish stocks, destroy marine habitats, and undermine the livelihoods of domestic fishers and vulnerable coastal communities. Several respondents indicated there was knowledge of sea turtle bycatch and intentional capture in some of these fisheries, adding an additional layer

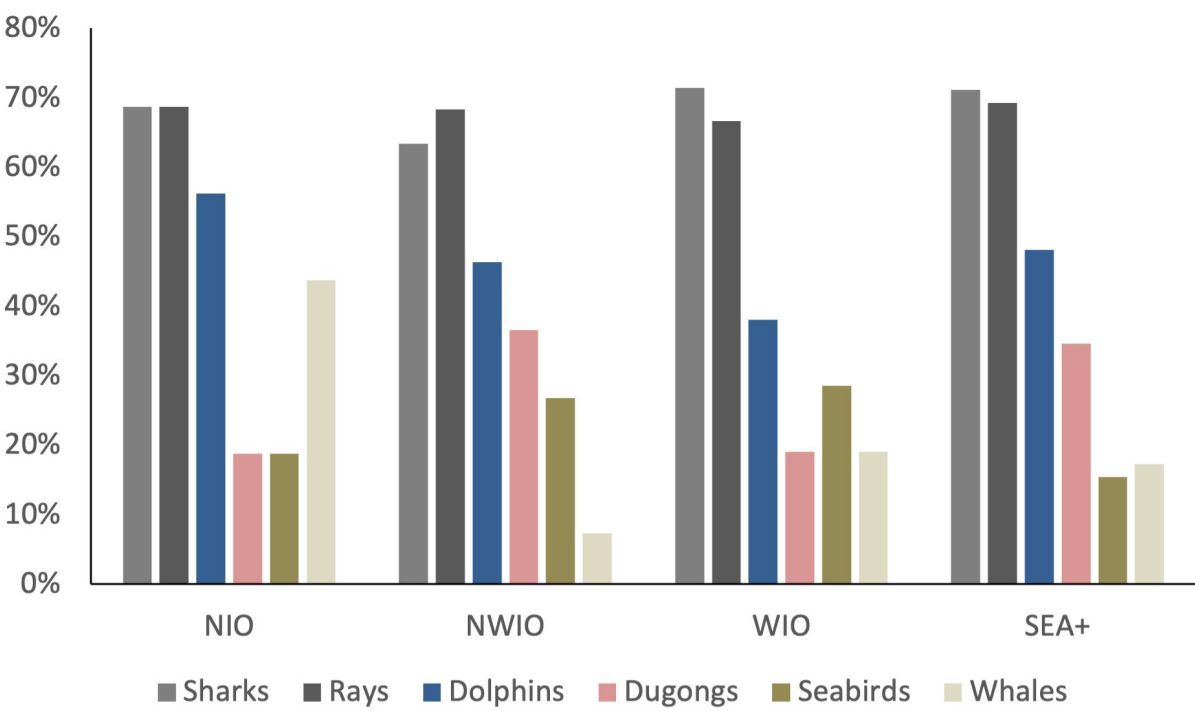


Figure 11. Proportional bycatch of non-sea turtle species across the four IOSEA sub-regions, calculated as a proportion of each sub-region.

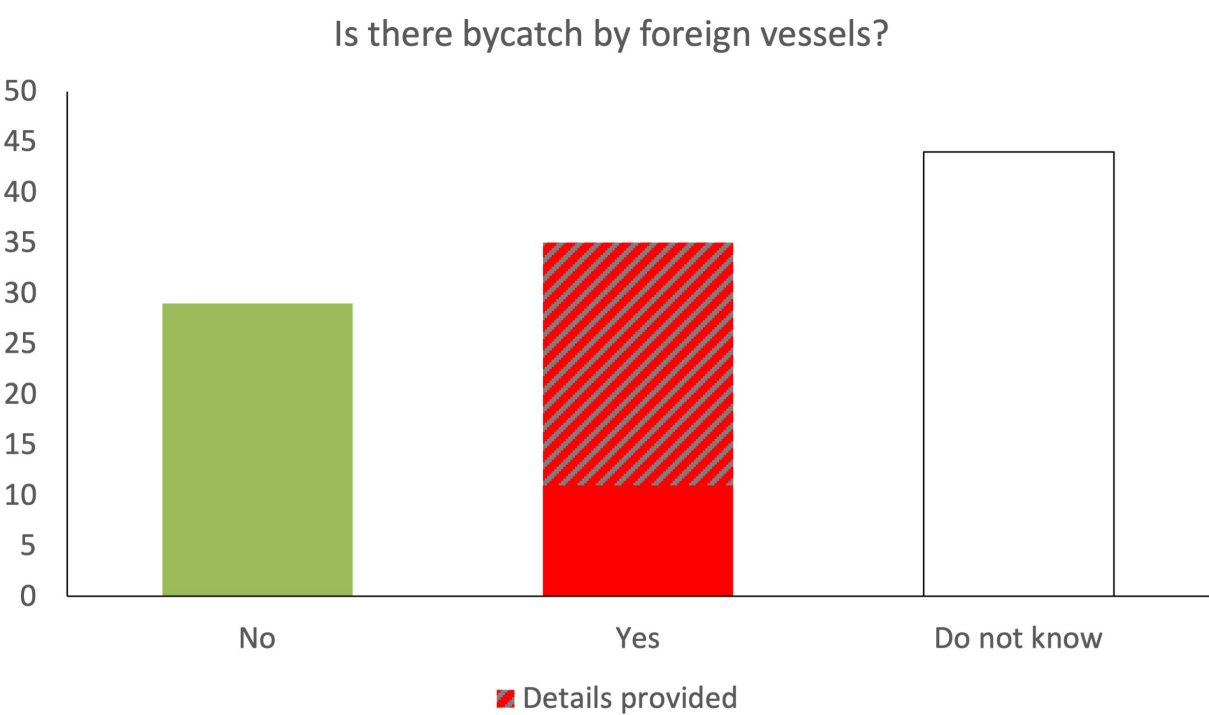


Figure 12. Bycatch of sea turtles (and in some cases other species) by foreign vessels in the IOSEA region.

of pressures on sea turtles in the IOSEA region that currently remains unmanaged and underreported.

3.4 Bycatch Impacts by Fishery

Species-specific impacts in commercial fisheries indicate that green and hawksbill turtles appear to be impacted the most across all fishery types, particularly in gillnet and trawl fisheries, and to a lesser degree in purse seine and longline fisheries (Figure 13). This aligns with the results for species abundance from respondents (see Section 3.2.1). However, there are some challenges with interpretation: while green turtles are herbivorous and forage in areas favoured by bottom trawlers, hawksbills tend to associate more with coral reefs where trawling would result in the loss of fishing nets. Purse seine and

longline industries, on the other hand, operate far offshore where hawksbills are only infrequently encountered, likely during migrations associated with reproduction. There may be some overlap of responses with artisanal fisheries, which might explain these reportedly high bycatch rates of hawksbills in commercial fisheries, but the Indian Ocean Tuna Commission database does not list hawksbills as longline bycatch, and commercial fishery bycatch records do not frequently list hawksbills. This does not discount that some hawksbills may be caught this way, but the interpretation of these results requires caution.

Within artisanal fisheries, respondents reported that gillnets were responsible for large proportions of green and hawksbill turtle bycatch, which resonates with what

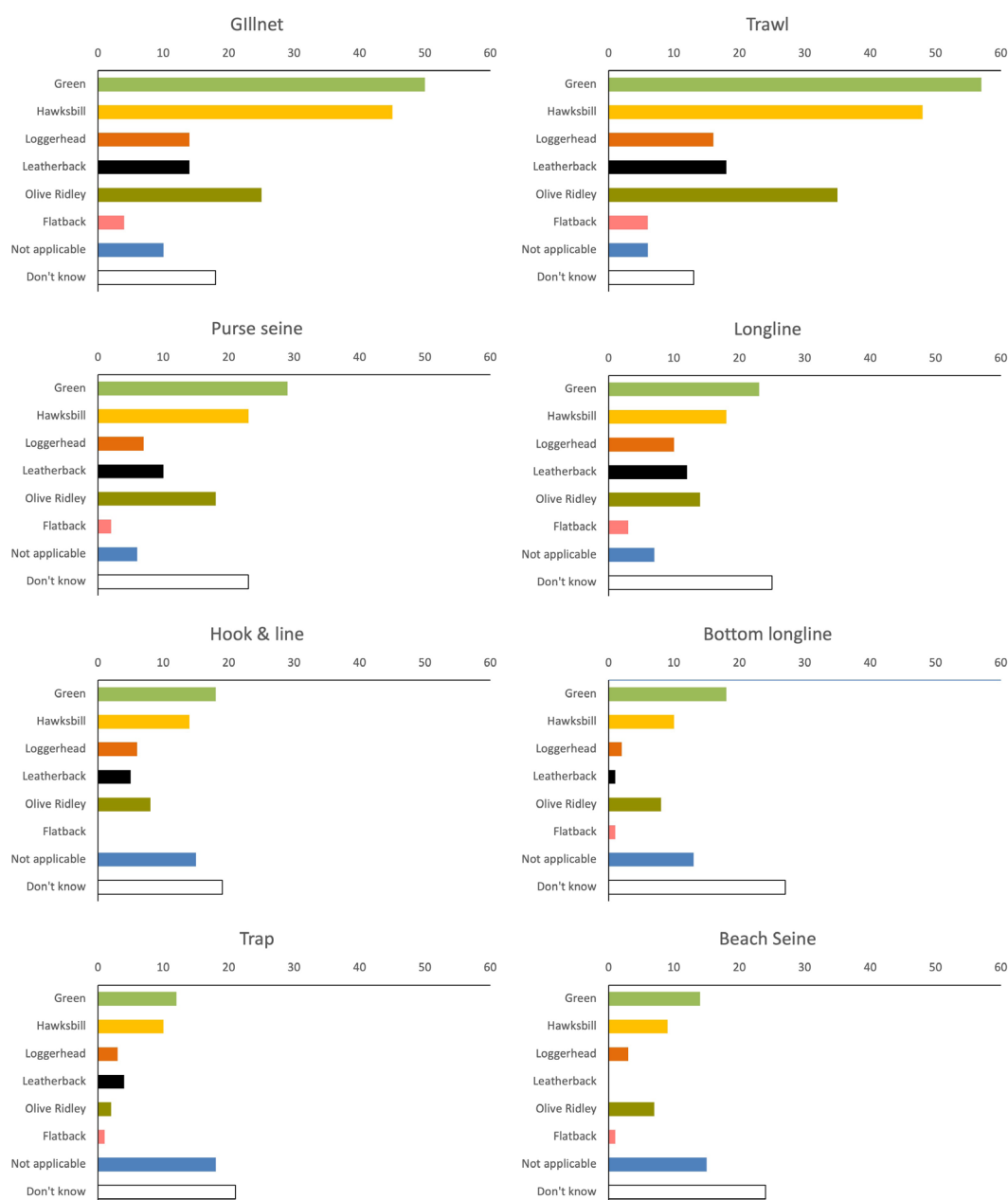


Figure 13. Proportional impacts to different species by different commercial fisheries in the IOSEA region.

is known elsewhere in the world and for some specific locations within the IOSEA region. Gillnets are used prolifically throughout the region and, as can be seen from the substantive impacts on turtles (Figure 14), they are likely an urgent priority for management. Artisanal or small-scale trawl fisheries did not appear to impact turtles as substantively as in commercial fisheries. It is possible that the reports of hawksbill captures in some of these artisanal fisheries are due to the fact they operate closer to shore where hawksbills are found more frequently.

Attention should also be drawn to the high proportion of *Don't know* responses in both commercial (Figure 13) and artisanal (Figure 14) fisheries, with the exception of

commercial trawl and gillnet fisheries, which appear to be the most understood. This lack of knowledge on the extent of impacts to different species of sea turtles by commercial and artisanal fisheries presents significant obstacles to the development of targeted management measures.

3.5 Use of Mitigation Measures to Address Sea Turtle Bycatch

The following sections describe the frequency of use (or lack thereof) of different mitigation measures in the different fisheries, along with levels of uncertainty around the use of specific measures. The mitigation measures

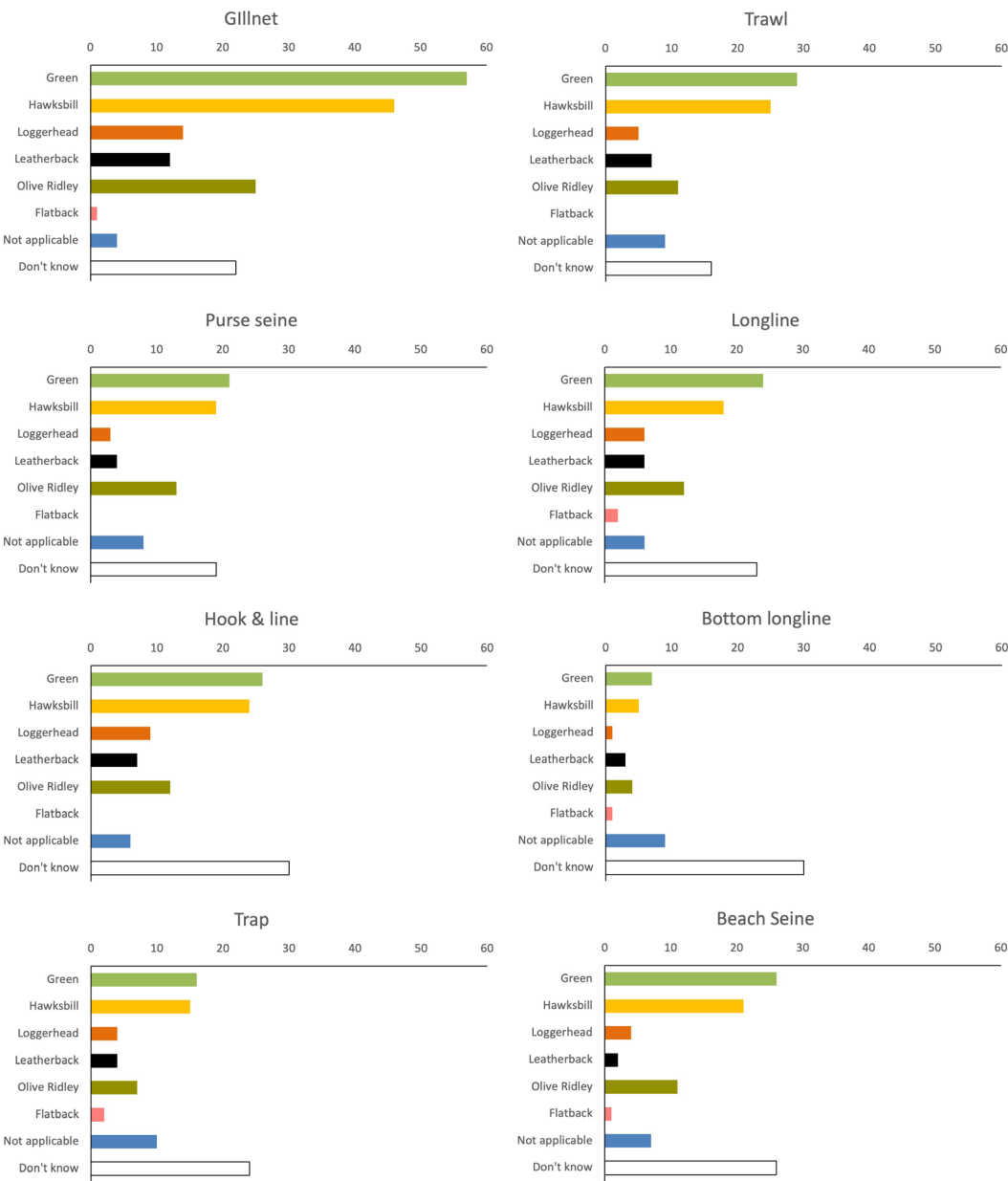


Figure 14. Proportional impacts to different species by different artisanal fisheries in the IOSEA region.

were provided to the respondents as response options based on known mitigation measures in use in some IOSEA and other global fisheries. The list also provided an *Other* option so that respondents could add mitigation measures of their own.

3.5a Gillnet fisheries

Gillnet fisheries had the largest number of different mitigation measure options, along with a number of *Other* measures introduced by respondents, such as voluntary seasonal closures, limits on the number of flotation buoys, and the use of drumlines to replace gillnets. Respondents from Saudi Arabia and Malaysia indicated that electronic monitoring cameras were being installed on some vessels, and a respondent from Indonesia reported there were restrictions on mesh sizes and specific areas where gillnets could be used. One respondent from the UAE indicated that seasonally a *dafara* net was used, which is a relatively small net, about 100 meters long, typically managed by two fishermen. In Kenya, catch and release is promoted as a way to decrease bycatch, but it is reportedly a small spatial-scale programme. In Pakistan, fishers reportedly use limited soak times, voluntary seasonal closures, and limited number of flotation buoys.

Known and established mitigation measures that were provided as possible response choices in the questionnaire included the timing of operations (whether the nets were deployed during the day, at night, or both); the linear length and depth of the net; the mesh size (smaller mesh sizes catch indiscriminately but can sometimes be too small for turtles to be entangled, whereas larger mesh sizes are more problematic for sea turtles); the depth of net deployment (whether the net was deployed at the surface with more flotation than weight, or deployed at the bottom with more weight than flotation, or whether it stretched from surface to seabed); the use of light deterrents (some gillnet fisheries have used LED lights to deter entanglement of some species) or silhouette deterrents (trials have been conducted with shark silhouettes to see if this deters turtles from approaching the nets); limits on soak times (the length of time the nets remain in the water); seasonal closures (where the fishery is not permitted during certain seasons, often in combination with spatial closures); restrictions on the time of day that the nets can be deployed; the use of safe handling procedures such as for releasing entangled bycaught turtles; and restrictions on the amount of flotation on the nets or even the use of no floats at all (some trials have successfully used buoy-less nets to mitigate turtle bycatch when fishing for fish that stay on the seabed).

Of significant concern was the number of respondents who indicated that many mitigation measures were not used (blue columns, Figure 15), and the degree of uncertainty about the use of mitigation measures (white

columns, Figure 15). Also of note was that none of the mitigation measures were extensively used in gillnet fisheries (green columns), and where measures were implemented, they were mostly used to a low or moderate degree. On a positive note, 70% of respondents indicated that at least a few mitigation measures were in place, but this was tempered by the ~10% of respondents who indicated no mitigation whatsoever was being used in gillnet fisheries.

The two least frequently used measures to deter turtle bycatch were limits on soak time and use of silhouettes. Soak times are challenging to enforce given fishers operate offshore and it is impractical to monitor when nets are deployed and retrieved. Shark silhouettes have been used experimentally in some gillnet fisheries but they are considered impractical for widescale use given the bulkiness of the silhouettes.

It appeared that mesh size and seasonal closures were the two measures that could be extensively implemented, likely linked to the relative ease of implementation. Mesh sizes can be controlled by limiting the sale of nets to only those that are permitted, while seasonal closures apply to all fishers, and therefore fishing vessels from those fisheries would be expected to remain in port. It is likely that experimentation among fishers may also find solutions to gillnet bycatch, potentially through collaborative programmes with NGOs and fishing gear specialists (e.g. specialists with the US National Marine Fisheries Service, and those from other countries).

However, addressing bycatch in gillnet fisheries will remain challenging across the entire IOSEA region given the difficulties in enforcing restrictions once fishers leave port and disperse widely. It is likely that any uptake of mitigation measures will be voluntary, and these will need to be introduced in such a way that fishers see benefit to their implementation.

At a sub-regional level, there appeared to be less uptake of mitigation measures in the NWIO and WIO than in other regions, and a greater degree of uncertainty about mitigation in the SEA+ sub-region (Figure 16). A small proportion of respondents indicated that mitigation measures were used extensively in gillnet fisheries in all regions, but we believe that this is the most unregulated fishery across the region and that it is unlikely that any measures are extensively used. There may, however, be pilot projects or small spatial-scale projects in which measures are used.

3.5b Trawl fisheries

Mitigation options for trawl fisheries include the use of Turtle Excluder Devices (TEDs) which are the most effective measure for mitigating sea turtle bycatch (these consist of grids that fit in the long neck of trawl nets to

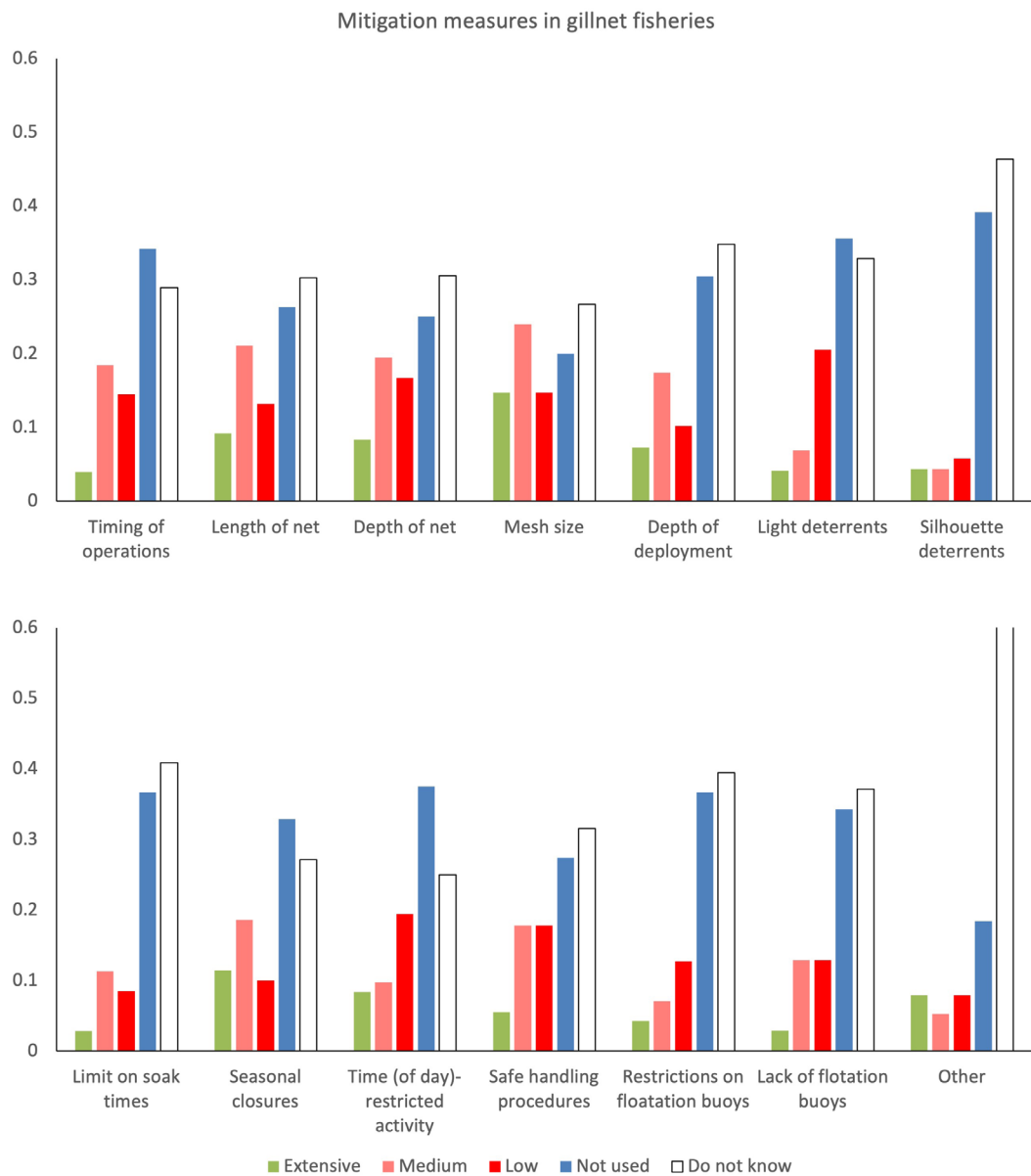


Figure 15. Degree of implementation of various mitigation measures in gillnet fisheries in the IOSEA region.

prevent turtles from being entrained in the net); safe handling procedures (allowing live turtles to recover before being released); mesh size (smaller mesh sizes usually do not entangle turtles as much as larger mesh sizes); limits on tow times (turtles need to surface to breathe, so limiting tow times can lower the mortality rate of entrained turtles); seasonal closures; and restrictions on the timing of operations. The responses to *Other* mitigation measures provided by respondents largely relate to seasonal closures and the use of TEDs. Respondents from Bahrain and the UAE also indicated that trawling was banned in their respective countries.

As with gillnet mitigation measures, there was a high level of uncertainty over whether any mitigation measures were used. The lowest levels of uncertainty

were around the use of TEDs, which are partially used in some countries (Figure 17, top). For instance, one respondent in Malaysia indicated TEDs were used in some fisheries, but not nationwide. It appears that the TED programmes were more well known – possibly linked to the greater visibility of the programmes – and thus there was less uncertainty around their use (irrespective of whether they were used or not). The most extensive use of TEDs was reported by all respondents from Australia. However, TEDs were also noted for Saudi Arabia, where there was a known trial programme in 2024 (National Center for Wildlife, unpublished data); respondents from Madagascar and the Islamic Republic of Iran also indicated TEDs were extensively used. In Madagascar, TEDs are mandated for shrimp trawlers, but enforcement is weak, leading to poor implementation.

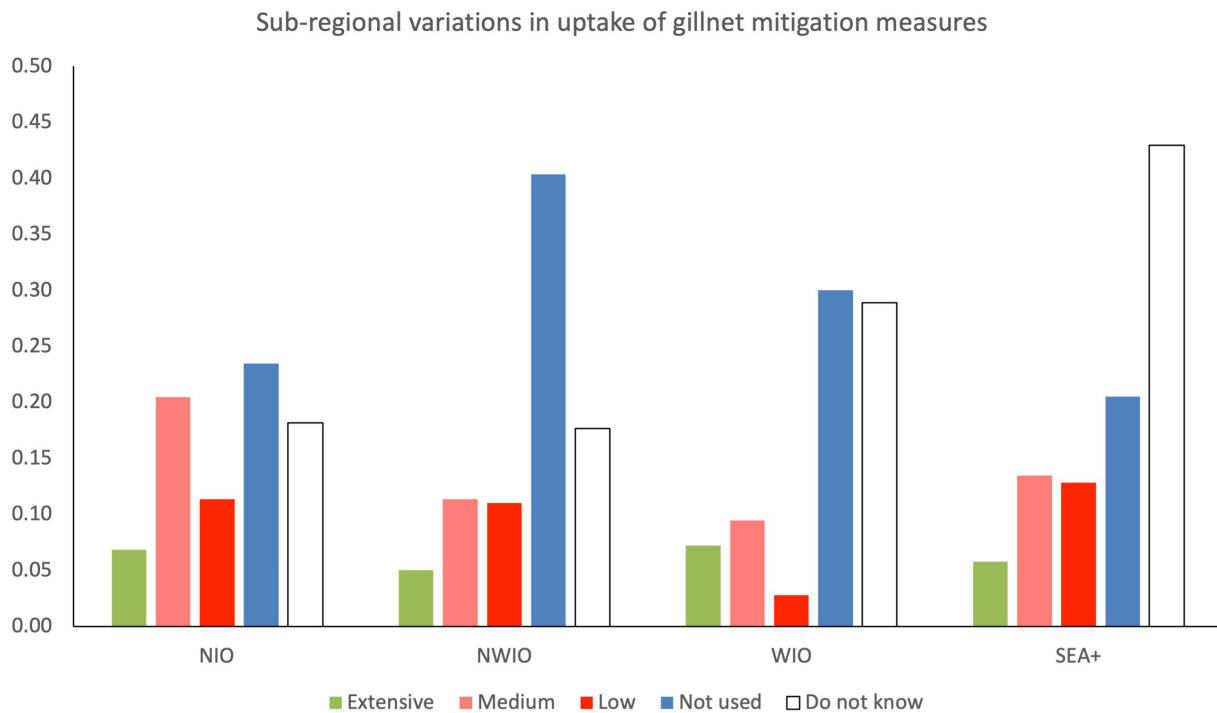
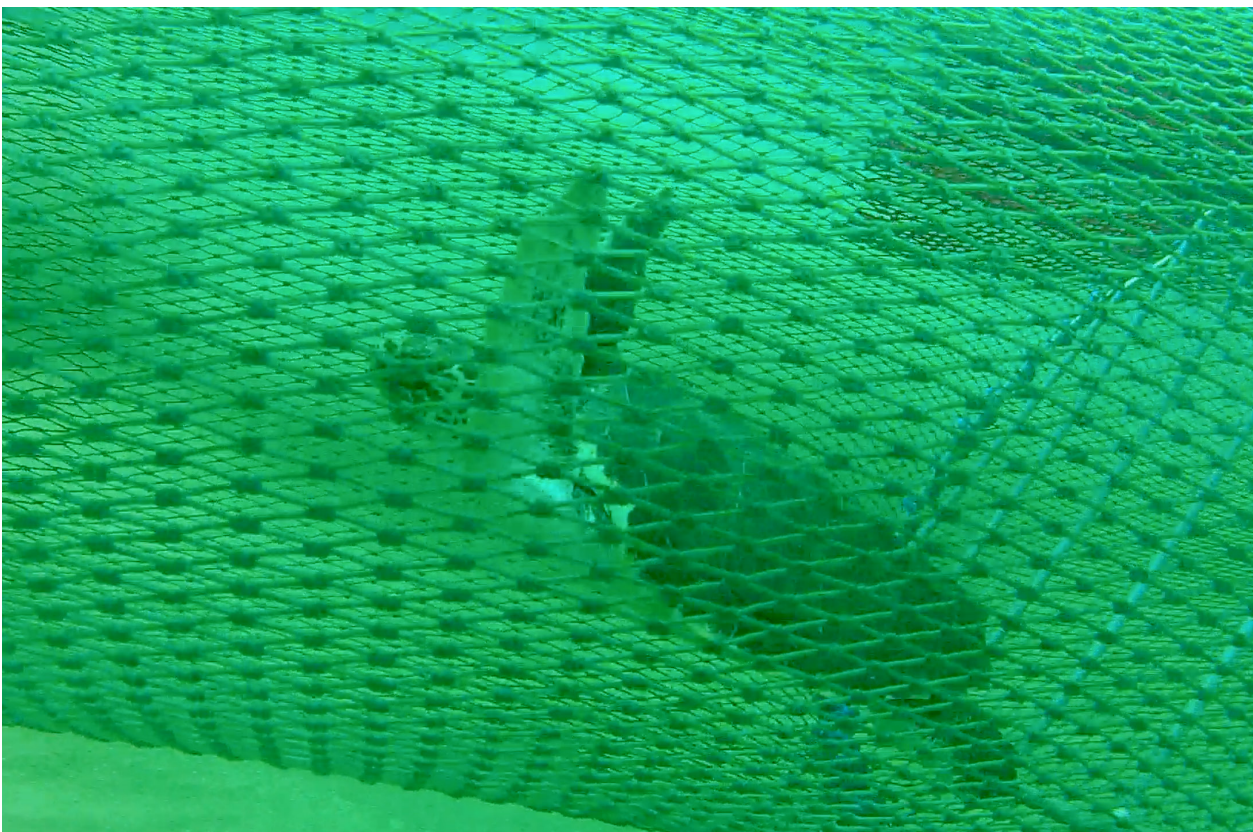


Figure 16. Sub-regional differences in uptake of mitigation measures in gillnet fisheries.



Picture 2. A small turtle in a trawl net equipped with a turtle excluder device (Photo © Marine Research Foundation)

To our knowledge, there are no TED programmes in Iran. Mesh size and seasonal closures appeared the most extensively used measures, likely, as in the case of gillnets, linked to the ease of enforcement. Overall, however, use of mitigation measures in trawl fisheries

were reportedly low or, in most cases, not used at all. At a sub-regional level, the WIO had the lowest uptake of trawl mitigation measures relative to respondent numbers, although it was reported that at least one good programme exists in Kenya. The NWIO had the lowest levels of use

of mitigation measures, with nearly 50% of respondents indicating that no measures whatsoever were used to mitigate turtle bycatch (Figure 17, bottom).

3.5c Purse seine fisheries

Known mitigation measures in purse seine fisheries to address sea turtle bycatch include immediate releases (whereby a turtle is usually dip-netted out, or the net is partially lowered to allow the turtle to escape); safe handling procedures (including keeping slow or sluggish turtles angled down on the vessel deck until they recover); seasonal or temporal closures; and time-of-day restrictions on activities. No *Other* mitigation measures were identified by the respondents. One respondent from Indonesia indicated that

immediate releases were mandated in Regional Fisheries Management Organisation (RMFO) fishing areas.

It appeared that safe handling and immediate releases were the most commonly used mitigation measures, with seasonal closures and time-of-day restrictions less common (Figure 18). However, the degree of uncertainty regarding mitigation of turtle bycatch in purse seine fisheries remained high for all mitigation measures. One respondent from the UAE indicated that purse seine fishing was not used in their country.

There were only minor differences across sub-regions, with uptake being slightly higher in the WIO and uncertainty being the highest in SEA+.

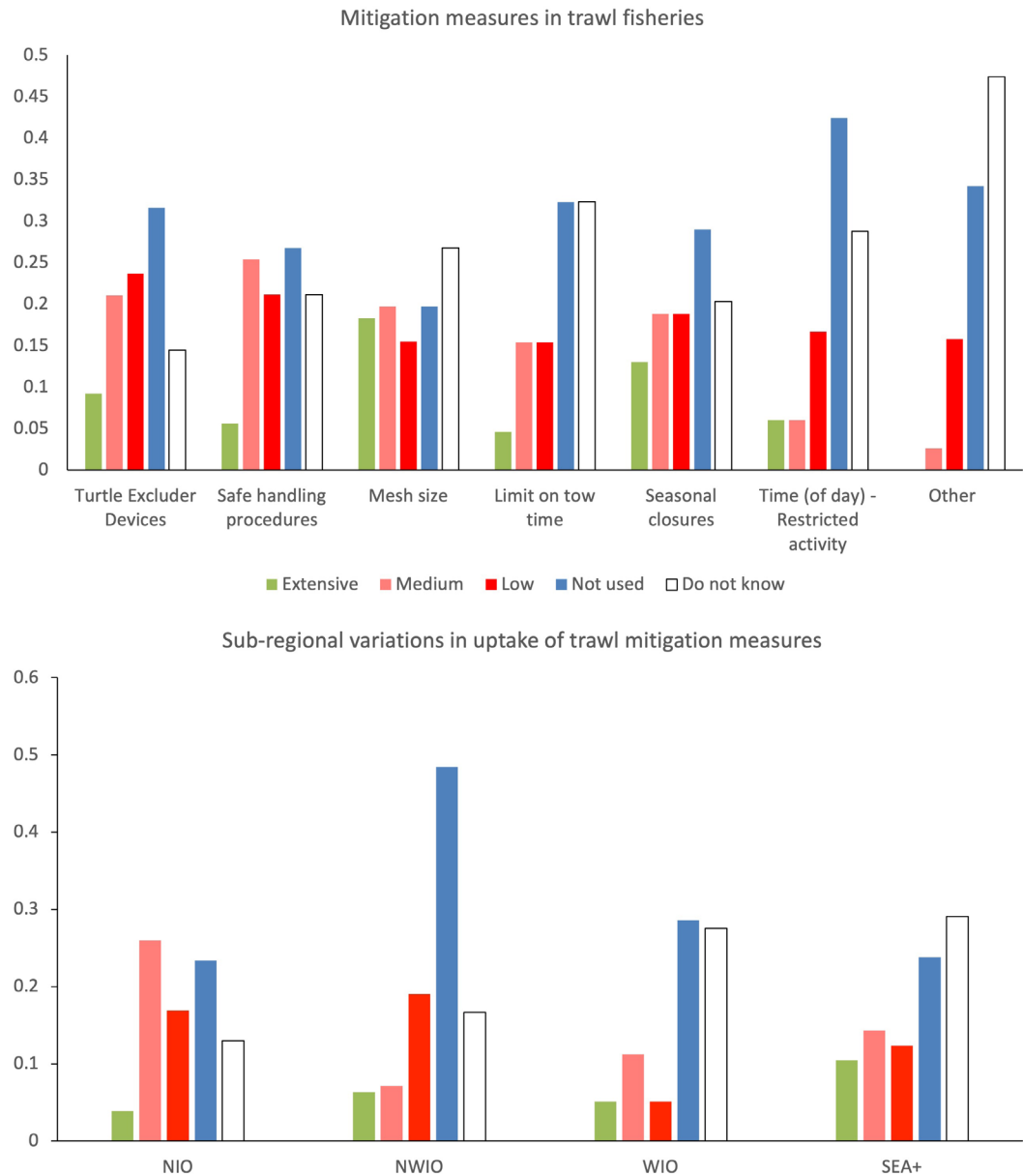


Figure 17. Degree of implementation of mitigation measures in trawl fisheries in the IOSEA region (top); and sub-regional differences in uptake of mitigation measures in trawl fisheries (bottom).

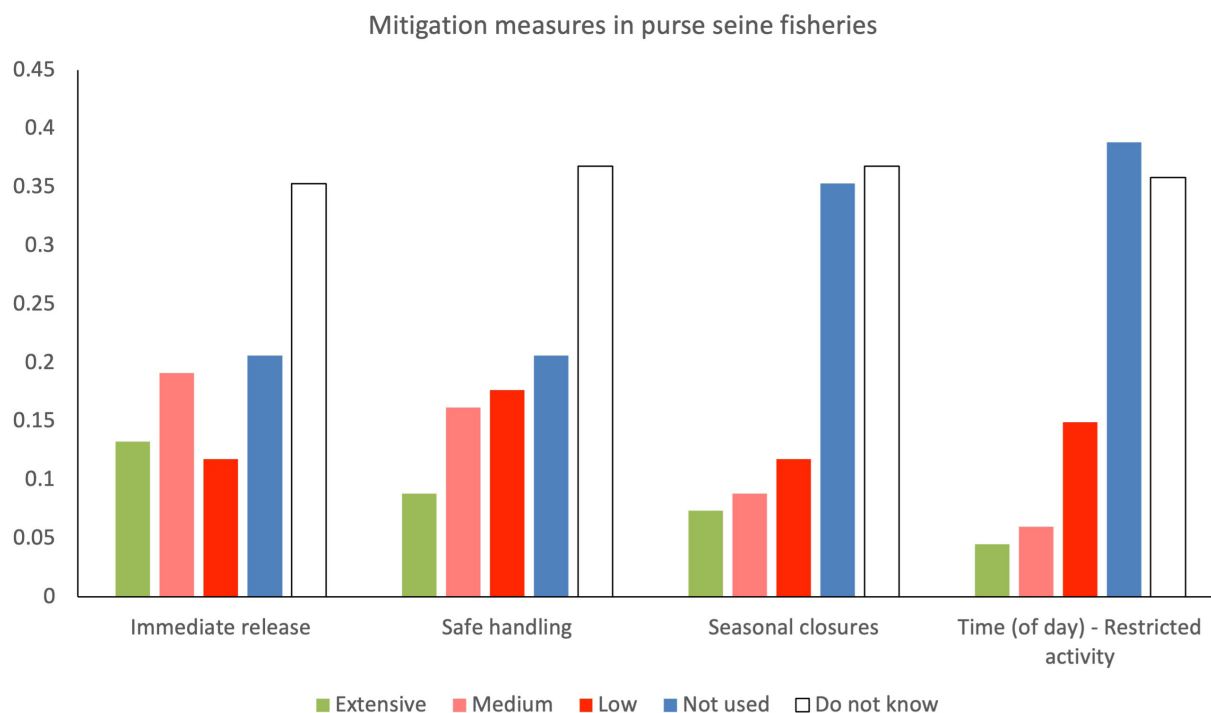


Figure 18. Degree of implementation of mitigation measures in purse seine fisheries in the IOSEA region.

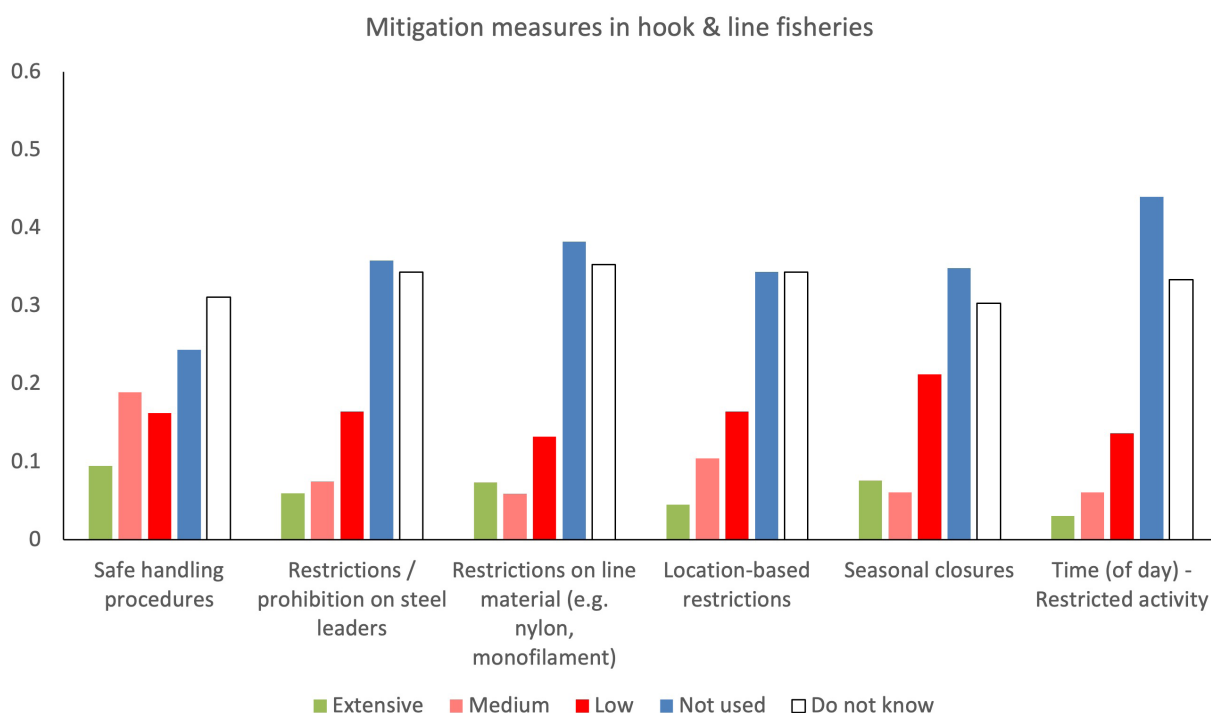


Figure 19. Degree of implementation of mitigation measures in hook & line fisheries in the IOSEA region.

Many purse seine fisheries, particularly small-scale fisheries, use Fish Aggregating Devices (FADs) that use nets, ropes, or canvas material hung below the surface structure to provide a larger area that attracts fish. These entangling materials can also lead to sea turtle mortality; changing the design of FADs to reduce the amount of

entangling material would therefore help prevent turtles from becoming caught. Comprehensive training for vessel captains and crews on sea turtle safe handling, release techniques, and resuscitation methods would also improve post-capture survival.

3.5d Hook & line fisheries

Known bycatch mitigation measures for hook & line fishing include safe handling procedures (dehooking, removing leaders and line, preventing entanglement); restrictions on the use of steel leaders (the short length of line between the hook and the main fishing line, which may be metal-sheathed nylon, or stainless steel – of which the latter can impact turtles); restrictions on fishing line material and strength; possible location restrictions; seasonal closures; and time-of-day restrictions. There were no *Other* mitigation measures identified by the respondents.

Overall, it appeared that safe handling was the most used mitigation measure, but there were no measures that stood out as being used extensively – indeed many respondents indicated mitigation measure uptake was generally non-existent (Figure 19). There were no substantive differences at the sub-regional level, with the exception of slightly higher uptake of mitigation measures in the NIO and greater uncertainty in SEA+. It is probable that developing and requiring the use of safe handling and release measures for caught turtles will significantly reduce post-release mortality in hook & line fisheries.

3.5e Trap fisheries

Known mitigation measures to minimise bycatch in trap fisheries include safe handling procedures; number of funnels per trap; the use of biodegradable funnel ties (so

that these may degrade naturally if the trap is lost and the trap will not continue to fish indiscriminately – known as *ghost fishing*); enhancing the visibility of the trap to surface lines (so they are visible to turtles, at least during the day); limiting the number of traps set together (so that if the marker buoy is lost a smaller number of traps is lost); seasonal closures; and time-of-day restrictions. There were no *Other* mitigation measures identified by the respondents, with the exception of a note from one respondent from the United Arab Emirates which stated that traps were banned for a period of five years. Two other respondents from the UAE also indicated traps were banned in that country. This possibly refers to Ministerial Decree No.82 of 2019, banning the use of gargoor (fish traps) in the Abu Dhabi emirate.

Overall, it appeared that most mitigation measures were not used in trap fisheries in the IOSEA region (Figure 20). Where these were used, it was with a very low level of uptake; only a few respondents suggested that any measures were extensively used anywhere in the region. One respondent from Malaysia indicated that measures relating to safe handling, the number of funnels, the visibility of trap lines, the number of traps set together and seasonal closures were all used extensively. Limiting the number of traps set together was also reported as extensively used in Qatar and Sri Lanka.

3.5f Beach seine fisheries

As in the case of purse seine fisheries, known mitigation measures for beach seine fisheries include immediate

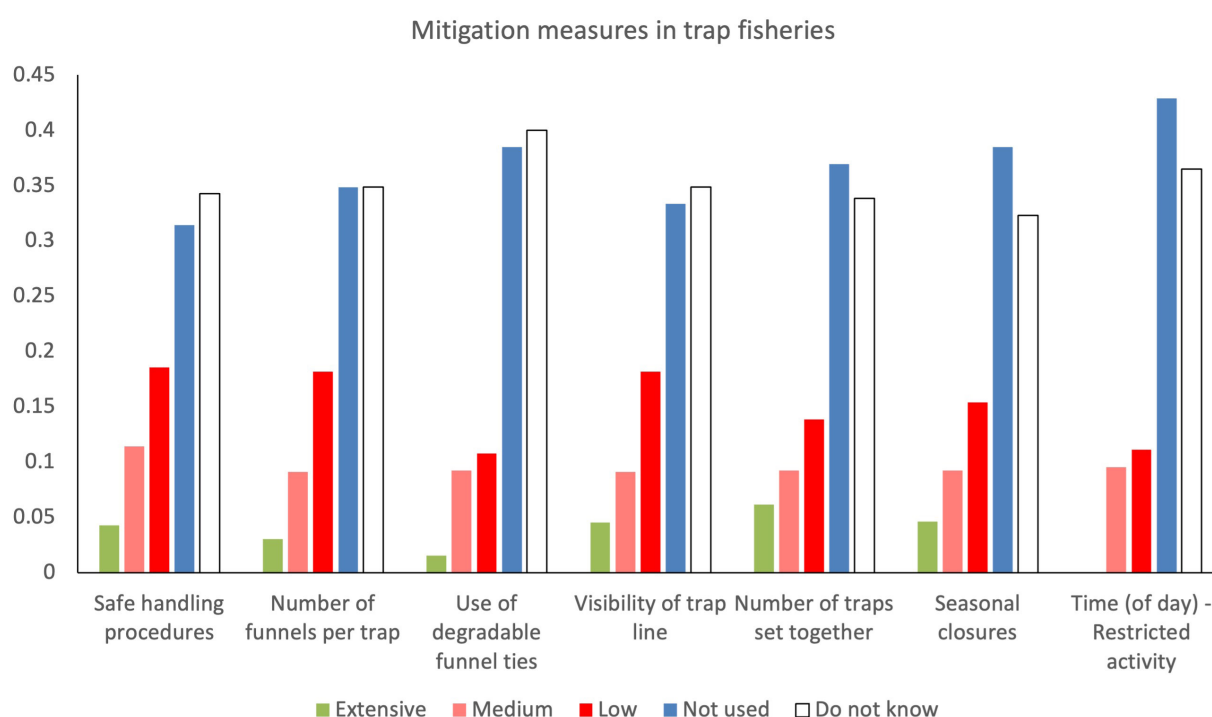


Figure 20. Degree of implementation of mitigation measures in trap fisheries in the IOSEA region.

releases (usually the net is partially lowered to allow the turtle to escape); safe handling procedures (including keeping slow or sluggish turtles angled down on the beach until they recover); seasonal or temporal closures; and time-of-day restrictions on activities. No *Other* mitigation measures were identified by respondents.

Two respondents from the UAE indicated that this type of gear was not used in Abu Dhabi, but that it was extensively used in other emirates. Indeed, in Sharjah and Ras Al Khaimah, for example, nets that can measure several kilometres in length are deployed by powerful speedboats and then retrieved with 4x4 vehicles on the

beach. These nets regularly entrain tens of sea turtles. However, these turtles are generally released safely back to the sea unharmed.

No specific mitigation measures were used extensively in beach seine fisheries, but immediate release and safe handling procedures appeared to be used – at least to some extent – across the IOSEA region. Seasonal closures and time-of-day restrictions appeared to be less commonly used (Figure 21, top). At the sub-regional level, uncertainty was lower in the NIO and WIO, but remained very high in SEA+. Interestingly, it was only in the NIO that any mitigation measures were reportedly used extensively;

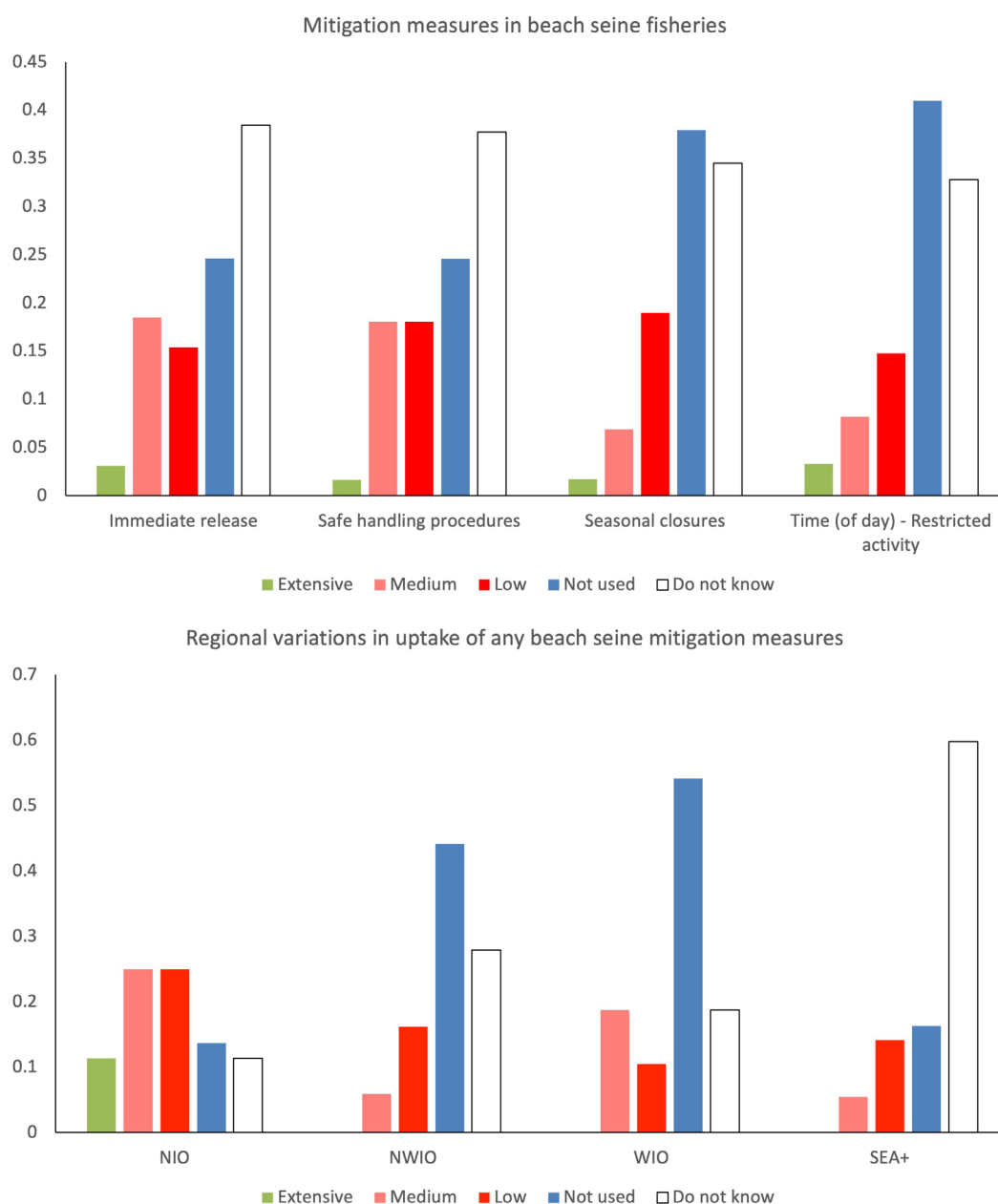


Figure 21. Degree of implementation of mitigation measures in beach seine fisheries in the IOSEA region (top); and sub-regional differences in uptake of mitigation measures in beach seine fisheries (bottom).

this sub-region also recorded the lowest number of *Not used* responses. The NWIO and WIO regions, on the other hand, had far greater response rates for *Not used* than NIO and SEA+ (Figure 21, bottom).

3.5g Bottom longline fisheries

Known mitigation measures in bottom longline fisheries include restrictions on the size of hooks (larger hooks generally result in less bycatch); limits on soak times (the length of time the hooks remain in the water); safe handling procedures (there are several methods for safely removing hooks or for cutting lead lines closer to the turtles); seasonal closures; and timing of operations. Overall, the uptake of mitigation measures in bottom longline fisheries was reported as low, with a far greater proportion of respondents indicating none were used (Figure 22). One respondent from the UAE indicated that longlines were not used in that country.

At the sub-regional level, uptake was comparatively higher in the NIO for all bottom longline mitigation measures, although only at *Medium* and *Low* levels, with almost no *Extensive* uptake. Uncertainty levels were very high across all four sub-regions, with *Do not know* comprising more than half of the responses in SEA+. However, SEA+ was also the region with the least *Not used* responses, which suggests that some efforts are under way to address turtle bycatch in these fisheries.

3.5h Longline fisheries

Known, effective mitigation measures in longline fisheries include the use of circle hooks (compared with the traditional J-shaped hooks, these hooks are more circular; and extensive studies have shown that these hooks result in less turtle hooking events, or at a minimum that the hooks are easier to remove); the choice of bait (studies have shown that the use of mackerel or other small fish instead of squid results in lower levels of turtle bycatch); the depth at which longlines are set (with deeper sets resulting in lower bycatch rates of some species); limits on the number of hooks per set; restrictions on the size

of hooks (larger hooks generally result in less bycatch); limits on soak times (the length of time the hooks remain in the water); safe handling procedures (there are several methods for safely removing hooks or for cutting lead lines closer to the turtles); seasonal closures; and timing of operations. Interestingly, a number of these measures were developed initially as mitigation measures for seabird bycatch. As such, there are co-benefits to implementing these measures to reduce both turtle and seabird bycatch simultaneously.

One respondent from Australia indicated that crew awareness / education programmes, line weighting regimes, no discharge of offal during setting and hauling, and mandatory carriage of line cutting and dehooking devices were extensively used. Dehooking and bringing turtles to a rehabilitation centre was also noted by a respondent from Réunion (France), and a respondent from Madagascar reported the extensive use of nylon leaders. One respondent indicated that longlines were not used in the UAE.

Overall, across the IOSEA region there was no extensive uptake of any of these mitigation measures (Figure 23). A substantial proportion of respondents indicated that few or none of the mitigation measures were being used, and that when they were, the level of uptake was low. There was also substantial uncertainty about the use of these measures in longline fisheries.

At a sub-regional level, it appeared there was greater uptake of mitigation measures in the WIO and SEA+ regions, with a larger proportion of respondents in the NWIO and the NIO indicating no measures were being used (Figure 23, bottom). However, there appeared to be far greater uncertainty surrounding mitigation in the WIO and SEA+. This may occur when people are aware of pilot activities that are under way but do not know the details or the degree of uptake, or when measures are government-mandated but not widely used by fishers.

Given that commercial (and to a lesser extent artisanal) longline fisheries significantly impact sea turtles through



Picture 3. Beach seine fishing with several turtles caught in the net (Photo © Nicolas Pilcher)

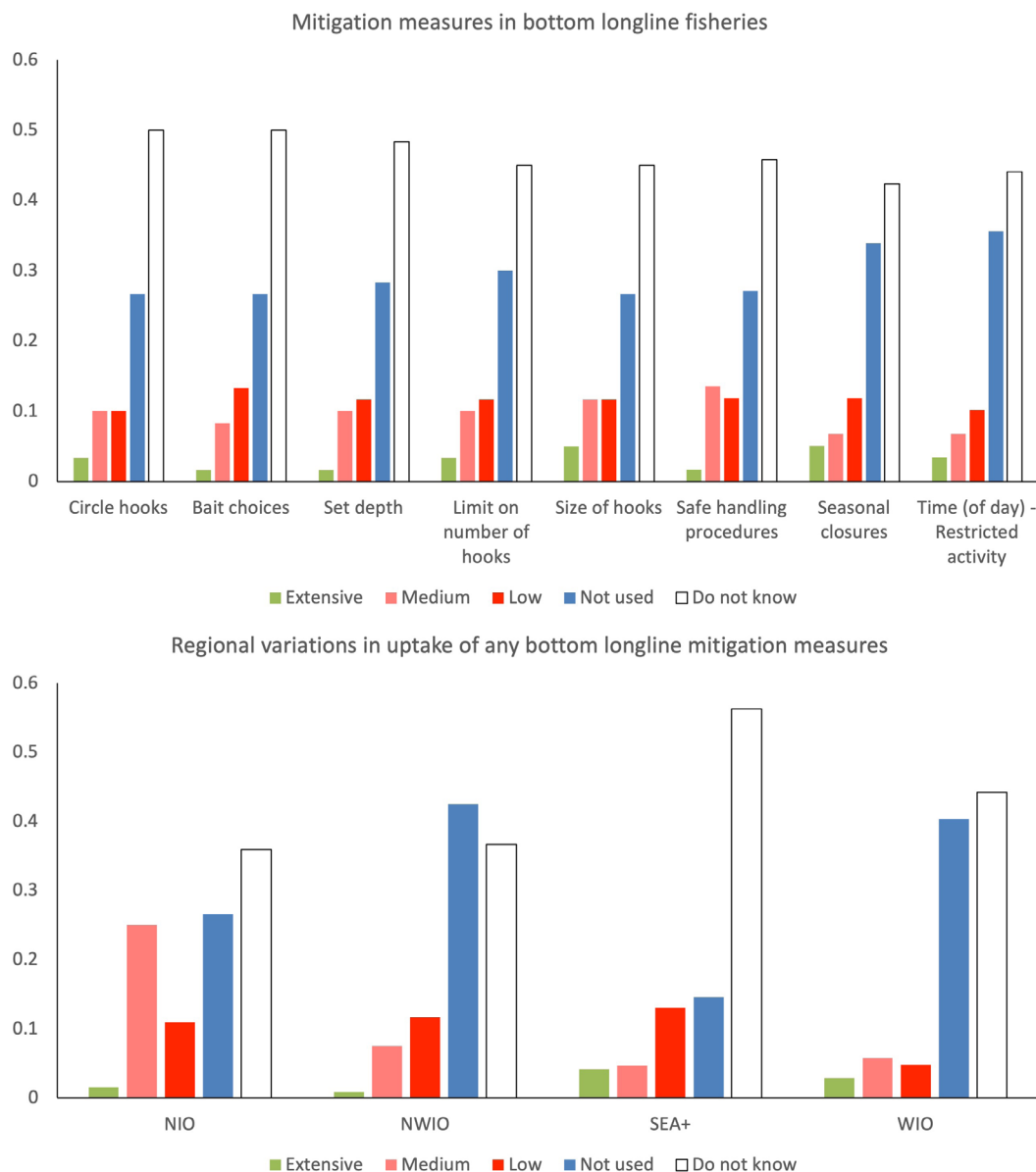


Figure 22. Degree of implementation of mitigation measures in bottom longline fisheries in the IOSEA region (top); and sub-regional differences in overall uptake of mitigation measures in bottom longline fisheries (bottom).

entanglement in fishing lines and ingestion of hooks, leading to injuries, drowning, and death, and that entanglement rates are high in most regions of the world, this is an area of the fishing industry that will require close scrutiny. Sea turtles are attracted to the baited hooks. Once caught, they are often unable to surface to breathe, resulting in drowning. Hooks can also become lodged in their digestive system, causing severe damage, or snag in their flippers, leading to debilitation and death. These interactions are a major cause of decline in sea turtle populations worldwide, as well as in the Indian Ocean region. Several trials have been conducted to test mitigation measures, and some countries have comprehensive measures in place to address bycatch of sea turtles in longline fisheries, but there still remain many countries in the IOSEA region that have yet to implement the FAO guidelines to reduce marine

turtle mortality in fishing operations. This will likely lead to substantial sea turtle mortality, both at regional and sub-regional levels.

3.6 Engagement of Stakeholders in Addressing Turtle Bycatch

Generally, across the IOSEA region, the questionnaire data suggest that there was substantial engagement from governments and NGOs in addressing bycatch of sea turtles. Local NGOs were considered to be by far the most engaged, followed by international NGOs and central governments, and to a lesser degree by provincial / state / local governments (Figure 24). However, as was pointed out by one respondent, it is important to distinguish between government departments. Fisheries departments

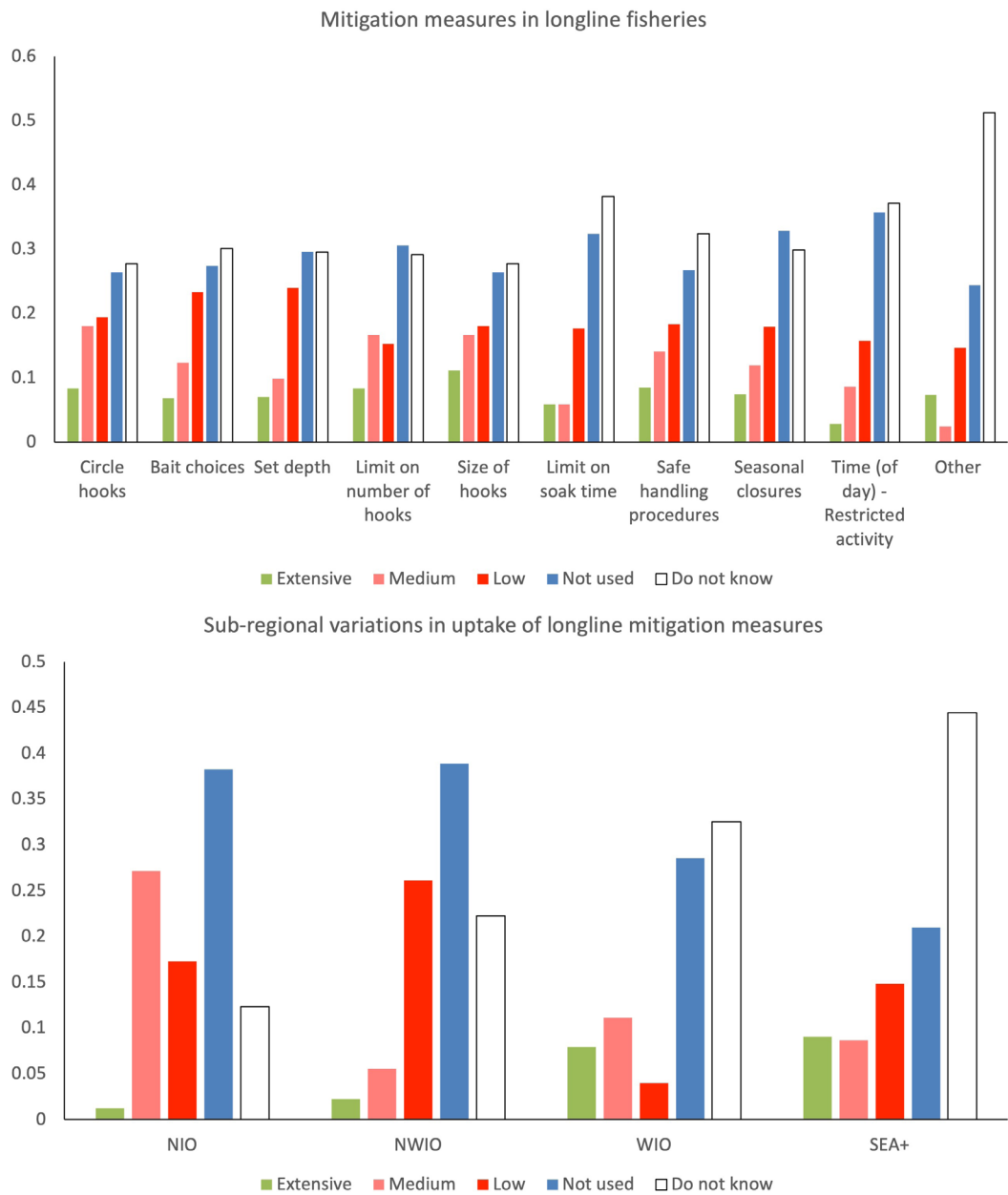


Figure 23. Degree of implementation of mitigation measures in longline fisheries in the IOSEA region (top); and sub-regional differences in uptake of mitigation measures in longline fisheries (bottom).

oversee fishery operations and management but may have little interest in bycatch, while wildlife conservation departments have a greater interest in reducing bycatch but may have less leverage when it comes to addressing the issue. The respondent also pointed out that interest can be highly dynamic and can change within a short time, further challenging government involvement. Additionally, turnover of government agency staff is usually high, and officers may be posted to other duties shortly after they become engaged in addressing turtle bycatch, whereupon the process often needs to start all over again.

Another respondent suggested that government activity is often dependent on an external party (usually an

international NGO) providing funding and/or capacity for a bycatch project. The project is rolled out, people attend meetings, there may be a trial for some gear modification or introduction of a new fishing technique, a few photos are taken and a report is written, but nothing actually changes on the ground. The only consistent work to reduce sea turtle bycatch comes from local NGOs engaging with local fishing communities. If this is done with genuine intent and respect, then it can be effective. The work of Local Ocean Conservation in Watamu (Kenya) is an example of this, as is that of the Marine Research Foundation in Malaysia, and the Environment Society of Oman, Future Seas, and Ocean Ecology Network in Oman.

In general, there was reportedly little engagement

from commercial fishing companies and fishers in addressing bycatch, although there were a small number of respondents from Bangladesh, India, Madagascar, Malaysia and the Philippines who indicated these groups were highly engaged. There was little mention of the involvement of other groups, such as environmental consulting companies, in addressing bycatch of sea turtles in the IOSEA region; these were not seen as active drivers of bycatch reduction at a regional level.

At a sub-regional level, several differences became apparent: NGO engagement was significantly lower in the NWIO than it was for governments, and fishers and

commercial fishing companies were reportedly barely engaged in addressing turtle bycatch (Figure 25). It may be that the smaller number of NGOs working in this region accounts for this discrepancy, or there may indeed be different levels of engagement. There was also substantially lower international NGO engagement in the NWIO, WIO and NIO than there was in SEA+, which may be hindering the uptake of bycatch mitigation. In the WIO there was higher engagement of NGOs than of government agencies, and only modest engagement of fishers and commercial companies. In the NIO it appeared that local NGOs were the most engaged, along with state and local government agencies, with a lower



Picture 4. Loggerhead turtle caught on a longline branch (Photo © Mathieu Barret)

level of engagement of central governments. The SEA+ region demonstrated the highest levels of engagement of NGOs, both international and local, as well as substantial engagement of central and local government agencies, but the lowest level of engagement of fishers and fishing companies.

It is clear that in some regions there is a need for greater involvement of central governments to establish legal requirements to address bycatch, while supporting local and international NGOs – which not only appear to be the most engaged stakeholders, but also have the capacity and resources to address the issue. Fishers also need to be more engaged as addressing bycatch can impact livelihoods.

3.7 Priorities for Management (by Fishery and Species)

Respondents were asked to name which sea turtle species were most impacted by each of the different fisheries. While there was a substantial number of respondents who answered *Do not know*, it was evident that green turtles were identified more often than any other species, both for commercial (Figure 26, left) and artisanal fisheries (Figure 26, right). Hawksbill turtles were also a common choice across all fisheries, with the exception of bottom set longlines in artisanal fisheries, although the numbers were dwarfed by those for green turtles. Olive ridley turtles were seen as a highly impacted species, and in fact were chosen more often than hawksbill turtles across most commercial and artisanal fisheries, with the exception of artisanal hook & line and trap fisheries.

It was interesting that green turtles were perceived to be the species most impacted by all fisheries in the IOSEA region, given that the most recent IUCN Red List Assessment indicates that the species has largely recovered from pre-exploitation levels. It is possible that the sheer number of green turtles in the ocean is the reason they were chosen as the species most impacted. From a conservation standpoint, however, the Critically Endangered leatherback and hawksbill turtles, as well as subpopulations of loggerhead turtles, remain as significant species of concern.

Leatherback sea turtles were reported as being impacted by commercial and artisanal longlines, which is in keeping with existing knowledge on bycatch of this species. Leatherbacks were also reported in trap fisheries, where they often become entangled in the float lines. Interestingly, there were few indications of loggerheads as a key bycatch species, given they are known to be caught in longline fisheries which are widespread in the Indian Ocean.

A key finding from this process was the *Do not know* response, which accounted for 41.1% of all responses for commercial fisheries and 38.0% of responses for artisanal fisheries. This indicates there is still a substantial knowledge gap in regards to the impacts of commercial and artisanal fishing on sea turtle species in the IOSEA region.

3.8 Challenges in Implementing Bycatch Mitigation Measures

A lack of technical know-how and skills, a lack of funding, and a lack of prioritisation by governments were ranked as

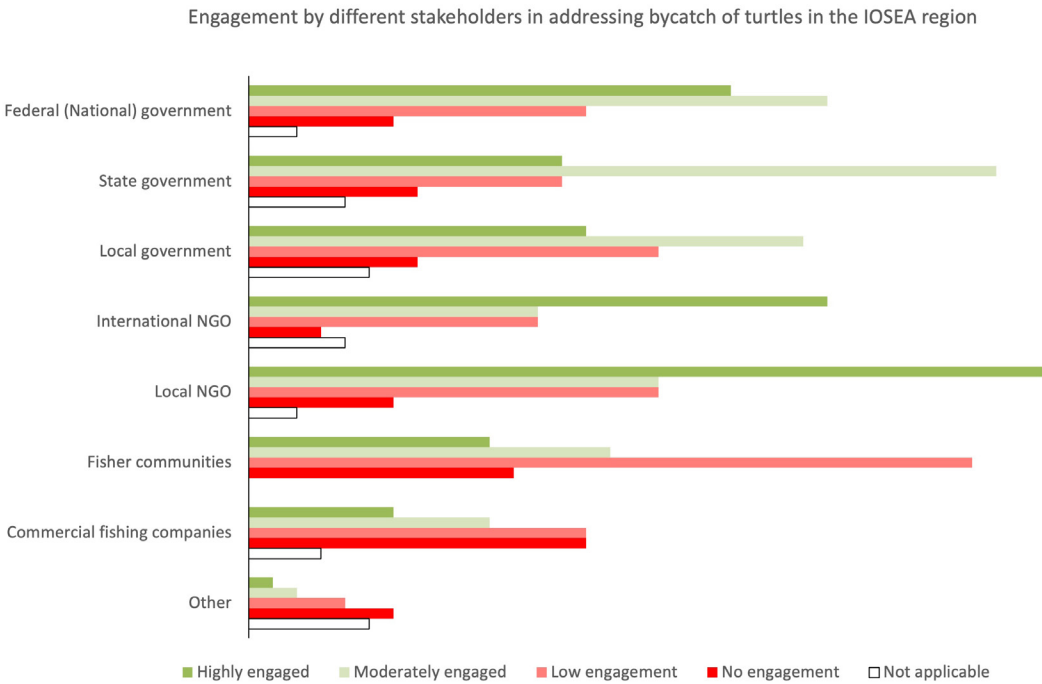


Figure 24. Engagement of different stakeholders in sea turtle bycatch mitigation across the IOSEA region.

the key challenges facing sea turtle bycatch in the IOSEA region. Research, legal requirements and enforcement of existing policies were ranked as the least significant challenges, while competing priorities, lack of buy-in from fishers, and remoteness of fishing practices were seen as moderate challenges (Figure 27).

The fact that research was ranked low is interesting as this suggests, in theory, that we know what needs to be done, but that the requisite technical know-how and

skills are limited and therefore the research is not being implemented on the ground. This is possibly also linked to the lack of funding.

The fact that prioritisation by government agencies was also ranked high and buy-in from fishers was ranked as moderate suggests that there is a need to address bycatch by using a combination of top-down (policy first) and bottom-up (fisher engagement) approaches. Enforcement of existing policies was ranked low, perhaps suggesting

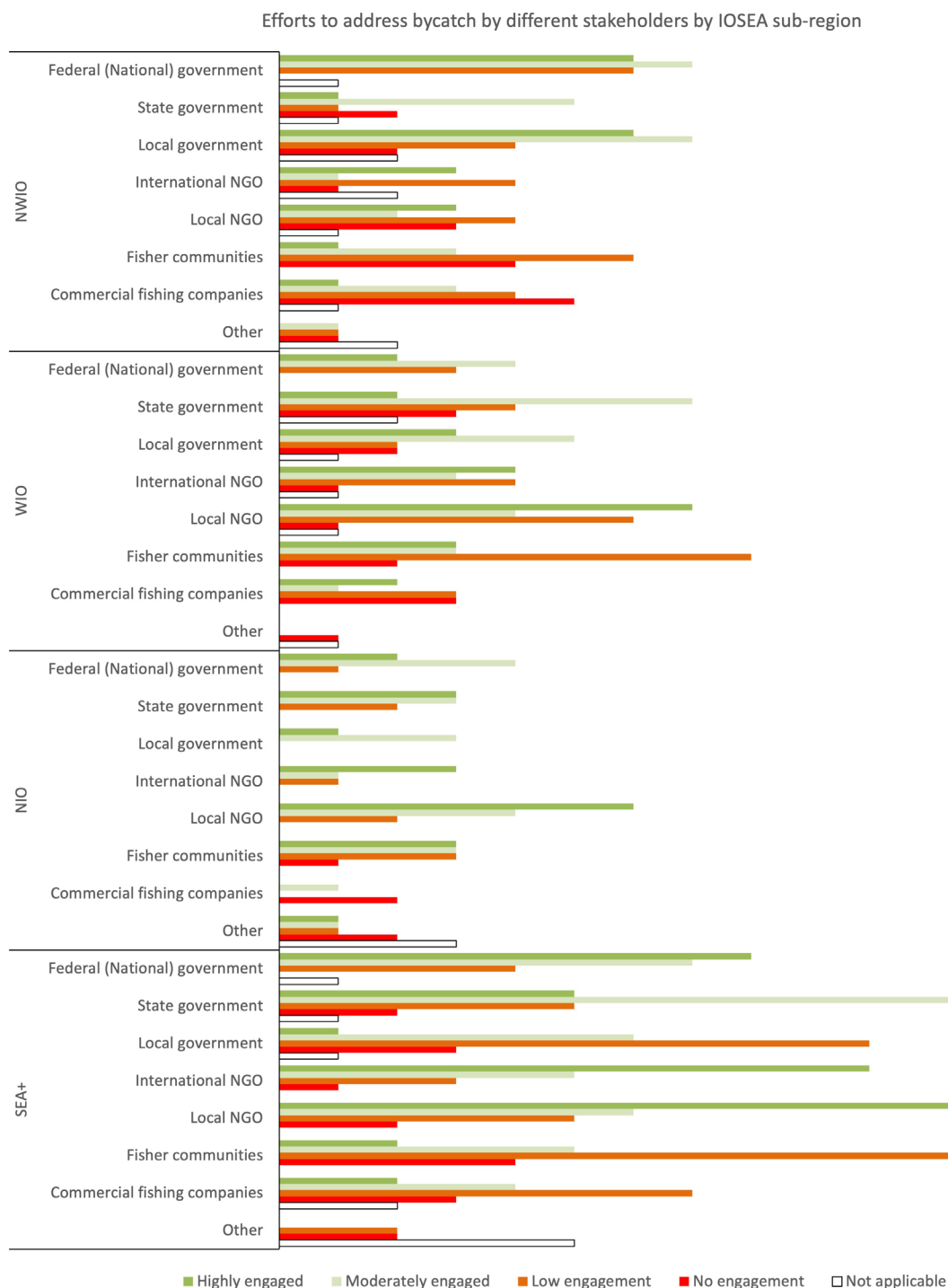


Figure 25. Engagement of different stakeholders in mitigating sea turtle bycatch at the IOSEA sub-regional level

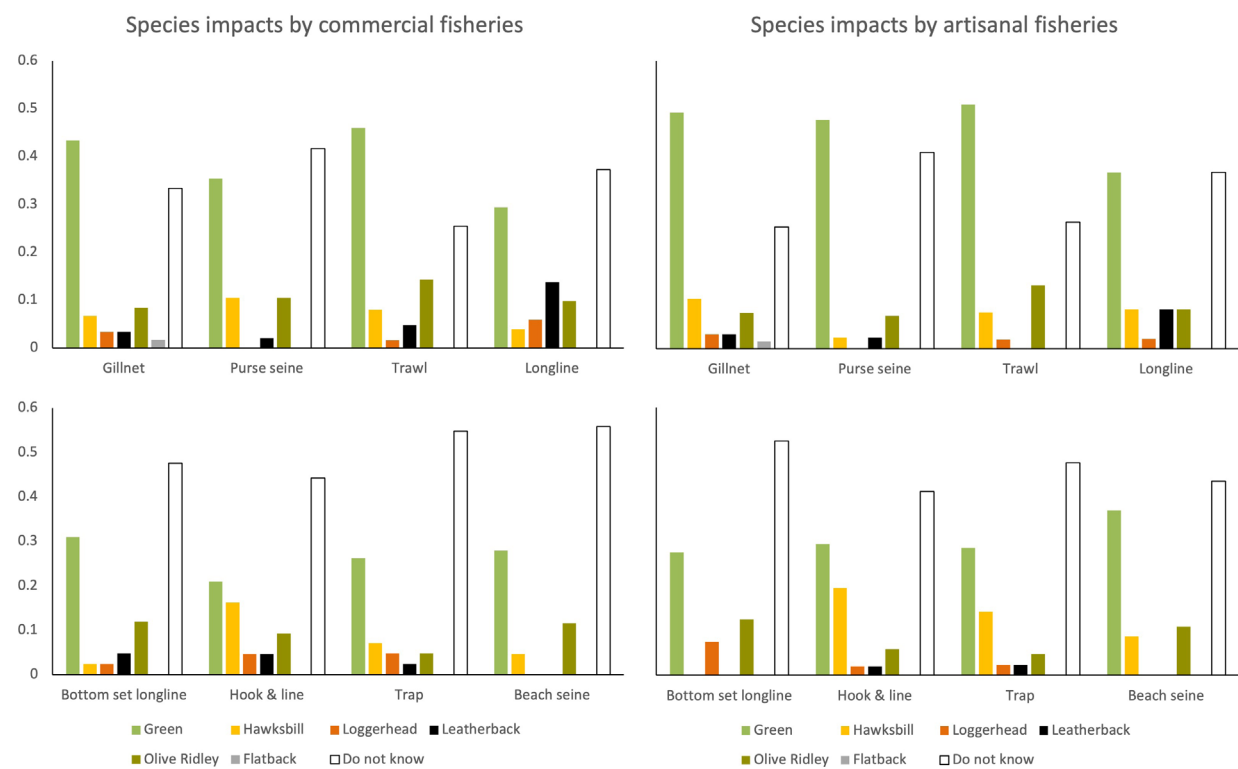


Figure 26. Turtle species identified as the single most impacted by different commercial (left) and artisanal (right) fisheries in the IOSEA region.

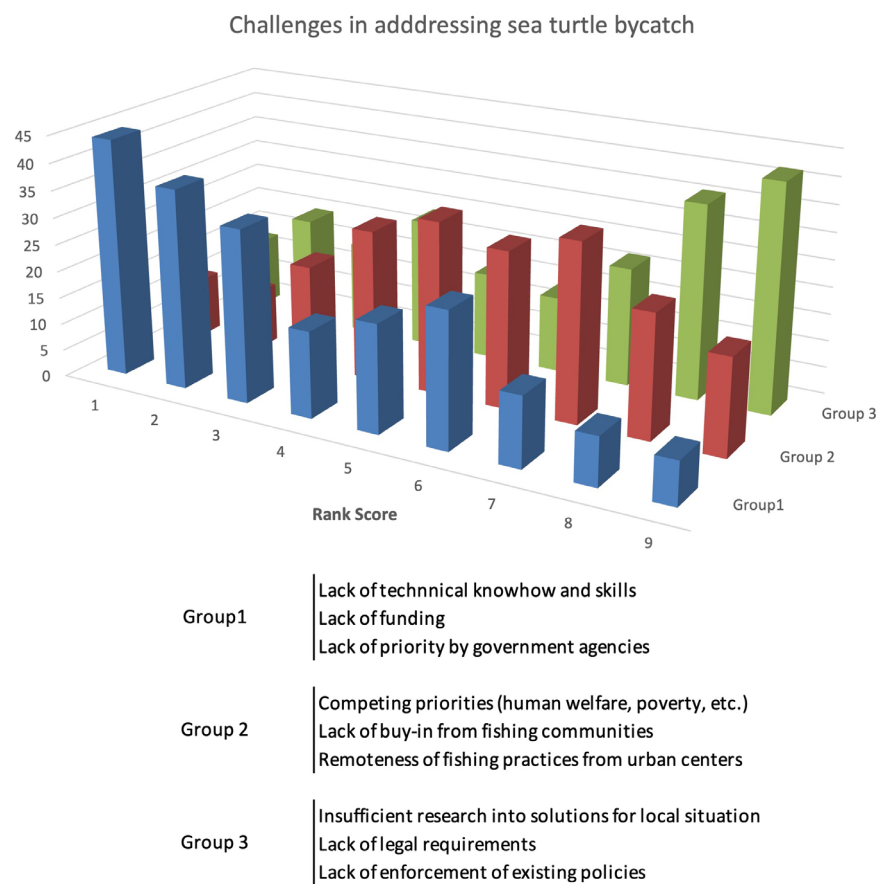


Figure 27. Prioritisation of key challenges in addressing sea turtle bycatch in the IOSEA region.

that where policies exist, they are enforced, but that little attention is given to creating policies that address sea turtle bycatch where these do not currently exist. A lack of legal requirements is also ranked low, suggesting that legal instruments exist but may not be prioritised for implementation. Potentially, the two middle-ranked challenges – competing priorities and remoteness – are at play here (too many things to do, and ‘out of sight, out of mind’).

Addressing sea turtle bycatch is complex. Major hurdles such as poor data / underreporting, economic barriers for fishers (cost of gear, lost catch), lack of enforcement / governance, difficulty of integrating solutions into diverse small-scale fisheries, socio-cultural factors (poverty, reliance on turtle products), and technical challenges with gear modification and proper release, are all challenges faced, to one degree or another, across the globe. These challenges are compounded by the intricate life histories of sea turtles, with their multiple habitat requirements for feeding, nesting and migrating, and their air-breathing limitations that put them at risk of drowning.

Solving the bycatch challenge requires an interdisciplinary approach, implemented over long periods and at substantial cost. One needs to understand the technical aspects of the

fishery, the social dimension of fishing and the communities who are impacted by conservation and management action, the political realm in which the fishery operates, and the priorities assigned by government agencies to solving sea turtle conservation issues. There also needs to be funding to sustain what are often long, drawn out engagements that take time to address bycatch challenges. These often include technical and gear-related solutions, awareness programmes, outreach, engagement with government officers, development of training aids, field trials and, eventually, monitoring and enforcement efforts. This requires balancing conservation with fisher livelihoods through better management, community involvement, and innovative technology.

The *Lack of prioritisation by governments* (identified as a key challenge in Figure 27) contrasts somewhat with the reportedly high levels of engagement of government agencies as depicted in Section 3.6. It is possible that this refers to a need for actual government-led initiatives rather than those already initiated by NGOs and other agencies, and suggests turtle conservation requires greater direct government involvement. The fact that *Lack of legal requirements* was ranked as a low priority suggests that legal instruments exist to protect turtles; it could be, however, that these are ineffective at present to address bycatch.

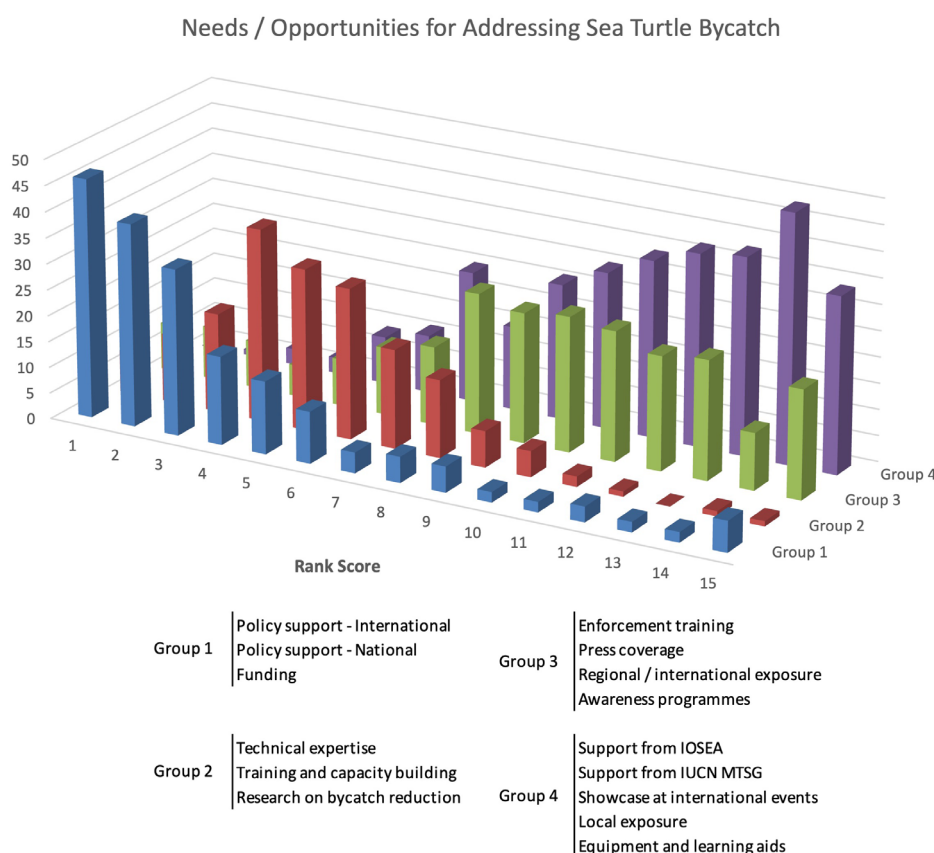


Figure 28. Prioritisation of needs and opportunities for reducing bycatch of sea turtles in the IOSEA region.

3.9 Priority Requirements for Moving Forward

The need for national and international policy support, and funding for bycatch programme implementation were ranked as the top three requirements for addressing turtle bycatch in the IOSEA region (Figure 28), followed by technical expertise, training and capacity-building, and research.

The need for added research contrasts somewhat with the low priority given to this as a challenge (Section 3.8 above). However, from the high proportion of *Do not know* responses in earlier sections it seems clear that added research is needed to better understand the impacts of each fishery in order to help design mitigation solutions.

Enforcement training, media coverage, project exposure and awareness ranked even lower, with international recognition, local exposure and equipment / learning aids all ranked as the lowest priority needs. With the exception

of equipment and learning aids, these rankings appear to be rational; establishing sound policy / legislative regimes, raising sufficient funds for long-term programmes, and developing technical expertise to address bycatch challenges are seen as more pressing needs.

While policy may exist at national levels, there may be an opportunity to better align policy at an IOSEA regional level to protect sea turtles from bycatch across the various fisheries, as well as better ways of aligning IOSEA turtle protection objectives with those of the Indian Ocean Tuna Commission and other regional bodies.

It also appears that funding – a perennial issue for conservation – is a concern for multiple respondents, and that conservation efforts might benefit from some form of cohesive IOSEA-level approach for multinational funding that addresses sea turtles, community livelihoods and food security.



Picture 5. Malaysian fishermen deploying a Turtle Excluder Device (Photo © Nicolas Pilcher)

IV. Summary of Findings

Green and hawksbill sea turtles were reported as the most common species in the IOSEA region and also the most commonly impacted by IOSEA fisheries. However, there was also substantive bycatch of loggerheads and leatherbacks, and a high take of olive ridley turtles in the NIO. Flatback turtles, given their limited spatial distribution, were infrequently mentioned, but the responses to the questionnaire by multiple respondents in Australia suggests that bycatch of flatbacks remains a matter of concern.

Gillnets, trawls, longlines and purse seine fisheries were the most abundant commercial fisheries, while artisanal fisheries were dominated by hook & line, gillnets and beach seines. All these fisheries are known to impact sea turtles through various means: trawls usually soak nets for several hours during which sea turtles drown; gillnets left unattended for multiple hours can drown entangled turtles; longlines cause direct injuries through hooks and entanglement in the lines, as do hook & line fisheries.

Of particular concern was the ubiquitous use of gillnets across the region, both in commercial and (unregulated) artisanal fisheries. Given the widespread use of gillnets and the difficulties in enforcing regulatory measures, it is likely gillnets present the largest challenge in addressing bycatch of sea turtles. Conversely, given the efficacy of and know-how surrounding the use of Turtle Excluder Devices (TEDs), trawl fisheries appear to be the most advanced in terms of addressing turtle bycatch. Unfortunately, TEDs are barely used across the IOSEA region, with the highest levels of uptake in Australia.

The magnitude of bycatch is likely very high: in the tens of thousands of sea turtles per year, with green, hawksbill and olive ridleys the most numerous. It is likely that the more limited references to leatherbacks and flatbacks is not because of the relative impacts, but the substantially smaller populations of these species in the IOSEA region. Relatively little information about bycatch of loggerhead turtles was provided.

From a sub-regional perspective, there were high overall levels of uncertainty (*Do not know*) and non-use of mitigation measures (*Not used*) across all four IOSEA sub-regions. This lack of information makes it challenging to draw any meaningful conclusions on the differences between the actual degree of mitigation uptake across the sub-regions, other than to note that uncertainty levels were consistently higher for SEA+ countries, and that uptake of mitigation measures – at *Extensive*, *Medium* and *Low* levels – tended to be moderately higher in NIO countries, followed by NWIO countries. It is likely that the number of different countries and approaches to fisheries management in SEA+ confounds understanding of how mitigation measures are used.

Even though there was significant agreement among respondents by region, there was also some polarisation. In some cases, there were those who considered the use of specific mitigation measures to be extensive while others considered them to be non-existent. These confounding results provide an interesting reflection on the questionnaire/data collection process. It is likely that a more targeted approach that engages only those people working on bycatch mitigation programmes would reduce some of the confusion, but that would probably mean that the pool of respondents would also be substantially reduced.

It appears that NGOs and local government agencies tend to lead bycatch mitigation efforts in most sub-regions, with less engagement from central governments, commercial interests, and fishing communities. Globally, the inclusion of fishing communities in bycatch mitigation has proven an indispensable requirement, and the IOSEA region will need to better engage with fishers to develop effective mitigation strategies.

A lack of technical know-how and skills, lack of funding and lack of prioritisation by governments were ranked as the key challenges facing sea turtle bycatch in the IOSEA region. Research, legal requirements and enforcement of existing policies were ranked as the least significant challenges, while competing priorities, lack of buy-in from fishers and remoteness of fishing practices were seen as moderate challenges.

The highest priority requirements for moving forward in addressing sea turtle bycatch were the need for national and international policy support, and funding, followed by technical expertise, training and capacity-building, and research. From the high proportion of *Do not know* responses in earlier sections, it seems clear that additional research is also needed to better understand the impacts and details of each fishery in order to help design mitigation solutions.

Possibly among the greatest concerns was the evident lack of awareness across the IOSEA region of the extent of the use and uptake of mitigation measures by the different fisheries in the IOSEA region. Over 40% of respondents indicated having no knowledge of what mitigation measures were in place in any of the fisheries – commercial or artisanal. This was evident from the extremely low proportion of responses reporting that a mitigation measure was ‘Extensively’ or even ‘Moderately’ used in any of the fisheries. This is extremely worrying because a lack of knowledge suggests a concomitant lack of mitigation effort. And the lack of mitigation effort suggests turtles will continue to be taken across the IOSEA region at an alarming rate unless proactive measures are taken to address the particular impacts of different fisheries and the threats that these pose to turtle species in the region.

V. Priority Recommendations

The survey results confirm that bycatch of marine turtles remains a major threat across the IOSEA region. Significant knowledge and capacity gaps persist, but these should not delay urgent action; indeed, they are also reasons in themselves to act immediately. This section outlines recommendations on next steps that could be taken at different levels and by different stakeholders to improve bycatch knowledge, monitoring, reporting and mitigation, which would considerably improve the conservation status of marine turtles.

5.1 Requirements for Improved Reporting / Understanding of the Bycatch Challenge

The survey revealed significant knowledge gaps regarding the state of bycatch and the extent to which mitigation measures are used across different fisheries. Many respondents answered *Do not know* to a high number of questions, highlighting a lack of knowledge or limited access to it. Responses were also often polarised, indicating differing understanding/opinions. To close these gaps, it is crucial that efforts are made to improve the understanding of bycatch and ensure information is available to all relevant stakeholders. This will allow practitioners to identify where the threat is most intense and target efforts accordingly. Standardised data collection and reporting formats and means of dissemination would also promote a better understanding of efforts already under way in the region.

5.2 Addressing Bycatch Challenges

It is clear from the present levels of bycatch and the magnitude of impacts on sea turtles that action should be taken regardless of knowledge gaps. Many solutions for tackling bycatch are readily available and should be applied to fisheries management. Turtle Excluder Devices are a proven mitigation measure in trawl fisheries. Circle hooks and bait choice reduce sea turtle bycatch in longlines. Safe handling protocols can change the outcome of a bycatch event from a mortality to a survival. A sound approach would be to pursue research on specific bycatch mitigation measures while simultaneously implementing available solutions. Signatory States may wish to prioritize action on high-impact fisheries and at-risk species, either by abundance (green and olive ridley) or by risk of extinction (hawksbill, leatherback and loggerhead).

5.3 Strengthen Monitoring and Knowledge Acquisition

There is a need to strengthen monitoring of bycatch in fisheries, and to support IOSEA states in building monitoring capacity. Monitoring programmes have, in the past, taken the form of on-board observers and (usually less

reliably) logbook records. But emerging low-cost electronic monitoring technology coupled with Artificial Intelligence (AI) detection software and open-source coding offers some interesting opportunities for expanding monitoring programmes. While the results in some places suggested that this is particularly relevant to the SEA+ sub-region, there is likely to be a need for monitoring across the entire IOSEA region. It is imperative that implementing action is not delayed while such programmes are being developed, but rather that Signatory States invest simultaneously in sea turtle bycatch monitoring and implementation of bycatch reduction measures as parallel tracks.

Bycatch continues to be one of the most serious threats to marine turtles in the IOSEA region. While fisheries continue to expand, turtle populations remain under serious threat. To address this, governments, NGOs, local communities, and the IOSEA Secretariat and Advisory Committee all have vital roles to play. In order to track progress over time, it is suggested that this questionnaire survey or some similar tool is repeated in 3-5 years. This will ensure that knowledge on bycatch is kept up to date and will inform further efforts to accelerate mitigation action.

5.4 Strengthen Policy Support for Sea Turtle Bycatch Mitigation

One of the challenges identified through the survey is the lack of robust policy frameworks requiring bycatch mitigation measures to be used in fishing activities, or a lack of policy implementation. To address this, governments should introduce and / or strengthen legal requirements to adopt bycatch mitigation measures and ensure they are properly enacted and enforced. These measures will vary across fisheries and can range from gear modifications (e.g. hook shape and size) and limitations on net deployment (e.g. by location, timing and depth), to spatial and temporal restrictions (e.g. seasonal closures during nesting periods and restricted areas). The introduction of Turtle Excluder Devices (TEDs) in Malaysia, which have been legally required in four states since 2017, is a strong example of collaboration between the central government agency, State agencies, fishermen and an NGO (the Marine Research Foundation), though ensuring continued and adequate enforcement remains critical.

5.5 Strengthen Engagement with Fishing Communities

Another key challenge is the lack of fisher engagement. To foster stronger buy-in from fishing communities, NGOs can play a vital role by supporting community-led initiatives, raising awareness of turtle conservation and rewarding good practices for bycatch mitigation. Inspiration can be drawn from similar initiatives already in place in other regions, although it is vital that they are tailored to local social and cultural contexts. This could include outreach campaigns

for fishing communities, showcasing success stories, and greater engagement of policymakers and fishers alike. Fisher engagement initiatives such as awareness-raising programmes with fisher exchanges, storytelling, and incentives for good practices may also enhance sea turtle bycatch mitigation approaches.

5.6 Coordinating Funding Programmes

The IOSEA Marine Turtle MOU Secretariat has played a vital role over two decades in coordinating activities across the region and fostering exchange of information and good practices among Signatories to the MOU, and even with outside parties. Further avenues might be worth exploring, such as the possibility of developing regional project proposals seeking funding on behalf of Signatories through different sources, such as the Global Environmental Facility (GEF) or other funding mechanisms both at national and global levels. Securing such funding for projects can be a powerful way to address capacity gaps and implement

concrete measures on the ground with tangible impacts for turtle conservation. That said, national governments need to buy-in to processes such as these, as funding commitments are often undertaken at the national level, with agreements signed by central government agencies.

5.7 Ensure Continued Technical Support

The IOSEA Marine Turtle MOU Advisory Committee should continue to leverage its scientific and technical expertise to support the activities of Signatory States and the Secretariat. The role of the IOSEA Advisory Committee can include providing guidance on mitigation measures and best practices, including emerging technologies, as well as identifying and developing technical toolkits and training materials for governments and fishers. Given that *Lack of technical know-how and skills* ranked among the top challenges in the survey, the Advisory Committee has a unique opportunity to advise on how to address this gap.



Picture 6. Leatherback sea turtle hatchling swimming in the open ocean (Photo © Adobe Stock Images)

Annex 1 - Bycatch Questionnaire



IOSEA Sea Turtle MOU Bycatch Questionnaire

Introduction

On behalf of the Advisory Committee of 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; <https://www.cms.int/iosea-turtles/en>), the Bycatch Working Group is trying to learn as much as possible about sea turtle bycatch in the Indian Ocean – Southeast Asia region. Amongst the tasks we will be undertaking are reviews of bycatch mitigation approaches, and liaising with other regional management organisations and MOUs. The information you provide will be used to offer advice to Signatory States on ways forward with regard to mitigating sea turtle bycatch in commercial and artisanal fisheries.

The goal of the Bycatch Working Group is to determine what is the state of knowledge in each country / region of the sea turtle bycatch challenges, and potential for mitigation.

You have been identified as a key resource person in with knowledge about turtles/fisheries in the IOSEA region, and we hope you will contribute to this process and help us better understand the current situation and the opportunities for addressing sea turtle bycatch in the future.

Note: This survey will collect data from one country per form. If you have data for more than one country please complete a different survey form for each country.

Please forward this survey link to other people you feel could contribute to this process - the more responses we get, the better we will be able to determine the status of sea turtle bycatch and mitigation approaches in the Indian Ocean - SE Asia region.

Explanatory Statement

We would like to ask you some very general questions about fisheries and bycatch in your country / region where you work. The questions will take about 20 minutes to complete. Information from this research could be used to help identify priorities for addressing bycatch of sea turtles in various fisheries. We envision producing (1) a report to the IOSEA Signatory States that describes the findings by country / region, and (2) possibly in a more public document for the wider scientific community if the responses warrant doing so.

Your participation in this survey is voluntary and confidential. We will not use your name or any personal information you share with us unless this is ok with you, and ONLY if you provide these at the end of the questionnaire. Individual answers will be collated and reported on as a group to provide a general idea of current status in different countries / regions, and we will absolutely not share your individual answers to anyone outside of the IOSEA Bycatch Working Group.

You can stop answering questions at any time by clicking on the Exit button on the top right of your screen.

If you have any concerns or complaints about the conduct of the project, please contact npilcher@mrf-asia.org

Please note, by continuing the survey you consent to take part in this research and agree to the information provided in this Explanatory Statement. THANK YOU FOR YOUR HELP !



IOSEA Sea Turtle MOU Bycatch Questionnaire
A bit about you...

* 1. What is your background?

- ☐ Fisher
- ☐ Academic
- ☐ Student
- ☐ Government official
- ☐ Conservation practitioner
- ☐ Other (please specify)

* 2. Where do you currently work?

- ☐ Academic Institution
- ☐ Local NGO
- ☐ National NGO
- ☐ International NGO
- ☐ Government agency
- ☐ Fisher
- ☐ Fishing community member
- ☐ Fishign industry member
- ☐ Research agency
- ☐ Other (please specify)

* 3. How many years have you been involved in this work

- ☐ 0-5 years
- ☐ >5-10 years
- ☐ >10-15 years
- ☐ >15-20 years
- ☐ > 20 years

4. Are you a National Focal Point for the IOSEA Sea Turtle MOU?

- ☐ Yes
- ☐ No

* 5. Country for which you are providing information



IOSEA Sea Turtle MOU Bycatch Questionnaire

Background information on sea turtles and fisheries

* 6. What sea turtle species occur in your country / country where you work?

- ☐ Green
- ☐ Hawksbill
- ☐ Loggerhead
- ☐ Leatherback
- ☐ Olive Ridley
- ☐ Flatback

* 7. What **COMMERCIAL** / **INDUSTRIAL** fisheries operate in your country / country where you work?
(**commercial** / **industrial** typically refers to fisheries with larger vessels unloading in ports to sell for profit, commercially oriented - accounted for in National catch statistics)

- ☐ Gillnet
- ☐ Purse seine
- ☐ Trawl
- ☐ Longline
- ☐ Hook & line
- ☐ Trap
- ☐ Beach seine
- ☐ None
- ☐ Other (please specify)

* 8. What **ARTISANAL** / **TRADITIONAL** / **SMALL SCALE** fisheries operate in your country / country where you work?
(**artisanal** (or **traditional**, **small scale**) typically refers to fisheries with smaller vessels operating for own consumption, or barter trade, or local sales - typically unaccounted for in National catch statistics)

- ☐ Gillnet
- ☐ Purse seine
- ☐ Trawl
- ☐ Longline
- ☐ Hook & line
- ☐ Trap
- ☐ Beach seine
- ☐ None
- ☐ Other (please specify)

9. Are there different definitions of Commercial vs Artisanal fisheries in your country / country where you work?

- ☐ Yes
- ☐ No

If Yes, please describe:

10. Do you know of any bycatch of sea turtles in foreign vessels that operate within the EEZ of your country?

- ☐ Yes
- ☐ No
- ☐ Do not know
- ☐ If yes, please could you provide details

11. This survey considers bycatch of sea turtles. However, do you know if there is bycatch of any other species in your country / country where you work?

- ☐ Dolphins
- ☐ Whales
- ☐ Dugongs
- ☐ Seabirds
- ☐ Sharks
- ☐ Rays
- ☐ Do not know
- ☐ Other (please specify)

- ☐ None of the above



IOSEA Sea Turtle MOU Bycatch Questionnaire

Impacts

Here we would like to find out what is known about impacts of bycatch from different fisheries on sea turtles.

12. Which species of turtle(s) are impacted by which **COMMERCIAL** fisheries?

	Green	Hawksbill	Loggerhead	Leatherback	Olive Ridley	Flatback	Not applicable	Don't know
Gillnet	☐	☐	☐	☐	☐	☐	☐	☐
Purse seine	☐	☐	☐	☐	☐	☐	☐	☐
Trawl	☐	☐	☐	☐	☐	☐	☐	☐
Longline	☐	☐	☐	☐	☐	☐	☐	☐
Bottom set longline	☐	☐	☐	☐	☐	☐	☐	☐
Hook & line	☐	☐	☐	☐	☐	☐	☐	☐
Trap	☐	☐	☐	☐	☐	☐	☐	☐
Beach seine	☐	☐	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐	☐	☐

Specify other **COMMERCIAL** fishery

13. Which species of turtle(s) are impacted by which ARTISANAL fisheries?

	Green	Hawksbill	Loggerhead	Leatherback	Olive Ridley	Flatback	Not applicable	Don't know
Gillnet	☐	☐	☐	☐	☐	☐	☐	☐
Purse seine	☐	☐	☐	☐	☐	☐	☐	☐
Trawl	☐	☐	☐	☐	☐	☐	☐	☐
Longline	☐	☐	☐	☐	☐	☐	☐	☐
Bottom set longline	☐	☐	☐	☐	☐	☐	☐	☐
Hook & line	☐	☐	☐	☐	☐	☐	☐	☐
Trap	☐	☐	☐	☐	☐	☐	☐	☐
Beach seine	☐	☐	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐	☐	☐

Specify other ARTISANAL fishery

14. Are these data publicly available?

☐ Yes

☐ No

If available, please list the source or URL.

If not available, can you indicate where these data are kept?



IOSEA Sea Turtle MOU Bycatch Questionnaire

What bycatch mitigation measures are currently in place in your country / country where you work?

This section refers to **actions on the ground**, rather than policies or action plans.

Please score each response as follows:

Low - one-off trials, very limited geographical coverage, experiments with small numbers of vessels / fishers, no government support

Moderate - Seasonal use in some fisheries but not all, does not cover all fishing vessels / fishers, where used has good accountability, some government support

Extensive - All vessels / fishers adopt the measure, good accountability, good government support

15. Gillnets

	Not used	Low	Medium	Extensive	Do not know
Timing of operations	☐	☐	☐	☐	☐
Length of net	☐	☐	☐	☐	☐
Depth of net	☐	☐	☐	☐	☐
Mesh size	☐	☐	☐	☐	☐
Depth of deployment	☐	☐	☐	☐	☐
Light deterrents	☐	☐	☐	☐	☐
Silhouette deterrents	☐	☐	☐	☐	☐
Limit on soak times	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Safe handling procedures	☐	☐	☐	☐	☐
Restrictions on floatation buoys	☐	☐	☐	☐	☐
Lack of floatation buoys	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐
Specify other mitigation measure					

16. Purse Seine

	Not used	Low	Medium	Extensive	Do not know
Immediate release	☐	☐	☐	☐	☐
Safe handling procedures	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐
Specify other mitigation measure					

17. Trawl

	Not used	Low	Medium	Extensive	Do not know
Turtle Excluder Devices	☐	☐	☐	☐	☐
Safe handling procedures	☐	☐	☐	☐	☐
Trash Excluder Devices	☐	☐	☐	☐	☐
Mesh size	☐	☐	☐	☐	☐
Limit on tow time	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐
Specify other mitigation measure					

18. Longline

	Not used	Low	Medium	Extensive	Do not know
Circle hooks	☐	☐	☐	☐	☐
Bait choices	☐	☐	☐	☐	☐
Set depth	☐	☐	☐	☐	☐
Limit on number of hooks	☐	☐	☐	☐	☐
Size of hooks	☐	☐	☐	☐	☐
Limit on soak time	☐	☐	☐	☐	☐
Safe handling procedures	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Specify other mitigation measure

19. Bottom set longline

	Not used	Low	Medium	Extensive	Do not know
Circle hooks	☐	☐	☐	☐	☐
Bait choices	☐	☐	☐	☐	☐
Set depth	☐	☐	☐	☐	☐
Limit on number of hooks	☐	☐	☐	☐	☐
Size of hooks	☐	☐	☐	☐	☐
Safe handling procedures	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Specify other mitigation measure

20. Trap

	Not used	Low	Medium	Extensive	Do not know
Safe handling procedures	☐	☐	☐	☐	☐
Number of funnels per trap	☐	☐	☐	☐	☐
Use of degradable funnel ties	☐	☐	☐	☐	☐
Visibility of trap line	☐	☐	☐	☐	☐
Number of traps set together	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Specify other mitigation measure

21. Hook & line

	Not used	Low	Medium	Extensive	Do not know
Safe handling procedures	☐	☐	☐	☐	☐
Restrictions / prohibition on steel leaders	☐	☐	☐	☐	☐
Restrictions on line material (e.g. nylon, monofilament)	☐	☐	☐	☐	☐
Location-based restrictions	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Specify other mitigation measure

22. Beach seine

	Not used	Low	Medium	Extensive	Do not know
Immediate release	☐	☐	☐	☐	☐
Safe handling procedures	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Specify other mitigation measure

23. Other fishery

	Not used	Low	Medium	Extensive	Do not know
Immediate release	☐	☐	☐	☐	☐
Safe handling procedures	☐	☐	☐	☐	☐
Seasonal closures	☐	☐	☐	☐	☐
Time (of day)-restricted activity	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Please specify the 'other' fishery type
and if applicable please also specify any other mitigation measure


IOSEA Sea Turtle MOU Bycatch Questionnaire

Interest in addressing sea turtle bycatch

Please help us better understand the interest at the National and Local levels on addressing sea turtle bycatch in fisheries in your country / country where you work.

24. Is there an interest in your country in addressing sea turtle bycatch?

- ☐ Yes
- ☐ No
- ☐ Only by NGOs
- ☐ Only among some NGOs and fishing communities
- ☐ It's not that simple...
- ☐ If it's not that simple, please provide some details

25. If you can, please indicate which parties are interested in addressing sea turtle bycatch

	Federal (National) government	State government	Local government	International NGO	Local NGO	Fisher communities	Commercial fishing companies	Other
Highly engaged (has funding and implements projects on the ground, policies and regulations in place, works closely with other stakeholders, evidence of positive impacts)	☐	☐	☐	☐	☐	☐	☐	☐

Moderately engaged (semi-

permanent funding, some projects on fleet- or locality-restricted basis, policies may exist but are not always implemented, some engagement with stakeholders, some positive impacts)

Low engagement (limited funding, occasional efforts on the ground, no policies or action plans, restricted by fishery type and reach, unknown impacts)

No engagement

Not applicable

Other (please specify)

26. Can you provide any additional details or links to reports to describe responses in the previous question?

Yes

No

Please provide any details here

27. Are there any measures to address bycatch of other species (e.g. marine mammals, seabirds, sharks and rays) in your country / country where you work?

Yes

No

If yes, please provide details here



IOSEA Sea Turtle MOU Bycatch Questionnaire

Priorities, limitations & opportunities

Nearly finished! This is the last part, and we just want to know a bit about where priorities should be focussed, and what limitations (if any) there might be to addressing sea turtle bycatch.

28. With regard to turtle loss / mortality, do you believe the bycatch situation is getting....

- ☐ Better
- ☐ Remains unchanged
- ☐ Worse
- ☐ Please provide details / support if possible

29. Which is the ONE species of sea turtle most impacted by each **COMMERCIAL** fishery? (provide only **one** response per fishery)

	Green	Hawksbill	Loggerhead	Leatherback	Olive Ridley	Flatback	Not applicable to this fishery	Do not know
Gillnet	☐	☐	☐	☐	☐	☐	☐	☐
Purse seine	☐	☐	☐	☐	☐	☐	☐	☐
Trawl	☐	☐	☐	☐	☐	☐	☐	☐
Longline	☐	☐	☐	☐	☐	☐	☐	☐
Bottom set longline	☐	☐	☐	☐	☐	☐	☐	☐
Hook & line	☐	☐	☐	☐	☐	☐	☐	☐
Trap	☐	☐	☐	☐	☐	☐	☐	☐
Beach seine	☐	☐	☐	☐	☐	☐	☐	☐

Other (please specify fishery and species impacted)

30. Are you able to very broadly estimate the annual sea turtle impacts / losses to **COMMERCIAL** fisheries overall?

	None	10s of sea turtles per year	100s of turtles per year	1000s of turtles per year	>10,000 of turtles per year	Do not know
Green	☐	☐	☐	☐	☐	☐
Hawksbill	☐	☐	☐	☐	☐	☐
Loggerhead	☐	☐	☐	☐	☐	☐
Leatherback	☐	☐	☐	☐	☐	☐
Olive Ridley	☐	☐	☐	☐	☐	☐
Flatback	☐	☐	☐	☐	☐	☐

31. Are your responses based on

- ☐ Knowledge of the fishery extent and impacts
- ☐ Occasional reports and presentations on this fishery in my country / region where I work
- ☐ Gut feeling based on personal experience
- ☐ Wild guess
- ☐ Not answered

32. Which is the ONE species of sea turtle most impacted by each **ARTISANAL** fishery? (provide only **one** response per fishery)

	Green	Hawksbill	Loggerhead	Leatherback	Olive Ridley	Flatback	Not applicable to this fishery	Do not know
Gillnet	☐	☐	☐	☐	☐	☐	☐	☐
Purse seine	☐	☐	☐	☐	☐	☐	☐	☐
Trawl	☐	☐	☐	☐	☐	☐	☐	☐
Longline	☐	☐	☐	☐	☐	☐	☐	☐
Bottom set longline	☐	☐	☐	☐	☐	☐	☐	☐
Hook & line	☐	☐	☐	☐	☐	☐	☐	☐
Trap	☐	☐	☐	☐	☐	☐	☐	☐
Beach seine	☐	☐	☐	☐	☐	☐	☐	☐

Other (please specify fishery and species impacted)

33. Are you able to very broadly estimate the annual sea turtle impacts / losses to **ARTISANAL** fisheries overall?

	None	10s of sea turtles per year	100s of turtles per year	1000s of turtles per year	>10,000 of turtles per year	Do not know
Green	☐	☐	☐	☐	☐	☐
Hawksbill	☐	☐	☐	☐	☐	☐
Loggerhead	☐	☐	☐	☐	☐	☐
Leatherback	☐	☐	☐	☐	☐	☐
Olive Ridley	☐	☐	☐	☐	☐	☐
Flatback	☐	☐	☐	☐	☐	☐

34. Is your response based on

- ☐ Knowledge of the fishery extent and impacts
- ☐ Occasional reports and presentations on this fishery in my country / region where I work
- ☐ Gut feeling based on personal experience
- ☐ Wild guess
- ☐ Not answered



IOSEA Sea Turtle MOU Bycatch Questionnaire

* 35. Which are the three top priority **COMMERCIAL** fishery / species combinations you believe should be addressed as soon as possible? (provide up to only **three** responses per matrix)

	Green	Hawksbill	Loggerhead	Leatherback	Olive Ridley	Flatback
Gillnet	☐	☐	☐	☐	☐	☐
Purse seine	☐	☐	☐	☐	☐	☐
Trawl	☐	☐	☐	☐	☐	☐
Longline	☐	☐	☐	☐	☐	☐
Bottom set longline	☐	☐	☐	☐	☐	☐
Hook & line	☐	☐	☐	☐	☐	☐
Trap	☐	☐	☐	☐	☐	☐
Beach seine	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

Please describe other fishery type

* 36. Which are the three top priority **ARTISANAL** fishery / species combinations you believe should be addressed as soon as possible? (provide up to only **three** responses per matrix)

	Green	Hawksbill	Loggerhead	Leatherback	Olive Ridley	Flatback
Gillnet	☐	☐	☐	☐	☐	☐
Purse seine	☐	☐	☐	☐	☐	☐
Trawl	☐	☐	☐	☐	☐	☐
Longline	☐	☐	☐	☐	☐	☐
Bottom set longline	☐	☐	☐	☐	☐	☐
Hook & line	☐	☐	☐	☐	☐	☐
Trap	☐	☐	☐	☐	☐	☐
Beach seine	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

Please describe other fishery type



IOSEA Sea Turtle MOU Bycatch Questionnaire

Reminder: Participation in this survey is voluntary and anonymous. There is an Exit button on the top right of your screen should you choose to end this questionnaire at any point.

37. Please rank factors which might prevent bycatch from being addressed in your country / region where you work, from most (top) to least (bottom) significant.

☐	Lack of technical knowhow and skills
☐	Lack of funding
☐	Lack of priority by government agencies
☐	Competing priorities (human welfare, poverty, etc.)
☐	Lack of buy-in from fishing communities
☐	Remoteness of fishing practices from urban centers
☐	Insufficient research into solutions for local situation
☐	Lack of legal requirements
☐	Lack of enforcement of existing policies

38. With regards to opportunities to address bycatch, which of the following would be most useful in your country / region where you work? Please rank from most (top) useful to least (bottom) useful

	Policy support from international conventions / instruments
	National policy support
	Funding
	Technical expertise
	Training and capacity building
	Research into locally applicable bycatch reduction tools / behaviours
	Supporting letter from IOSEA Secretariat
	Enforcement training
	Supporting letter from IUCN Marine Turtle Specialist Group
	Press coverage
	Showcase at international fora & events
	Regional / international exposure / learning opportunities
	Local exposure / learning opportunities with other fisheries
	Provision of on-board equipment and learning aids
	Awareness programmes

39. Do you know of any other potential opportunities that would promote addressing sea turtle bycatch in your country / region where you work?



IOSEA Sea Turtle MOU Bycatch Questionnaire

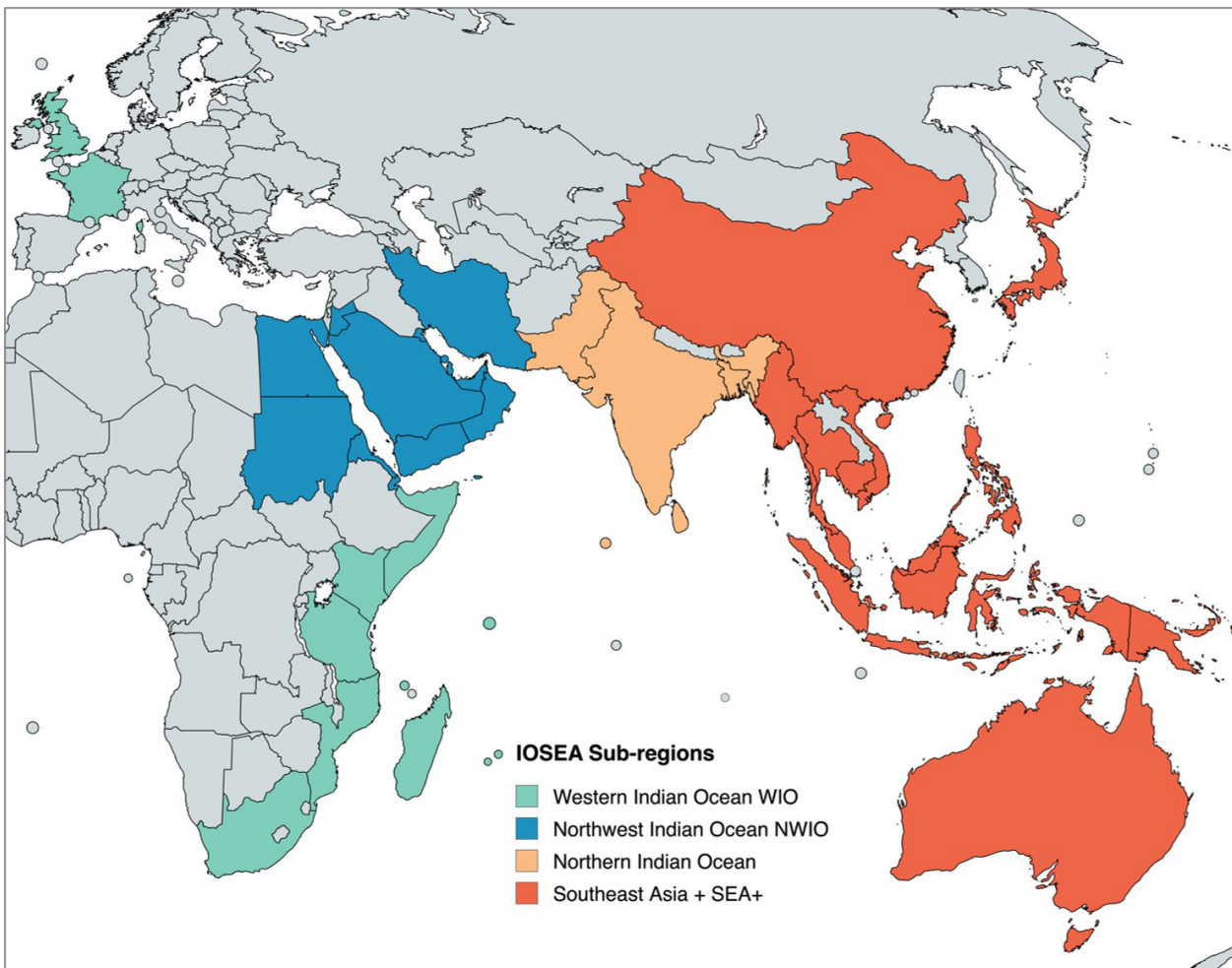
Thank you.

We are extremely grateful for your assistance, and hope that you feel this will better inform solutions for addressing bycatch.

40. Should you wish to receive further communication from us on this subject, please provide your contact details via the following link. This will ensure that your responses are not linked to your contact details in any way. You may also end the survey here without providing your contact details, and remain anonymous.

<https://www.surveymonkey.com/r/H7QQLJ6>

Annex 2 - IOSEA Sub-Regions



Western Indian Ocean (WIO): Comoros, France, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, *Somalia*, South Africa, United Kingdom, United Republic of Tanzania

North-Western Indian Ocean (NWIO): Bahrain, *Djibouti*, Egypt, Eritrea, Islamic Republic of Iran, Jordan, Kuwait, Oman, *Qatar*, Saudi Arabia, Sudan, United Arab Emirates, Yemen

Northern Indian Ocean (NIO): Bangladesh, India, Maldives, Pakistan, Sri Lanka

South-East Asia + (SEA+): *Brunei Darussalam*, Cambodia, Indonesia, Malaysia, Myanmar, Papua New Guinea, Philippines, *Singapore*, Thailand, *Timor-Leste*, Viet Nam + Australia, *China*, *Japan*, *Republic of Korea*, United States (not shown)

Non-Signatory States in the IOSEA Region are shown in *Italics*.



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 Turtles MOU)

is an intergovernmental environmental treaty concluded under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). The MOU applies to the waters and coastal States of the Indian Ocean and South-East Asia and adjacent seas, extending eastwards to the Torres Strait. This treaty area is considered to cover 44 States of which 36 are to date Signatories to the MOU and hosts six out of seven existing species of marine turtles: Loggerhead (*Caretta caretta*), Olive ridley (*Lepidochelys olivacea*), Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Leatherback (*Dermochelys coriacea*), Flatback (*Natator depressus*).

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