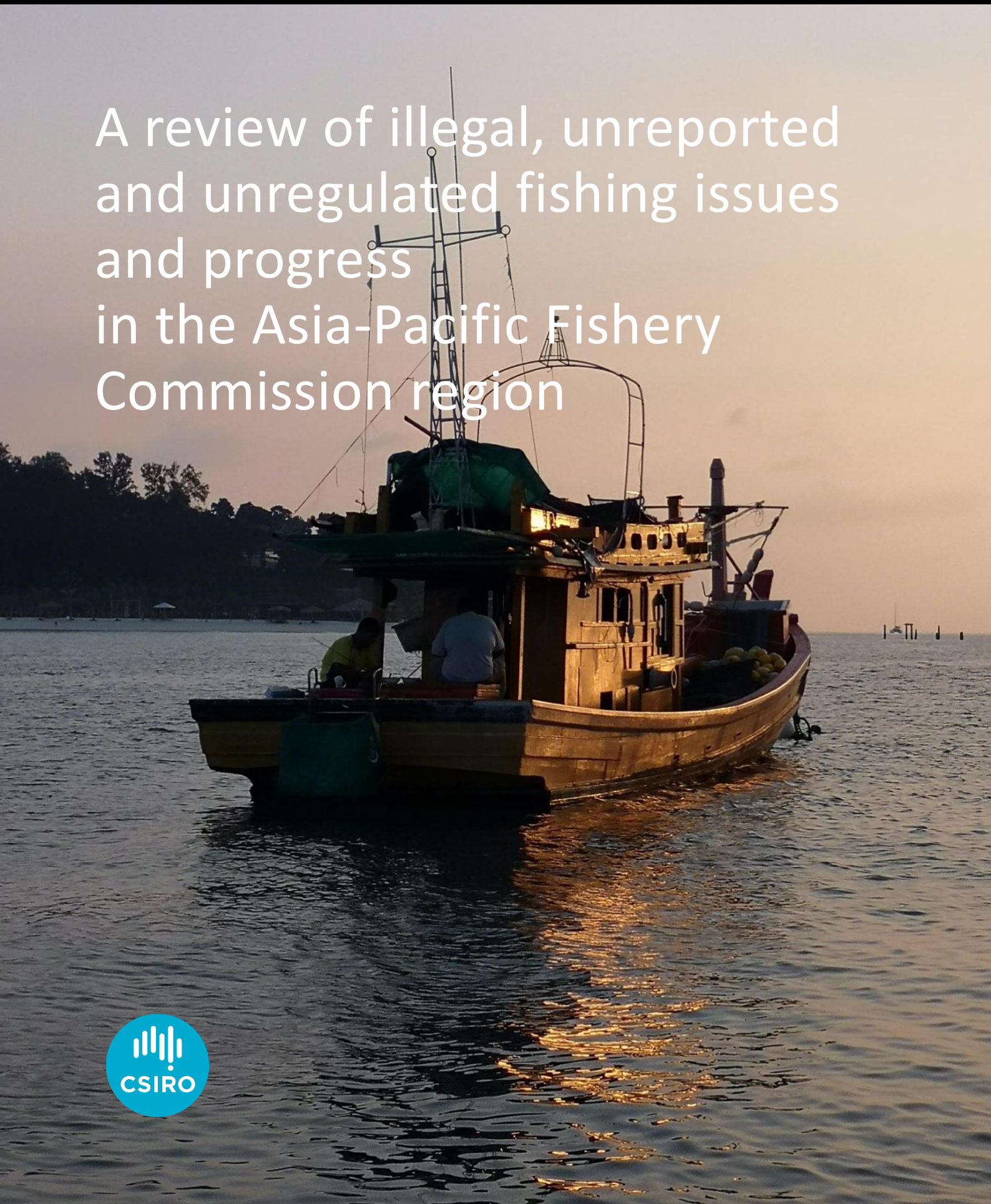
Food and Agriculture Organization of the United Nations

A review of illegal, unreported and unregulated fishing issues and progress in the Asia-Pacific Fishery Commission region



CSIRO

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A review of illegal, unreported and unregulated fishing issues and progress in the Asia-Pacific Fishery Commission region

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PREPARATION OF THIS DOCUMENT

In 2015, the Secretariat of the Asia-Pacific Fishery Commission (APFIC) prepared a study on illegal, unreported and unregulated (IUU) fishing in its area of competence. This report was presented as an information paper to the 34th Session of the Asia-Pacific Fishery Commission in Colombo, Sri Lanka, 2016 but was not published.

In January 2019, the FAO Regional Office for Asia and the Pacific (FAO RAP) signed a Letter of Agreement with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to conduct additional research in order to update the findings of the 2015 APFIC study and to further evaluate the changes and progress made in combating IUU in the Asia-Pacific region. This report documents the results.

Contents

Figures

Tables

Appendix tables

Acknowledgements

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The key methods underlying this report, online survey and expert elicitation relied on the goodwill, support and above all, the knowledge of individuals and organizations who provided the information. The authors would therefore like to extend their genuine thanks to the following collaborators:

- To all participating regional fisheries institutes for their support and interest in the project, and in extending their encouragement to their staff to complete the survey;
- To the staff who took the time to complete the survey; the knowledge of each participant was invaluable and has helped to better understand IUU fishing in the region; and
- To the expert panel, in particular for the generosity of time taken and depth of knowledge imparted during interviews, and for following up on key points of interest.

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Finally, the authors would like to acknowledge Mr Adi Budi Wicaksono, Vice Director of Surveillance and Fleet Operations, Ministry of Marine Affairs and Fisheries, Indonesia. Mr Wicaksono was a valued colleague and friend, as well as an important contributor to this project. His death is a great loss to his colleagues, friends and family.

Acronyms and abbreviations

ABNJ	Areas beyond national jurisdiction
AFMA	The Australian Fisheries Management Authority
APEC	The Asia-Pacific Economic Cooperation
APFIC	The Asia-Pacific Fishery Commission
ASEAN	The Association of Southeast Asian Nations
BOBP	The Bay of Bengal Programme
CP	Complexity parameter
CPC	Contracting party country
CPI	Consumer Price Index
CTI-CFF	The Coral Triangle Initiative
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
EEZ	Exclusive economic zone
ETP	Endangered, threatened and protected (species)
EU	European Union
FAD	Fish aggregating device
FAO	Food and Agriculture Organization of the United Nations
FAO RAP	FAO Regional Office for Asia and the Pacific
FFA	Pacific Islands Forum Fishing Agency
GRT	Gross tonnage
HP	Horsepower
IOTC	Indian Ocean Tuna Commission
IUU	Illegal, unreported and unregulated (fishing)
JV	Joint venture
LOA	Length overall
MCSE	Monitoring, control, surveillance and enforcement
MSC	Marine Stewardship Council
MT	Million tonnes
NM	Nautical mile
NOAA	National Oceanic and Atmospheric Administration
NPOA-IUU	National Plans of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing
PC	Pacific Island Community
PNA	Parties to the Nauru Agreement
PPP	Poisson Point Process
PSMA	UN FAO Port State Measures Agreement
RFMO	Regional Fisheries Management Organizations
RPOA	The Regional Plan of Action to Promote Responsible Fishing Practices
SEAFDEC	The Southeast Asian Fisheries Development Center
UNCLOS	UN Convention on Law of the Sea
UNFSA	UN Fish Stocks Agreement
VMS	Vessel monitoring system

Executive summary

Illegal, unreported and unregulated (IUU) fishing constitutes a persistent and pressing problem estimated to account for up to USD 23 billion annually in the APFIC area of competence (hereafter referred to as the 'APFIC area'). The effects of IUU fishing can be severe, particularly for small-island and coastal developing states heavily dependent on fisheries, and include adverse impacts on peoples' livelihoods, food security, national economies and the environment. Countries unable to fulfil international obligations for fisheries management and governance risk incurring trade sanctions on their fisheries exports, a growing issue as export markets tighten their controls. Furthermore, IUU fishing is increasingly associated with national and transnational organized criminal activities, although the evidence remains mixed.

FAO commissioned this report two years ago to produce an independent update to an unpublished 2015 study on IUU fishing in the 'APFIC area', which was presented to the APFIC as an information paper in 2016 (FAO, 2016a). The 2015 study used a mixture of media reports, literature reviews and interviews to build a picture of hotspots of illegal fishing across the 'APFIC area'. This report builds on the previous work, incorporating additional analysis methods to predict illegal fishing in a transparent manner. Based on discussions with the APFIC Secretariat, it was decided to limit the study to the illegal component of IUU fishing. A key difference with the 2015 study is the extension of the estimation of illegal fishing from the 33 hotspots covered in the 2015 study to the entire 'APFIC area' in this study.

This report provides the following key outputs: (i) development and implementation of an agreed methodology for estimating illegal-fishing levels and progress; (ii) information from case studies in three Asia-Pacific countries; and (iii) analysis of results from the agreed method estimating the incidence of illegal fishing and implications of efforts to reduce it. The approach taken to achieve these goals included a structured online survey of fisheries officials in APFIC countries, semistructured interviews of key informants knowledgeable about illegal fishing in the APFIC region and analysis of articles on illegal fishing from public media data across the 'APFIC area'.

The methods developed and applied provide an appropriate design for a repeatable, transparent and cost-effective set of approaches for estimating illegal fishing in the 'APFIC area', including responses to illegal fishing and changes since 2015. These methods align with the draft design guidelines under development by FAO for estimating IUU fishing and improve on the methods developed in the 2015 APFIC study (FAO, 2016a). The hotspot case studies from the Asia-Pacific countries explore specific contexts and aspects of illegal-fishing problems in the region, while illuminating potential responses and associated recommendations.

Key findings included:

- Generally, the hotspots for illegal fishing identified in 2015 remain so, although level of activity may have changed.
- Additional hotspot areas of illegal-fishing activities included the southeast Bay of Bengal, the region at the border of Viet Nam's exclusive economic zone (EEZ) and the South China Sea, and the region between the Philippines and Indonesia in the Celebes Sea.
- Estimated illegal-fishing landings across the 'APFIC area', excluding the South China Sea, totalled 6.6 million tonnes (MT) in 2019, with a value of USD 23.3 billion.
- In both small-scale and industrial sectors, encroachment and breach of licence conditions were the most common infractions; followed by non-compliant gear, illegal transhipment and other premeditated activities.
- Surveys suggested that illegal landings generally comprised less than half of the total landings across the 25 species evaluated in this study.

- Species, sectors and entities varied significantly in the level of illegal fishing associated with them, with some predictable patterns. For instance, illegal shark catch reached 50 percent or more of the total landings in some cases. The proportion of illegal catch for tunas was small; however, the combined value exceeded USD 1.6 billion.
- Illegal fishing by domestic fleets represented less than 25 percent of the total reported illegal fishing (by value), suggesting that illegal fishing was undertaken mostly by foreign vessels operating illegally.
- However, for five of the countries examined, between 50 percent and 75 percent of IUU fishing (by value) was undertaken by domestic vessels, and for another four countries, illegal-fishing activities were fully undertaken by the domestic fleets.
- The median value of the catch from an IUU trip was relatively small. Reported incidents with values exceeding USD 1 million were seen in only eight locations, with the maximum incident having an estimated value of around USD 14.3 million.

Based on the data sources examined and the analysis, six issues were identified that were linked to illegal fishing. These issues were: 1) high levels of illegal fishing near borders, in shared zones and disputed waters; 2) frequent violation of bilateral agreements, particularly in the case of asymmetry between parties; 3) the prominence of fish buyers or purchasers in illegal fishing; 4) the likelihood that many of the violations documented were related to stock depletion and profitability; 5) the lack of alignment in regulatory systems and industry structure as a key factor leading to illegal fishing; and 6) the role of international management regimes in reducing illegal fishing.

Nine recommendations were made that the Commission and its member states might consider, which could support efforts to reduce illegal fishing in the region. They were:

1. Continued focus by APFIC and its members on illegal fishing in the region.
2. Establishment of a transparent, repeatable and cost-effective approach to benchmarking illegal fishing and the effects of interventions in the region.
3. Development of guidance for countries in legal and regulatory reform, particularly addressing structural alignment between industry and regulation.
4. Capacity development for enforcement agencies aimed at increasing knowledge of fisheries regulations and embedding the view that violations of fishery law merit action.
5. Information sharing to support cost-effective technological innovation in monitoring and surveillance by members.
6. Development of a platform for the sharing of monitoring information near borders that facilitates cooperation and reduces barriers to information sharing.
7. Focused effort to increase monitoring, surveillance and enforcement activities aimed at fish buyers.
8. Efforts to support members in addressing stock depletion and profitability of their fishing industries.
9. Highlighting the role of norms and other informal structures in increasing regulatory compliance.

Overall, the study validated many of the findings of the 2015 APFIC study, including underlying drivers, many of the areas of high illegal-fishing activity, and the key species and gears involved. The hotspots identified in 2015 appear to remain areas of concern today. This study differed from the 2015 study in the volume and value of illegal activity. This difference is likely to be largely due to an extension of the area of coverage from the 33 hotspots evaluated in 2015 to the entire ‘APFIC area’ in the current study.

Two key recommendations emerging from the 2015 study, which were not highlighted based on the current study results, but which remain relevant are: 1) the value of a risk assessment study to identify areas with relatively high levels of illegality which could be usefully addressed incorporating the risks related to corruption; 2) the importance of training officials involved in IUU-related activities on fisheries regulations in their jurisdictions, juxtaposed by investigative techniques and procedures for handling evidence.

Part I

Introduction and summary of past results and methodologies

Purse seine vessel returning to port, Satun, Thailand.
Photograph: ©FAO/Simon Funge-Smith

1 Background to the Asia-Pacific Fishery Commission region

The Asia-Pacific Fishery Commission (APFIC) is a regional fisheries body of the Food and Agriculture Organization of the United Nations (FAO). Established in 1948, it is one of the longest established regional fisheries bodies. The purpose of the Commission is "to promote the full and proper utilization of living aquatic resources by the development and management of fishing and culture operations and by the development of related processing and marketing activities in conformity with the objectives of its Members" (FAO, 2020a). Member countries have a mutual interest in the development and sustainable use of fisheries resources in the area of competence. The 'APFIC area' is the Asia-Pacific region from the Bay of Bengal in the west, to the Arafura Sea in the east to the boundary of the Yellow Sea in the north. This region is the biggest producer of fisheries and aquaculture globally (Figure 1.1).

APFIC member countries in 2021 number Australia, Bangladesh, Cambodia, France, India, Indonesia, Japan, Malaysia, Myanmar, Nepal, New Zealand, Pakistan, the People's Republic of China, the Philippines, Republic of Korea, Sri Lanka, Timor-Leste, Thailand, the United Kingdom, the United States and Viet Nam.

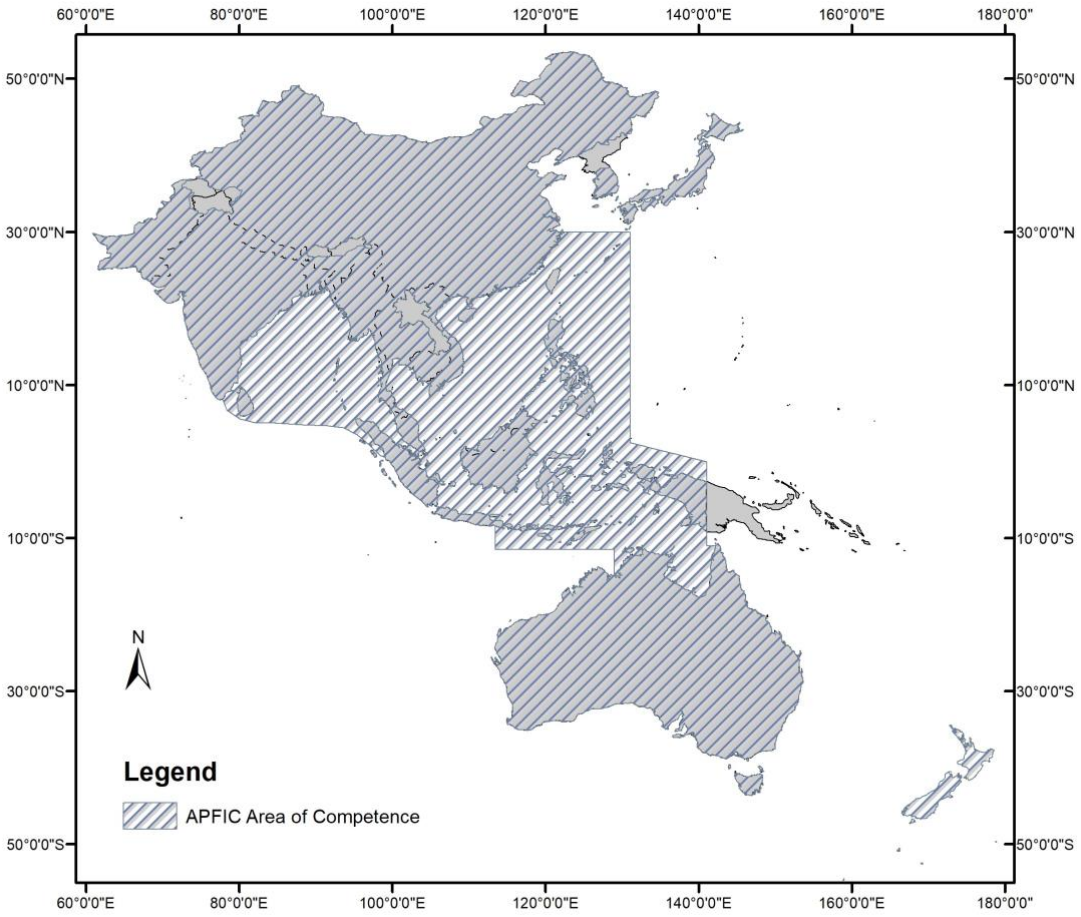

Figure 1.1: APFIC area of competence (the 'APFIC area')
Source: Redrawn from FAO (2020) – *Summary of regional fisheries bodies*. Available at http://www.fao.org/fishery/rfb/apfic/en. Conforms to Map No. 4170 Rev. 18.1 UNITED NATIONS (February 2020).

1.1 Drivers of illegal, unreported and unregulated (IUU) fishing

Illegal fishing is an issue of international concern that dates back to the 1950s when decreasing trends in fish stocks were first reported. The motivations and drivers of IUU fishing are almost always economic and it is likely to continue given the ongoing strong demand in both local and global markets for seafood, which provides high quality protein vital for sustenance and other human health benefits (Pauly *et al.,* 2002; Garcia and Rosenberg, 2010). FAO (2016b) estimated the global annual fisheries catch at 90 MT of fish. However, the report cautioned that around 10 percent extra should be allowed to account for the hidden impacts of discards (one form of unreported catch). The report also highlighted the fact that its estimate of fish catch did not account for IUU fishing.

The drivers of IUU fishing, based on human behaviour, have been investigated as the economics of crime and punishment problems (Le Gallic and Cox, 2006). This requires an understanding of 1) the benefits realized from IUU; 2) the probability of detection; 3) the penalties; 4) the costs to avoid detection; and 5) the degree of the fisher's moral and social standing in society and how it might be affected (Sumaila, Alder and Keith, 2006). IUU fishing produces two economic advantages for the fisher. The first of these is the revenue from the catch and the second is the reduction in expenses that would be otherwise incurred if the catch was legal. Both economic drivers apply to individual fishers as well as to large-scale operators. However, there are risks of detection, which in addition to the foregone catch, may result in imprisonment, fines, loss of vessel, blacklisting and potential loss of standing in the community (Le Gallic and Cox, 2006; Sumaila, Alder and Keith, 2006). There is also an inverse relationship with the moral or social standing of a fisher and the degree to which she or he is prepared to illegally fish. Ultimately it is attitudes, world views and social norms that underpin the decision by individuals to undertake IUU fishing.

IUU catches have higher impacts on the environments and economies of developing nations, which are typically states with the least resources available to devote to monitoring and enforcement (Riskas *et al.,* 2018). In such cases, a key driver of IUU fishing by individuals is poverty, often with a lack of alternative choices to access seafood and/or fisheries-related wages. Individuals commonly live close to the fishing grounds and may have had historic access to the resource. Difficult social circumstances such as low or no employment and homelessness are also known drivers of IUU fishing (Garcia and Rosenberg, 2010; Riskas *et al.,* 2018). Beyond individuals' circumstances, their decisions to undertake IUU fishing are often associated with their beliefs, which can be thought of as non-economic motives that are linked to identity (Akerlof and Kranton, 2011), moral drivers (Sumaila, Alder and Keith, 2006) and social behavioural norms (Riskas *et al.,* 2018). This suggests that less-formal disincentives are needed if strong social norms against illegal fishing are held, especially if reinforced through community sanctions.

One of the main drivers of IUU by organized large-scale fleets is minimization of operational costs. Such cost trimming may include the avoidance of registration and reporting costs, sustainability requirements and fishing limits both spatially and temporally (Riskas *et al.,* 2018). The establishment of false operating companies also occurs to avoid penalties (Sumaila, Alder and Keith, 2006). Tax havens are used to minimize costs and may be useful for hiding the proceeds of IUU, with 12 out the 28 countries in this study declared as Flags of Convenience (used to gain immunity to rules) (Le Gallic and Cox, 2006).

A desire for greater profits is another primary driver of IUU fishing. Some examples include the mixing of illegal catch with legally obtained catches (Riskas *et al.* 2018) or product mislabelling. In the United Kingdom, mislabelling has ranged from 5 percent in supermarkets to as high as 25 percent in restaurants and among fishmongers (Helyar *et al.* 2014). However, the tactics for avoiding detection also have costs attached and include payments for reflagging, renaming and vessel modifications (FAO, 2016a). Finally, fishing overcapacity is another driver of IUU and is known to be exacerbated by boat building and other government subsidies such as reduced fuel costs (Le Gallic and Cox, 2006; Sumaila *et al.,* 2016).

Lack of monitoring, enforcement and punishment facilitates IUU fishing. According to a 2015 report of the Bay of Bengal Large Marine Ecosystem Project (BOBLME, 2015) and FAO (2016a), countries in the APFIC region with the highest levels of illegal fishing tended to have weaker control and enforcement, and they

also shared boundaries with states that had large fishing fleets. Examples of this pattern included Cambodia, Pakistan, Timor-Leste, Thailand and Viet Nam. These countries were all subject to high levels of illegal fishing by vessels from neighbouring states. National monitoring and reporting systems can help to inhibit unreported catches. BOBLME (2015) identified Cambodia, Myanmar and Sri Lanka as having the highest proportion of unreported catches: 21 percent to 205 percent, 10 percent to 70 percent and 10 percent to 103 percent, respectively. Given these findings, the BOBLME (2015) report recommended adoption of IUU fishing related Monitoring, Control, Surveillance and Enforcement (MCSE) indicators: "It is recommended that these indicators should be encompassed in a standard annual output to be released publicly to demonstrate capacity where it exists or privately within country to encourage funding to fill gaps in control and enforcement" (p. 316).

Strong fisheries management and governance can detect IUU issues such as ineffective vessel-related controls, false or double registration, non- or underreporting and lack of vessel monitoring systems (VMS). Other potential governance drivers are uncertain or unresolved maritime boundaries, tolerance of IUU because of reciprocal agreements and/or ignoring infractions as a way to ensure the return of detained fishers (FAO, 2016a). The presence of corruption is an overarching indicator of weaknesses in governance and corruption is often an integral part of IUU (Garcia and Rosenberg, 2010).

IUU fishing is also linked to the potential economic benefits associated with illegal wildlife trade (Riskas *et al.* 2018). Endangered, threatened and protected species (ETP) are often targeted in IUU-fishing operations as the size of the economic payoff is even higher for rare species compared to more common commercial species. High demand and premium prices are realized for some high-value, rare and live trade species of fish which are often targeted by IUU fishers (BOBLME, 2015). Riskas *et al.* (2018) evaluated the threats of IUU fishing of Southeast Asian and Indian Ocean turtles, finding that species targeted apart from turtles were those that commanded high value, which included sharks and rays (elasmobranchs), giant clams, sea cucumber and reef fishes. Over 50 percent of the experts canvassed in this study responded that lack of enforcement was the primary explanation for IUU, with the next highest response being access to valuable species (17 percent). When it came to domestic IUU fishing, more than 20 percent of the experts thought this was due to overfishing in those same local waters (Riskas *et al.* 2018).

IUU fishing fits the definition of a wicked problem (Rittel and Webber, 1973; Ludwig *et al.*, 2001, Akamani, Holzmueller and Groninger, 2016); despite huge efforts in enforcement and monitoring, IUU remains pervasive, complex and widespread (Riskas *et al.*, 2018; Sumaila *et al.*, 2020). The hard work put into managing fisheries in a sustainable manner will be futile if actions to address IUU fishing are not more deeply embedded and incorporated into fisheries planning, strategies and management approaches to achieve sustainable fishing. Disincentives are critical for reducing IUU fishing. Le Gallic and Cox (2006) estimated that a detection likelihood greater than 20 percent is required to sufficiently incentivize behaviour to comply with legal fishing practices.

There is international agreement on the need to end IUU fishing, most recently highlighted by the Sustainable Development Goals (SDG). SDG 14.4 states: "By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics". The other positive pressure to limit the effect of IUU-fishing drivers is the growing market demand for seafood with either full traceability from catch to plate (Sumaila, Alder and Keith, 2006) and/or local provenance, whether through private initiatives such as Marine Stewardship Council (MSC) certification or via regulatory requirements in market states, such as the Lacey Act in the United States.

1.2 Unique aspects

The 'APFIC area' has various unique features. With 15 of the 21 members having shared boundaries within the 'APFIC area', fisheries in the region are characterized by a high rate of transboundary stocks. Moreover, the proximity of the land areas of many of the countries means that the marine territories are quite compressed, with relatively little of the 'APFIC area' being outside of the EEZs of the countries.

A second feature of the 'APFIC area' is disputed maritime boundaries that result in conflicts over fisheries resources and potentially incursions into member states' EEZs, even outside the disputed areas. The frequency of this ambiguity across the region has an impact on the resources available for fisheries monitoring and enforcement, so many countries are under pressure to prioritize fisheries monitoring and enforcement in particular areas either due to high incursion rates or the potential for controlling the existing incursions.

Historically the region has been very productive in terms of fisheries resources and the resulting employment. This trend remains ongoing. In 2016, 12 of the top 25 countries in terms of capture fisheries production were APFIC members (FAO, 2018a). Nine of these members had EEZs within the 'APFIC area' and accounted for 54 percent of the production of the top 25 countries globally, and 43 percent of global capture fisheries production (FAO, 2018a). Roughly 2.3 million motorized fishing vessels operate in the Asia region, with 32 million fishers employed in the region out of roughly 40 million globally (FAO, 2018a). Overall, 80 percent of the world's direct employment in fishing and 80 percent of the vessels operating in fisheries are in the Asia region.

Fisheries employment in the region has experienced significant growth over the past decade, growing from 24 million to 32 million between 1995 and 2016, an increase of 36 percent. In contrast to this increase in employment, catches in the region are suggested to be growing more slowly (Funge-Smith, Briggs and Miao, 2012). The growth in catches is thought to be due to three factors: an increase in fishing effort, expansion of the geographical range of fishing activities and increasing the overall biomass of the fisheries due to depletionof higher trophic level species, resulting in an increase in smaller, shorter lived, fast recruiting species (Funge-Smith, Briggs and Miao, 2012).

This high productivity and significant output have made fisheries operating out of the APFIC member states among the largest exporters of fisheries products in the world, both by volume and by value (FAO, 2018b). As international attention to illegal fishing has increased, with two of the three main export markets adopting policies linking market access and control of IUU fishing, APFIC members have come under increasing pressure to address concerns over IUU fishing, including links to their fishing grounds, vessels and processors. As discussed below, the European Union (EU) has pressed specific countries to take action. Some APFIC member countries have also instituted major campaigns to address illegal fishing for other reasons, such as the initiative undertaken by Indonesia's government, taken as part of a larger domestic reform agenda. Taken together, this increase in attention and the resulting action being taken by the countries in the region, means that APFIC members as a group are relatively active in addressing administrative, legal and operational issues that have allowed IUU fishing to be a concern in the region. This concentration of effort in a single region is unique around the world.

1.3 APFIC 2015 study of illegal fishing in the APFIC region

FAO reviewed IUU fishing in the APFIC region in 2015, focusing primarily on the illegal components of IUU fishing, which was summarized in an information paper presented to APFIC in 2016 (FAO, 2016a). The report provided a background on illegal fishing in the APFIC region, identified IUU-fishing hotspots and provided analysis of those hotspots, leading to estimates of the characteristics, volume and value of illegal fishing across the APFIC region, including some surrounding areas outside the 'APFIC area'. The report included a discussion of factors that increased the potential for IUU fishing, based on the analysis, presented a risk assessment framework for considering IUU fishing in the region and concluded with recommendations. A key component of the report was a detailed set of case studies for each of the 33 hotspots identified in the report, provided as an appendix. The appendix with the case studies, and a summary of the key aspects of the report, prepared by the APFIC Secretariat, is included as Appendix A1 in this document.

The report highlighted various features of the APFIC region that are important components leading to the higher incidence of IUU fishing in the region. In particular, the prevalence of shared borders and a history of shared fishing areas between neighbouring countries have generated various issues. In this context, border incursions and related issues are fairly common. In some cases, historic shared access and unresolved

borders after the implementation of the United Nations Convention on Law of the Sea (UNCLOS) have led to shared management zones among countries, or the establishment of systems for permitting foreign vessels to operate, such as joint venture or licensing agreements. These arrangements have often been key factors in illegal fishing, as they can create management ambiguity and regulatory loopholes. Similarly, many countries across the region have relatively weak vessel registration systems, in the context of expanding fishing fleets. As such, countries in the region frequently have relatively large fishing fleets with poor oversight, leading to increases in the level of IUU fishing.

The FAO report used a mixture of literature and media review along with interviews to identify areas of high IUU activity in the APFIC region, and to estimate the type of illegal activity as well as the resulting volumes and lost values due to IUU fishing. The review identified 33 hotspot areas where IUU fishing was notable (Figure 1.2). It focused on systematic IUU fishing, as opposed to opportunistic activities, fishing without authorization in EEZ waters, contravention of management measures, unauthorized transhipments, fishing by vessels with inappropriate documentation and targeting of ETP (FAO, 2016a).

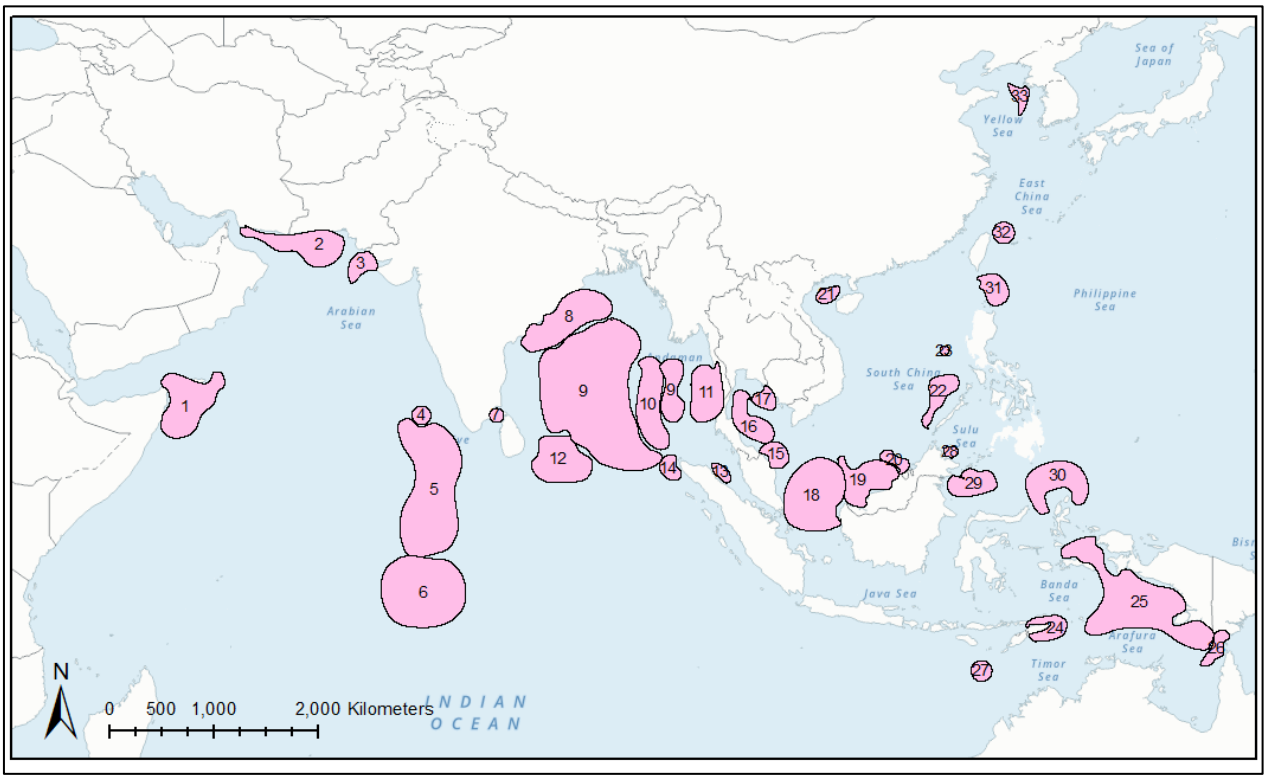

Figure 1.2: IUU-fishing hotspots in the Asian region identified in 2015 (Numbering is identified in Table 2.5)

Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021).
Note: Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.
Source: Redrawn from FAO (2016a).

The report found widespread IUU fishing across the APFIC region, with nearly every country in the region having some level of IUU fishing associated with foreign vessels or vessels with foreign beneficial ownership. Overall, encroachment was the most common infraction (100 percent of incidents), followed by documentation issues (88 percent), non-compliance with management measures (85 percent), catch of prohibited species (58 percent) and illegal transhipment (39 percent). Approximately 80 percent of cases identified showed a degree of premeditation.

The target species identified were generally demersal and small pelagic species, and thus not subject to either of the regional fisheries management organizations (RFMOs) operating in the area (Indian Ocean

Tuna Commission, Western and Central Pacific Fisheries Commission). Overall, the authors estimated between 2 MT and 2.5 MT of catch were taken across the 33 regions, worth between USD 3 billion and USD 5.2 billion. The authors also estimated that this equated to 2.3 percent to 10.4 percent of the total reported catch across the areas covered, although they excluded the East China Sea/Yellow Sea from the estimates. Excluding the western Indian Ocean, the estimates were consistently around 9 percent to 10 percent of the total volume. Trawl and purse seine fisheries in six of the hotspots accounted for just over 80 percent of the total volume, and a similar portion of the total value.

Key issues allowing IUU fishing to take place were identified in the report. The vast majority of the activity identified occurred near maritime boundaries, in disputed areas or in remote locations with low levels of surveillance. The authors found that while IUU fishing involves both large-scale and small-scale vessels, the bulk of the landings was by large-scale vessels. The authors presented a risk-based framework for identifying potential IUU-fishing hotspots. The framework included two components (1) the likely reward, driven by the resource quality, value and accessibility in the location and (2) the likely sanctions, driven by the clarity of the regulations, the likelihood of detection and the chance of effective legal sanction.

The report concluded with recommendations for addressing IUU-fishing hotspots in the region, including using risk assessment to prioritize areas and actions, and a table of specific actions that could implemented, including vessel registries, vessel tracking and port controls on domestic and foreign vessels. These conclusions were derived from a summary of key drivers of IUU fishing in the region, covering both governance and economic drivers. A key recommendation was that these actions in each member country be based on National Plans of Action, as laid out in the FAO guidelines.

1.4 Other studies providing IUU estimates in the region

Two additional regional estimates of illegal fishing were completed in or around the 'APFIC area'. A Global Environment Facility-funded project assessed IUU fishing across the Bay of Bengal, which was expanded to include various additional countries (BOBLME, 2015). The analysis and associated report covered 17 countries and territories across the region, with significant overlap with the APFIC membership. Countries covered included Bangladesh, Brunei Darussalam, Cambodia, Timor-Leste, India, Indonesia, Malaysia, the Maldives, Myanmar, Pakistan, Papua New Guinea, the Philippines, Singapore, Sri Lanka, Thailand and Viet Nam.

The study estimated illegal and unreported fishing across the countries from 1990 to 2013. The analysis underpinning the estimates in the study used the anchor point-influence approach, developed by Pitcher *et al.* (2002). This method used reported catches, in this case to FAO, as a basis for the time trend in total catch. It then used media reports, interviews and other records to create inflation factors for that time trend which attempted to account for illegal and unreported components of the catch. The study explicitly excluded unregulated fishing, on the grounds that it was not relevant for the countries covered by the study.

The study estimated that illegal and unreported catch across the 17 countries covered was between 4.5 MT and 14.4 MT, valued between USD 6 billion and USD 21 billion annually. Illegal and unreported catches had nearly equal shares of the total volume and value. The illegal and unreported component of catch was estimated to be a significant component of total production in the 17 countries, equivalent to between 24 percent and 82 percent of the total first landed value of approximately USD 25.5 billion.

States whose production was dominated by large-scale industrial tuna fisheries in general had lower illegal and unreported catches as a component of their fisheries, e.g. the Maldives (0.9 percent to 18 percent), potentially due to the additional control and management measures associated with those fisheries. Conversely, countries with the highest levels of illegal fishing tended to have weaker control and enforcement and shared boundaries with states with large fishing fleets. In particular, the report identified Cambodia, Pakistan, Timor-Leste, Thailand and Viet Nam as having high levels. The report suggested that these countries were all subject to fishing by foreign vessels from neighbouring states, which contributed to high levels of illegal fishing. Indonesia was estimated to have the highest level of illegal fishing, by volume,

with an estimated loss of between 1.5 MT and 2.4 MT, in part due to the large size of Indonesian fisheries. Indonesia was followed by Thailand (0.6 MT to 2.1 MT) and Viet Nam (0.3 MT to 1.1 MT), in terms of total losses to illegal fishing.

Unreported fishing follows similar patterns to illegal fishing, based on the study. Countries such as the Maldives, with a high component of their fisheries coming from internationally managed tuna fisheries, tended to have the lowest levels of unreported catch. Countries with weaker national monitoring and reporting systems were estimated to have higher levels of unreported catch. Cambodia, Myanmar and Sri Lanka were identified as having the highest proportion of their catches unreported (21 percent to 205 percent, 10 percent to 70 percent and 10 percent to 103 percent, respectively). By value, the countries with the highest estimated losses to unreported fishing included India (USD 0.6 billion to USD 1.8 billion), Indonesia (USD 0.5 billion to USD 1.5 billion), Myanmar (USD 0.4 to USD 1.2 billion), Sri Lanka (USD 0.1 to USD 1.0 billion) and Thailand (USD 0.4 to USD 1.2 billion).

Estimated IUU fishing by species and species groups suggested that 'marine fishes not identified' and minor catch species (individual species which make up less than 2 percent of national catches) were the largest component of reported catches by volume within the region (total volume between 1990 and 2013 175 148 164 tonnes). They were estimated to be between 16 percent and 50 percent illegally caught and 10 percent to 37 percent unreported, making them the largest in both categories by volume. In terms of proportions of the catch that were predicted to be illegal, the species/group with the highest minimum illegal catch was 'Mussels' at 30 percent, followed by 'Miscellaneous aquatic invertebrates' at 28 percent and 'Miscellaneous marine molluscs' and 'Clams, cockles, arkshells' at 26 percent each. Regarding the unreported percentage, 'Miscellaneous marine crustaceans' had the highest minimum unreported catch, at 28 percent. The next highest minimum unreported catches were for 'Shads' at 18 percent, 'Miscellaneous aquatic invertebrates' and 'Mussels' each at 15 percent.

The report also included a section on risk assessment for IUU fishing and recommendations. The risk assessment noted that various risks occurred in more than 50 percent of the countries, including illegal fishing in closures, illegal harvest of protected species, including sharks, illegal transhipment, landing catches in unauthorized foreign ports and use of prohibited gear. A key recommendation from the BOBLME (2015) report was the development of a standardized reporting system for MCSE-related information. The authors suggested that this system should include four components: information on the number of inspections conducted, information on infractions, estimates of IUU catch weight and species composition, as well as documentation on prosecutions, including the size of sanctions.

In addition to these two efforts, The Forum Fisheries Agency (FFA) contracted a review of IUU fishing in its jurisdiction in 2016 (MRAG Asia Pacific, 2016). This estimate focused exclusively on tuna fisheries in the Pacific Island Nations and thus had only a very small area of overlap with the 'APFIC area'. As such, the estimates are not included in detail here. However, it is noteworthy that the analysis found significant levels of IUU fishing, accounting for 70 percent of the volume in the purse seine sector, and ranging from 11 percent to 19 percent of total volume for the longline sector. Most purse seine IUU fishing was related to misreporting and use of fish aggregating devices (FADs) at unauthorized times or locations, while longline IUU fishing was largely associated with misreporting and transhipping.

1.5 Review of IUU estimation methodologies

FAO in Rome commissioned a study and a supporting workshop in 2015 to review the existing approaches to estimating catch by IUU fishing, evaluate the merit of producing a global estimate and consider whether it might be included in the biannual *FAO state of the world fisheries and aquaculture* publication (available at http://www.fao.org/fishery/sofia/en). Based on the workshop, a review of existing methodologies was commissioned and an advanced draft was made available online (Macfadyen, Caillart and Agnew, 2016), hereafter referred to as the *Study of studies* (Macfadyen, Caillart and Agnew, 2016). The *Study of studies* identified 89 reports estimating IUU levels, of which 44 provided catch estimates and were included in the

analysis. These studies ranged in scale from single fisheries up to regional or global assessments but tended to focus on marine industrial fishing, particularly fishing by foreign vessels, and used a wide range of methodologies.

Conceptual approaches to estimating unknown catches taken by the various reports fell into a number of categories, including estimates of unknown catches by unknown vessels, estimates of unknown catches by known vessels, unknown catches more generally, unlinked to vessels, and other IUU fishing that does not result in unknown catches. Methodologies and data sources used in the reports reviewed by the study were tightly linked and included: 1) inspection data from patrols, ports, observers and other sources; 2) remote sensing data from satellite, aircraft, vessel surveys and onboard cameras; 3) estimates of missing catches derived from stock assessment models; 4) trade data analysis, including catch documentation, import, export and market data; and 5) expert judgement. The review found that each of these data sources and the supporting methods had benefits and drawbacks, with no single best method emerging.

In general, larger scale regional or global estimates relied on a meta-analysis of other studies and information, as opposed to the more primary data, listed above, used by the more narrowly focused studies. These meta-analyses typically focused on using reported catch data and estimating inflation factors based on information from a range of sources. For instance, the Bay of Bengal study discussed in Section 1.4 used this approach and primarily relied on information reported in the media to estimate catch inflation factors. The most widely applied method for this type of meta-analysis, as reported by the *Study of studies*, is the anchor point-influence approach developed by Pitcher *et al.* (2002). The *Study of studies* quotes a summary of this catch reconstruction method from Pauly and Zeller (2015) as "catch reconstruction, undertaken using the following methodology:

1. Identification, sourcing and comparison of baseline reported catch times series, i.e. (a) FAO (or other international reporting entities) reported landings data by FAO statistical areas, taxon and year; and (b) national data series by area, taxon and year;
2. Identification of sectors (e.g. subsistence, recreational), time periods, species, gears etc., not covered by (1), i.e. missing data components. This was conducted via extensive literature searches and consultations with local experts;
3. Sourcing of available alternative information sources on missing data identified in (2), via extensive searches of the literature (peer-reviewed and grey, both online and in hard copies) and consultations with local experts. Information sources include social science studies (anthropology, economics, etc.), reports, colonial archives, data sets and expert knowledge;
4. Development of data 'anchor points' in time for each missing data component, and expansion of anchor point data to country-wide catch estimates;
5. Interpolation for time periods between data anchor points, either linearly or assumption-based for commercial fisheries, and generally via per capita (or per fisher) catch rates for non-commercial sectors;
6. Estimation of total catch times series, combining reported catches (1) and interpolated, country-wide expanded missing data series (5); and
7. Quantifying the uncertainty associated with each reconstruction."

The study of IUU fishing in the FFA jurisdiction by MRAG Asia Pacific (2016) provided a concise and clear summary of how a similar meta-analysis approach was applied in that context. The research team built a conceptual model describing the fishery, identified key IUU-fishing activities of interest and gathered information on the frequency of those activities. This information was used to define a most likely value and a range for each activity. The resulting distributions were used in a Monte Carlo simulation of the fishery to then make estimates of the overall level of IUU fishing and the resulting catch volume that was likely impacted. The study departed to some extent from other meta-analysis type regional approaches in being focused on a relatively well-monitored fishery, where there was extensive information available and a relatively homogenous system. This allowed the authors to build a conceptual model and implement the

Monte Carlo analysis that would typically be prohibitive in a multicountry, mixed gear, mixed species set of fisheries.

One key issue that the *Study of studies* highlighted was the challenge in conducting regional or global studies, with analyses losing granularity or having increased uncertainty as the scope of the study increased, due to the variability in the information that is available across contexts. The report highlighted that transparency for the sources of information used in the studies and the weaknesses in the analytic methods were major issues hindering the value of the studies. Based on the outcomes of the 2015 workshop and the subsequent *Study of studies*, FAO is currently developing guidelines for estimating IUU fishing.

Since this APFIC study commenced, FAO has released an advanced draft of its guidelines (FAO, 2018b) for estimating IUU fishing based on the *Study of studies*. While the draft guidelines do not provide a single suggested methodology, they do include a useful set of design principles which can assist in improving the quality of estimates of IUU fishing (FAO, 2018b). The principles outlined for studies in the FAO guidelines include: clear objectives and scope, reproduceable methodology, transparent and data-driven conclusions, use of consensus across multiple sources of data, clarity of assumptions, mechanisms to account for uncertainty, provision of estimates of confidence, the importance of statistical rigour, stakeholder participation, the use of risk-based approaches and peer review (FAO, 2018b). In general, the guidelines divide IUU estimation methodologies into top-down and bottom-up methods, using terminology similar to that described for the FFA study discussed above. The guidelines discuss several of the cases raised in the *Study of studies*, in particular highlighting the FFA study.

While various estimates of large-scale IUU fishing have been made using the anchor-point influence approach, controversy surrounds many of these estimates. A recent high-profile paper on illegal catches in the United States that are exported to Japan (Pramod, Pitcher and Mantha, 2017) was subsequently retracted by the publisher due to issues related to data sources, transparency and reliability (Hilborn *et al.,* 2019; Pramod, Pitcher and Mantha, 2019). A revised version of the publication remains highly contested, including by the head of the US National Marine Fisheries Service (Hilborn *et al.,* 2019). Similarly, while estimates of fraud in the marketplace suggest that the prevalence may be high, reanalysis of these patterns points to some significant issues with the original estimates (Luque and Donlan, 2019). Finally, some proxies that claim to provide information on illegal fishing are contested on the basis of their conceptual connections to illegal fishing or utility for management action (Macfadyen *et al.,* 2019).

Given the size of the APFIC region and the diversity of fisheries therein, the approaches that are appropriate for estimating illegal fishing in the 'APFIC area' are somewhat limited. The anchor-point influence approach has been applied to most of the countries, however, the method requires significant time and resources, making it difficult to use in a repeatable manner. More importantly, as discussed above, the method has been subject to significant criticism, largely due to the lack of a transparent, repeatable method for incorporating information (Hilborn *et al.,* 2019).

Similarly, many of the data sources and supporting methods used in other studies are not appropriate for the APFIC region at this juncture. Given the diversity of species taken by fisheries in the region, using missing catches from stock assessments is not a viable option, as most species are not covered by formal stock assessments. Use of inspection data or surveillance data would be difficult as there is no central repository for this information. Where it is collected, it is held by each of the APFIC members individually. Moreover, recent action by the EU has led to pressure on many of the APFIC members to address IUU fishing. As such, members may be more reluctant than at other times to release data related to violations by their nationals or in their waters.

This situation leaves the two options explored in the *Study of studies* and discussed in the FAO guidelines (FAO, 2018b); the use of reported catch data and the use of expert judgement. However, in the use of expert judgement, in particular, a key requirement is to address the concerns that have been raised around transparency and repeatability. These considerations align closely with the draft FAO guidelines for IUU estimation, and if well executed, a study based on this approach could provide a useful example for future estimation approaches.

1.6 Review of management efforts since the previous estimate by FAO

Adoption of various international management efforts by countries provides an insight into the capacity and progression of the region towards combating IUU fishing. Key international targets for ratification include: the UN Convention on Law of the Sea (UNCLOS), the UN Fish Stocks Agreement (UNFSA), the UN FAO Port State Measures Agreement (PSMA), the UN FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement), along with adoption of the UN FAO Code of Conduct for Responsible Fisheries. Across the region, there is close to complete adoption/ratification of UNCLOS, with only a few countries still working towards adoption. In comparison, only four countries (Myanmar, the Philippines, Republic of Korea and Sri Lanka) have ratified the UN FAO Compliance Agreement. More than half of the countries have adopted the Code of Conduct for Responsible Fisheries as the standard for their fisheries planning, policy and management, whereas more than half are still working towards adopting the UNFSA. Regionally there has been comprehensive adoption of the PSMA, with only seven countries (China, India, Malaysia, Nepal, Pakistan, Timor-Leste and the United Kingdom) still to sign up to the agreement.

In addition to these international targets, various national-level efforts exist as key indicators for countries progressing towards effective targets for combating IUU. An overarching statement of intent such as the National Plans of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (NPOA-IUU) is key in understanding national-level processes and goals. For example, such documentation will provide insight into fisheries regulations, sustainability of goals and guidance as to whether, for example, the fisheries management regulations are geared towards sustainable fishing, or supporting commercial enterprises. The range of technology uptake and capacity across the region is vast. Some countries have world class infrastructure technology, regulations and staffing, whereas others are information-rich, but poor technologically. However, national initiatives are a rapidly changing space with increasing uptake and efforts by all countries across the region. There is widespread expertise, progress and implementation in e-monitoring efforts and associated software and hardware. For example, Thailand has several thousand vessels with VMS, along with cameras linked to winches and hatches on vessels set to monitor transhipment and communicate via satellite in real time. Whereas Myanmar, though information-rich, is in the early stages of adopting technology and establishing a pilot VMS in the national fleet. Similarly, Timor-Leste is using small-scale GPS equipment to understand the movements of the national fishing fleet.

Regionally, there is a range of international organizations and efforts aimed at improving the capacity of fisheries management, surveillance and enforcement. Key regional bodies include: the BOBP-IGO, ASEAN, APEC, APFIC, RPOA IUU, SEAFDEC and CTI-CFF. These groups on the whole tend to have either a formal or informal collaborative working relationship.

The Southeast Asian Fisheries Development Centre (SEAFDEC) is the key regional partner providing comprehensive training towards improving and enabling sustainable fisheries in the region. It has a longstanding presence, established in 1967, and deep knowledge of and involvement with ministries across the region. As such it is highly regarded by countries in the region and regarded as a key leader for standard operating procedures and training. It is currently engaged in delivering a regional vessel registration programme, capacity development for addressing IUU fishing, creating a regional catch documentation system and a number of other efforts to address IUU fishing in the region.

The Regional Plan of Action for IUU fishing (RPOA IUU) headquartered in Indonesia and covering Southeast Asia and Oceania is an active group for regional coordination and cooperation to address IUU fishing, The RPOA has three active working groups covering its three geographic subregions and has fostered information sharing, joint patrol programmes and communication among members.

The Bay of Bengal Programme Intergovernmental Organization (BOBP-IGO) is working in fisheries in the Bay of Bengal region and coordinating with surrounding countries and regional organizations. The BOBP-IGO was the lead agency for the recent GEF-sponsored report on IUU fishing across the BOBP and APFIC regions

(BOBLME, 2015). Recently, BOBP-IGO held a meeting to establish an RPOA IUU for its region, in parallel with the existing RPOA covering the ASEAN and Oceania region (Anonymous, 2020a). While still in development, this process augurs well for efforts to advance regional cooperation in addressing IUU fishing.

The Asia-Pacific Economic Cooperation (APEC) is a regional body which includes many of APFIC's members. In 2019 APEC ratified a roadmap for addressing IUU fishing across its members, developed by the Oceans and Fisheries Working Group in APEC. In 2020 Malaysia hosted the APEC meetings and this will be followed by New Zealand in 2021. Both of these APFIC members will be developing activities to support APEC members in addressing key tasks in the roadmap. Malaysia is potentially planning a series of meetings to support countries in making the best use of VMS for instance, although this process has been interrupted by the COVID-19 pandemic that broke out in early 2020 and so is uncertain at the moment.

In addition to these key regional bodies, a range of other partners is working in the region at the country level. These may be formal long-term engagements embedded within ministries or small project-based consultancies, with partners ranging from foreign aid donors to commercial providers. For example, the Danish International Development Agency is embedded within the Myanmar Department of Fisheries. It is assisting in the advancement of all aspects of MCSE across the department, from development of an IUU task force to assisting with the adoption and integration of VMS. Similarly, OceanMind, a UK-based company, is working directly within the Thai Department of Fisheries to improve analytic capacity and technology. WorldFish, an international non-profit organization, is another important contributor to the management of small-scale fisheries in the region, with strong collaborations among Bangladesh, Cambodia, Myanmar and Timor-Leste. These partnerships are critical to improving capacity across the region, advising on a range of topics from development and operation of MCSE taskforces to managing tracking systems for small-scale fisheries.

The United States National Oceanographic and Atmospheric Administration (NOAA), the Australian Fisheries Management Authority (AFMA) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) are also involved across the region with efforts ranging from country-level gap assessments, in-country surveys to understand fisher attitudes, to hands-on boarding and inspections training, and capacity development for fisheries management agency staff. The Singapore Information Fusion Centre is another key regional body aimed at improving maritime surveillance capacity across the region. The centre works collaboratively, with country representatives from across countries and governments to inform and support interdiction for maritime challenges spanning fisheries to piracy.

The EU has also engaged a number of countries in the region after the promulgation of its policy to reduce IUU fishing. The EU process involves extensive consultation, with both self-assessment and independent assessment of a country's measures to control IUU fishing. Thus, while the process and the assessments are sometimes controversial, the EU policy and status of countries provide an independent measure of the quality of efforts to control IUU fishing. The EU is currently funding several large capacity development programmes in support of countries addressing their issues related to IUU fishing.

FAO is very active in supporting countries in the Asia-Pacific region to combat IUU fishing. The FAO programme to prevent, deter and eliminate IUU fishing is coordinated by the central FAO office in Rome. FAO has focused in particular on activities to support the adoption of the PSMA by countries in the region, with 18 countries in the Asia-Pacific region being parties to the PSMA as of December 2019. The FAO support programme focuses on policy and legal frameworks, institutional arrangements and operational procedures to support countries to effectively fulfil their obligations as coastal, port, flag and market states. The programme also emphasizes the importance of information sharing and cooperation at the regional level, supporting existing regional mechanisms where they exist.

FAO's work programme to prevent, deter and eliminate IUU fishing is coordinated by FAO Rome. The 'Global Programme to Support the Implementation of the PSMA and Complementary International Instruments' focuses on strengthening the implementation of the PSMA, related international agreements and regional mechanisms to combat IUU fishing. A growing number of countries in the APFIC region (to date Cambodia, Malaysia, Indonesia, the Maldives, Myanmar, the Philippines, Sri Lanka and Thailand) have

participated in the programme. These efforts focus on assisting countries with development of their policy and legal frameworks, institutional arrangements and operational procedures to effectively fulfil their international obligations. The programme also emphasizes the importance of regional information sharing and cooperation and supports existing regional mechanisms in this regard.

A number of APFIC members were contacted by the EU as they were pre-identified as being at risk of having IUU-fishing issues covered by the EU policy (see https://ec.europa.eu/fisheries/sites/fisheries/files/illegal-fishing-overview-of-existing-procedures-third-countries_en.pdf). The Republic of Korea, Papua New Guinea, the Philippines, Taiwan Province of China and Thailand were all pre-identified as potentially subject to measures under the policy. These APFIC members have all made adequate progress in addressing IUU fishing, leading the EU to revoke its pre-identification after action was undertaken by the countries. Sri Lanka was pre-identified, and subsequently listed under the policy as subject to trade measures. It has since taken adequate action to be de-identified and have its trade measures lifted. Viet Nam also has been pre-identified. However, to date the measures Viet Nam has implemented have led the EU to hold the process in its current status, instead of moving further to trade restrictions. Cambodia is the only remaining APFIC member with either a pending identification or being actively subject to EU measures. Thus, overall, many of the APFIC countries have made significant progress in addressing their vulnerability to IUU fishing and distributing illegal fish products in their supply chains since the first EU pre-identifications were issued in 2012.

1.7 Goals of the current project

This report was commissioned as an update to the unpublished 2015 study on IUU fishing in the 'APFIC area' (FAO, 2016a). That report used a mixture of media reports, literature review and interviews to build a picture of hotspots of illegal fishing across the 'APFIC area'. The primary tool underpinning the 2015 study was interviews with key respondents with a wide knowledge of IUU fishing in the APFIC region. However, these key respondents were subsequently not available, and thus a simple update of the unpublished 2016 report was not possible. The current project has three main goals.

Goal 1: Design and deliver a repeatable, transparent and cost-effective set of approaches for estimating illegal fishing in the 'APFIC area', including responses to illegal fishing and changes since 2015. The agreed methodology for estimating illegal-fishing levels and progress has three components: a structured survey delivered to fisheries officials in APFIC countries; a semi-structured interview delivered to key informants knowledgeable about illegal fishing in the APFIC region; and analysis of articles on illegal fishing from public media data across the 'APFIC area'. Based on the information gained from this goal, the project team addressed the second output and Goal 2.

Goal 2: Develop three illustrative case studies from Asia-Pacific countries, exploring aspects of the illegal-fishing problem in the region and potential responses to them. In light of the criticism of various estimation approaches for IUU fishing, and in particular for those that use either confidential data or expert judgement, a summarized version of the data is provided along with supporting analysis.

Goal 3: Provide results and supporting summarized data, consistent with human ethics requirements, for the survey, interviews and media analysis to document current levels of illegal fishing and shifts since the 2015 assessment.

Part II
Methodologies and findings

Aftermath of dynamite fishing on a coral reef, Indonesia. Photograph: ©Prilfish (Flickr) under Creative Commons 2.0 licence

The methods developed for this project were designed to provide quantitative estimates of components of the illegal portion of IUU fishing according to the project goals. Based on consultation with the APFIC Secretariat and FAO RAP, it was agreed that the primary focus would be on illegal fishing, as opposed to unregulated or unreported fishing.

Furthermore, the methods for the project were designed to create regional estimates for the areas covered by the 'APFIC area', but without specific emphasis on particular countries' national waters, EEZs or disputed areas. While in some cases information is presented that includes these specific geographic boundaries, they are not the emphasis of the overall report. Similarly, foreign versus domestic vessels are not identified, except where reported in our data sources. These two design criteria were specified to avoid sensitivities among survey and interview respondents and elicit more open responses.

Three other important design criteria for the methods developed for this project were transparency, repeatability and cost-effectiveness. In this context, transparency implies that the methods and conclusions should flow clearly and logically from the information presented. Thus, where judgements are used, they should have explicit criteria and data analysis should be logical and outcome focused. The second criterion means that any other analyst working with the data collected in this project and following the methods outlined, should come to similar conclusions. Similarly, if the tools developed in this project are applied in the future, there should be enough information to replicate the process and reach updated conclusions. Finally, the methods should be cost-effective. While not an explicit goal for the APFIC Secretariat, given that the current project is an update of the 2015 report developed for APFIC, it seems prudent to assume that this process may be extended or repeated in the future. Furthermore, cost-efficiency will assist in assuring that the work done by APFIC is more widely applicable for organizations and countries interested in addressing IUU fishing.

Formal elicitation methods based on structured surveys represent an alternative which can accommodate these requirements. There are some issues, such as challenges in assigning numerical values to some types of questions and issues with a respondent bias. However, if such surveys are paired with an appropriate statistical approach that corrects for bias, they can provide quantitative or semi-quantitative estimates of the level, structure and trends of illegal fishing. Using appropriate stratification and replication across experts, these methods can produce reliable estimates even in data-poor contexts and can readily be expanded to incorporate other types of information as they emerge.

Here this method is paired with two other approaches, which formed the backbone of the information used in the 2015 APFIC study (FAO, 2016a). In addition to extracting information based on online surveys with fisheries officers, media reports of illegal activities in the APFIC region were analysed and targeted interviews with key informants were undertaken. The media analysis provides an independent source of information on locations, activities, violations, catches, flags and a range of other information on vessels involved in illegal fishing. The media analysis used a template based on that used in the previous APFIC study, incorporating information on the types of infractions, the value of the catch, location, flag state and various other information. The targeted interviews investigated in-depth information on locations, species and illegal activities across the APFIC region. As with the media analysis, these were designed using the interview structure from the 2015 study as a basis, although with some differences to provide more structure around the responses.

While this study draws on similar methods used in the 2015 APFIC study, there are some fundamental differences in methods. A number of these differences flow from a focus on estimating the illegal component of landings, as opposed to a focus on the illegal activities of vessels, as the basis for estimation. For instance, in contrast to the previous effort to estimate illegal fishing by foreign vessels in the APFIC region, this study does not differentiate vessel ownership. Similarly, in contrast with the previous study, here estimates are not explicitly limited to large-scale industrial vessels. This approach has some advantages, for instance avoiding the need for making assumptions about prevalence in a fleet given reports on individual vessels.

A second difference between the two studies lies in the collection and treatment of the data. In the current study, both the surveys and the media data were analysed with formal statistical tools. This allowed

separation of various contributing factors, such as respondent experience and target species, in making estimates of the likelihood of illegal fishing. These formal models also allowed for predictions outside of the observed data, such as estimates of illegal fishing at a regional scale, based on maps provided by respondents. By building on the valuable contributions of the 2015 study, and extending the analytical approach used to the underlying data, it is intended that this report and the supporting methods can provide a template for future monitoring of IUU fishing in the APFIC region and beyond.

A third fundamental difference between the two reports is the area of focus for the estimation of illegal fishing and subsequent volumes and values of the resulting products. The 2015 APFIC study estimated the level of illegal fishing for 33 hotspots across the 'APFIC area' and the surrounding region (FAO, 2016a). Based on these estimates, the authors then constructed an estimate of the volume and value of illegal fishing for these 33 areas and summed it to give an estimate for the 'APFIC area' overall. Conversely, the current study focuses not only on these 33 hotspots, but also on the remaining portion of the 'APFIC area'. Thus, the estimates for illegal fishing developed in this report should be interpreted as an estimate for the whole of the 'APFIC area', and being more inclusive, are likely to be larger than those in the 2015 study.

As noted in Section 1.5, in the time since this study commenced, FAO has released draft guidelines for studies estimating IUU fishing (see http://www.fao.org/3/CA0458EN/ca0458en.pdf, accessed 4 June 2020). The guidelines do not provide a single methodology, but instead a set of design principles which can assist in improving the quality of estimates of IUU fishing. In general, the draft guidelines divide IUU estimation methodologies into top-down and bottom-up methods. The methods undertaken in this study align very well with the FAO draft guidelines, in particular the bottom-up methodology associated with unseen behaviour of known vessels or activities, drawing on the use of expert stakeholder judgement as well as being a multidata source study built on transparent and reproducible data collection protocols and statistical analysis methods.

This report on illegal fishing in the 'APFIC area' consistently presents not only quantitative estimates, but also uncertainties, with the underlying analyses being designed to address variable sample sizes, respondent and reporting bias, and other features that can inflate estimates or create additional uncertainty. In addition, it aligns with draft guidelines in the estimation of economic consequences across multiple species and IUU activities, although as discussed above, the focus is primarily on the illegal component of IUU fishing.

2 Fisheries officers surveys

2.1 Survey design

An online, confidential survey was designed with an audience of front-line fisheries officials in mind. The aim was to extract first-hand information from people who may have directly observed the impacts of illegal-fishing activities. The survey is focused on the incidence of *illegal*-fishing activities rather than the entire umbrella of IUU activities.

The survey followed the principle that a fishing vessel is presumed to be engaged in illegal-fishing activities if it is shown to carry out activities in contravention of the conservation and management measures applicable to the area of operation. This might include, but is not limited to, fishing without a valid licence, in a closed area, beyond a closed depth or during a closed season, or by using prohibited gear, falsifying a boat's identity or obstructing the work of inspectors. These categories were aligned with those used in the 2015 APFIC study.

All responses remain anonymous and are kept completely confidential. Likewise, the identity of all respondents has been kept anonymous. Respondents will not be identified in publications or to APFIC members. Furthermore, results from surveys are only provided in aggregated form.

The survey comprised 15 questions and took an average of 30 minutes for respondents to complete. Before beginning, respondents were required to acknowledge that participation in the study was voluntary, that they were over 18 years of age and that they were aware that they could choose to terminate their participation in the study at any time and for any reason. The survey was approved by CSIRO's Social Science Human Research Ethics Committee (Ethics Clearance number 021/19) in accordance with the National Statement on Ethical Conduct in Human Research (2007).

The Web-based survey had three parts. A full transcript of the survey is provided in Appendix A2. An outline of which follows:

Part A

1. Preamble and Statement of Consent.
2. Respondents were asked to offer their level of experience (in years) with a list of 25 marine creatures. Options for response were: None; < 1 year; 1–5 years; 5–10 years; > 10 years.
3. Respondents were asked, with respect to the same list of 25 marine creatures, for their opinion on the proportion of landings that involved illegal-fishing practices in the past 12 months. Options for response were: None; Little; Less than half; More than half; Almost all; All.
4. Respondents were asked to select the subregion in which they worked from the following six options (see Figure 2.1):
    a. Gulf of Oman, Pakistan, West India, Arabian Sea and the Maldives
    b. Bay of Bengal, Andaman Sea, Malacca Strait
    c. Gulf of Thailand, South China Sea
    d. Arafura–Timor Sea, Banda Sea, Savu Sea
    e. Sulu–Celebes Sea, Sulawesi Sea, Makassar Strait, Halmahera Strait,
    f. East China Sea, Yellow Sea.

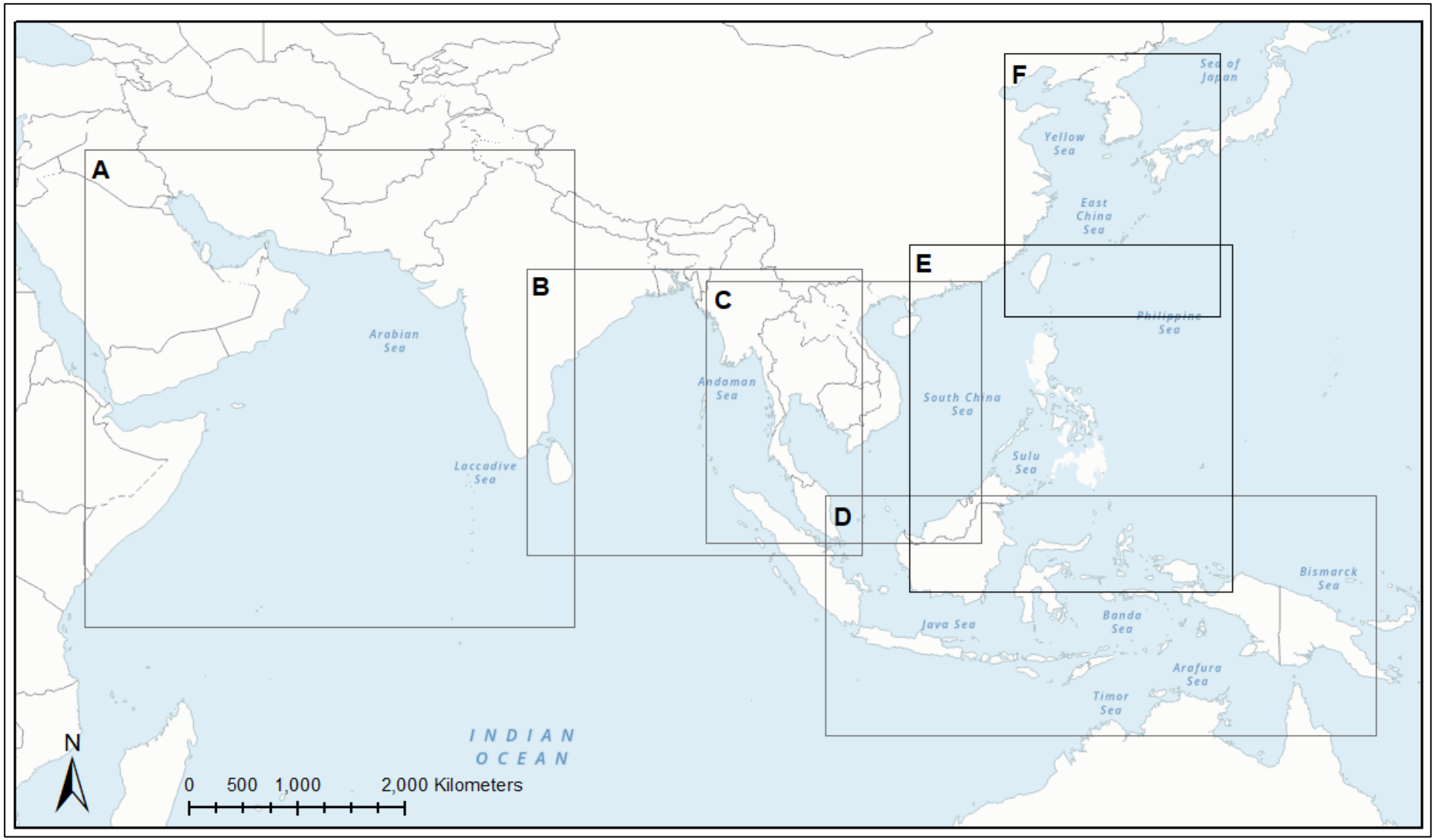

Figure 2.1: The APFIC area and APFIC member countries in the Asia-Pacific region divided into six specific subregions (see Table 2.1)

Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021). **Note:** Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

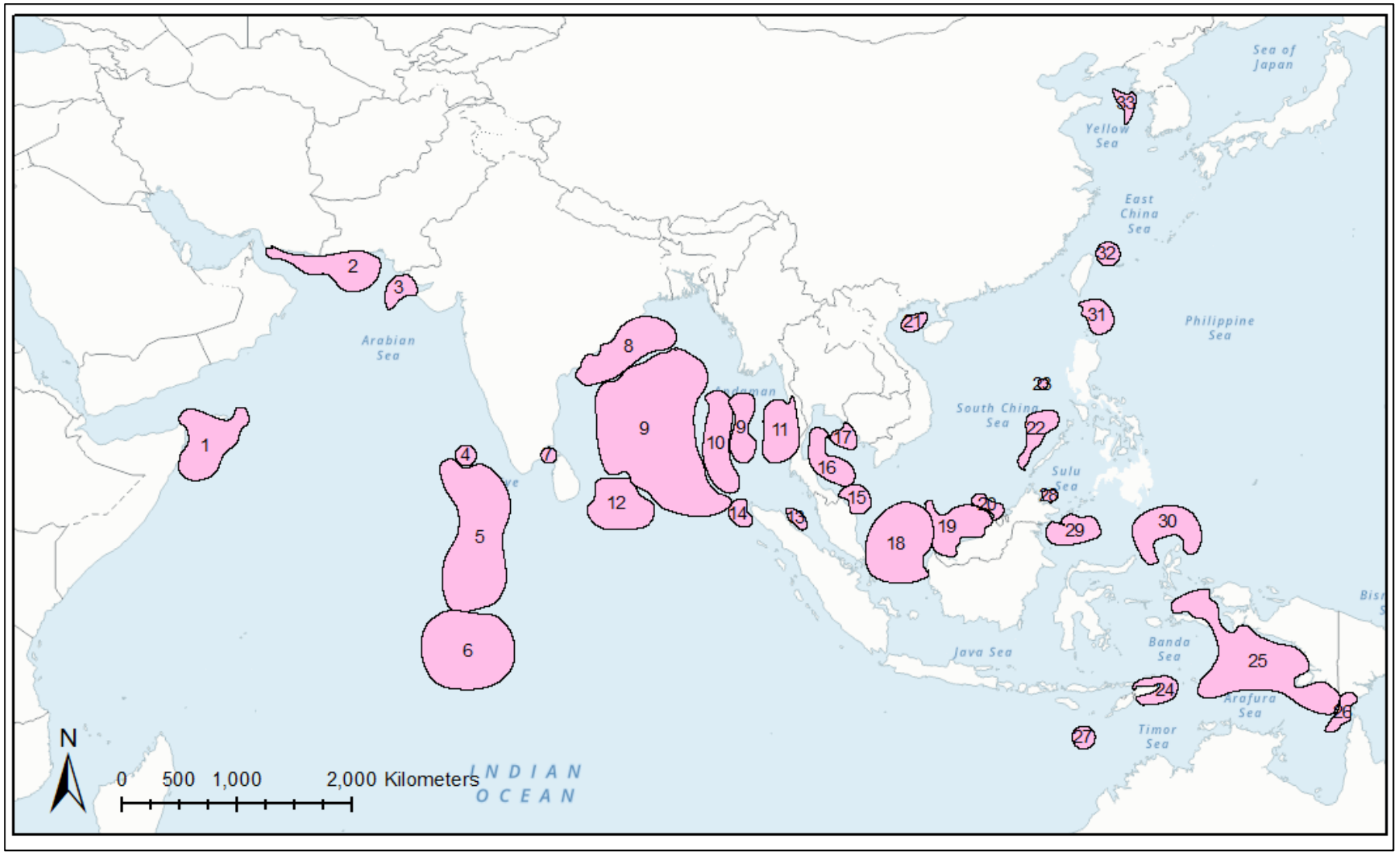

Figure 2.2: Approximate location of hotspots identified in the APFIC 2015 assessment of illegal fishing (Numbering is identified in Table 2.5)
Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021). **Note:** Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.
Source: Redrawn from FAO, 2016a

5. Respondents were then shown a map of their selected regions and asked to click on the map to designate areas which they believed were 'hotspot' areas for illegal fishing. Respondents could select from 1 up to 20 locations within the designated area as a hotspot.
6. Subsequently, respondents were shown a map of the hotspots in that region (Figure 2.2), identified in the unpublished 2015 FAO report (FAO, 2016a), and asked to score each hotspot as 'no' longer a hotspot, 'yes', still a hotspot or 'unsure'.

Part B

The questions in the second component of the survey focused on a set of three species specific to the chosen region, as well as a fourth species of the respondent's choice. Three species were preselected for each region based on FAO capture data from 2018 (FAO, 2018a) as well as species that were noted in the 2015 report as target species for that region (FAO, 2016a).

Species-specific questions included:

1. Respondents' experience with fishing and illegal activity for each of the four species. Respondents were provided with options on whether they had seen something, had read or heard about something or had no experience with the species;

2. Respondent's perception of the impact of illegal fishing on the four focal species, by ranking 1 to 4 (specifically "In your opinion, please rank these four species/seafood types from most (1) to least (4) impacted by illegal fishing activity");

3. Percentage of landings of each species that were thought to be involved in illegal activity in their country (using a slider bar);

4. Respondent to choose the relative probability of small-scale versus industrial fishing operations for involvement in illegal fishing for each of the four focal species;

5. Respondent to state the relative frequency of breaches for small-scale and industrial fishing for each of the following infractions (Never/Sometimes/Mostly/Always):
    a. Encroachment
    b. Breach of licence conditions
    c. Non-compliant gear
    d. Illegal transhipment
    e. Premeditated activity;

6. Which of the following regulations were breached: national regulations; bilateral agreements; FAO Compliance Agreement, CITES Agreement or UN Straddling Stocks Agreement; Not sure;

7. Which of the entities in the supply chain were involved in the illegal activity? Options provided to respondents were Fishers, Purchasers, Processors, Wholesalers, Exporters and Restaurateurs. Respondents could choose any number;

8. Respondents were asked to rank in order where they believed most illegally caught fish ended up:
    a. Local markets
    b. National markets
    c. Neighbouring markets
    d. International markets further afield

9. Respondents were asked to rank the following infrastructure in terms of the likelihood of its involvement in illegal-fishing activities:
    a. Markets
    b. Refrigerated trucks
    c. Exporters
    d. Transhipping boats
    e. Processing plants
    f. Fishing boats
    g. Restaurants

Part C

In the final part of the survey, respondents were offered a text box in which they were invited to add any further information which they felt was relevant or important to include.

All respondents were also given the opportunity to record their names and contact details if they were willing to be contacted for further discussion.

2.2 Survey distribution and responses

The survey was created on the online QuestionPro© platform which allowed a single link to be circulated to all participants, enabling truly anonymous responses.

The survey was introduced by FAO to representatives in 15 APFIC countries in July 2019. The research team followed up within one week to provide the same representatives further information about the project as well as a direct link to the anonymous online survey. The e-mail clearly stated that all representatives were receiving an identical link to the survey, demonstrating the anonymity of the survey. In the introductory e-mail, the research team indicated clearly that all respondents and their responses would be kept completely confidential. It was further stated that only collective responses would be provided to the APFIC Secretariat to help steer the implementation of a roadmap for the assessment of illegal fishing.

Representatives were asked to share the survey link “with all relevant officers who have knowledge of fishing activities in your jurisdiction.”

Subsequent to the initial e-mail (sent in July 2019), multiple reminder e-mail requests were sent to the identified point of contact for each country. Representatives also received a one-page project fact sheet, and a letter of support from FAO. They were further reminded via e-mail that the survey could be translated into their preferred language (it was only available in English initially). Despite receiving no requests for a translated version, the survey was translated into Khmer, Thai, Bahasa Indonesia and Vietnamese. When the translated versions became available online, an additional reminder was sent to all representatives with advice that the survey was now available in five languages.

A list of country contacts who were approached requesting assistance in circulating the link to the online survey is provided in Appendix A.2.

As of 25 March 2020, 45 responses had been obtained; subregion representation is given in Table 2.1.

Table 2.1: Responses to the survey by APFIC subregion

SUBREGION	SUBREGION DESCRIPTION	NUMBER OF RESPONSES
A	Gulf of Oman, Arabian Sea and the Maldives	1
B	Bay of Bengal, Andaman Sea, Gulf of Thailand	7
C	Gulf of Thailand, South China Sea	22
D	Arafura–Timor Sea, Banda Sea, Savu Sea	11
E	Sulu-Celebes Sea, Sulawesi Sea, Makassar Strait, Halmahera Strait	4
F	East China Sea, Yellow Sea	0
		45

Source: Current study.

2.3 Survey analysis and results

2.3.1 Controlling the quality of responses

The quality of answers by respondents in online surveys is often a concern. Respondents may not understand questions, may suffer from survey fatigue, lack of engagement or respond differently in cases where they have little knowledge or experience (Dillman *et al.,* 2009). It is challenging to detect engagement by respondents in fact-finding, although a number of metrics have been developed that are intended to detect the quality of responses.

Two metrics were used in this study. The first utilized a question which appeared at the beginning of each focal species section. This question (*question B.2* in Section 2.1, Survey design), asked the respondents to rank the level of illegality affecting each of the four focal species. These responses should correspond to the relative ranks of the scores for those four species from the scores for illegal landings across the initial list of 25 species (*question A.3* in Section 2.1).

The Spearman rank correlation among the ranks for each of the four focal species across these two questions was calculated. Positive correlations indicated concordance between the initial scores for the level of illegality and the rankings provided for the four focal species, indicative of a high-quality response. Negative scores indicated a lack of concordance, and potentially a lower quality response. Rank order correlations have an issue with ties between rankings; to address this, ranks were randomly assigned in the case of ties and the subsequent correlations were calculated. The randomized tie-breaking process was repeated 100 times, with the analysis based on the mean value of the ranks across the randomized values.

The rank correlation is also undefined when scores for one of the variables is the same across species. As the level of illegal landings in *question A.3* uses intervals, it was possible to have more than one of the focal cases with the same score. At the extreme, it was plausible that all four of the focal species might have had the same score. Given this issue, respondents were only downweighted as having incoherent responses when the respondent had a negative Spearman rank correlation, and if all the scores for the focal species were different. If both conditions were met, the respondent was given a consistency weight of 0; if that was not true, a weight of 1 was given.

The second metric of quality used was whether there was variation in scoring by the respondents across the levels of illegal landings for the 25 species in *question A.3*. If a respondent gave the same scores for every species, it was assumed that she/he was not engaged with the survey, and thus the answers should be downweighted with respect to other respondents. This is termed ‘respondent care’, in contrast to the consistency metric described above. This was captured by assigning a weight of 1 to respondents for whom answers differed across the species, while those with constant answers were given a weight of 0.

2.3.2 Predicting levels of illegal landings

A Bayesian cumulative multinomial logit model was used to analyse the responses with respect to the level of illegal landings occurring within species, using Bayesian ordinal mixed models (Bürkner, 2018) in the R statistical language (R Core Team, 2018). These models are designed to analyse data in which responses are broken into categories, where the categories have a natural order (such as few, some, many). The model included a random intercept term for the respondent, along with fixed effects for species, experience and region. The inclusive model was compared to simplified models, including only one or two fixed effects terms, along with a null model which assumed all scores shared a single average value. Models were compared using leave-one-out cross validation, as implemented in the R statistical language (R Core Team, 2018). All models included a random effect for the respondent.

All models incorporated a regression weight for each response, which represented the quality of that response and thus the importance that should be given to that observation in survey data analysis. The metrics developed for respondent coherence and care were used, as described above, to represent the quality of a respondent's answers. The two metrics were then combined using their sum: thus, the combined weights could range from 0 to 2. These combined weights were incorporated into the Bayesian cumulative multinomial logit model as regression weights on the observations. This equated to giving each data point an increased or decreased effect on the overall likelihood in the model, with a weight of 2 making a data point twice as influential on the likelihood as one with a weight of 1.

The comparison of models for standardizing the estimated illegal landings across the 25 species based on cross-validation suggested that the best model for the analysis included experience with the species and the species effect, but not the region (Table 2.2). This suggested that species that were landed illegally were fairly similar across regions. There was potentially also some effect of the small sample size in a few regions. Region A had only a single response, while region E had only four responses (Table 2.1), which would make it challenging to estimate differences unless those regions differed markedly in the level or species composition of species affected by illegal landings. However, the region-only model had no more predictive power than a null model, which assumed all scores were the same across species, suggesting that overall scores differed minimally across regions.

Table 2.2: Rankings of possible models for species scores by fisheries officers from survey *question A.3*. The estimated difference is the difference in the ability of the model to predict observations in a cross-validation, as compared with the ability of the best model. The best predictive model is listed in the first row and hence has a difference of 0 in comparison with itself. The standard errors provide a measure of how well the difference is estimated, with a 95 percent confidence interval corresponding to 1.96 times the standard error

MODEL	ESTIMATED DIFFERENCE	STANDARD ERROR
Species + experience	0	0
Species + experience + region	-0.32	0.6
Experience + region	-13	12
Experience	-13	12
Species + region	-16	10
Species	-17	10
Null	-33	15
Region	-33	15

Source: Current study

Based on the best-fitting regression model, which included a term for species, one for experience, a random effect for the respondent and a regression weight for response quality, it was possible to estimate the differential levels of illegal landings across species. Figure 2.3 shows the predicted category of illegal

landings for each species in *question A.3*. These predictions were based on the marginal value predicted for each species, with the experience set at its mean (2.85) across all observations. The model gives the probability of each of the possible levels of illegal landings that a respondent could choose in *question A.3*: 1) none; 2) little; 3) less than half; 4) more than half; 5) almost all; or 6) all. The error bars in Figure 2.3 show the boundaries of the 25th and 75th percentiles of the posterior distributions around the parameter estimates.

In general, the most common category for illegal landings across species groups was 'little', followed by 'less than half'. There were no species groups that were most likely to have 'none' of the landings illegal. Shark species were ranked as having the highest level of illegal landings across all taxa, with snail species (*Trochus* spp.) having the lowest estimated levels. Longtail tuna, albacore tuna and mackerel also had notably higher predicted illegal landings in comparison with most of the other species. The most likely level of illegal landings for shark species was less than half of the total, but there was more than a 1 in 5 chance (0.2 probability) that more than half of the sharks landed were illegal (Figure 2.3). Ten of the species had more than a 1 in 10 chance (0.1 probability) of more than half of their landings being illegal.

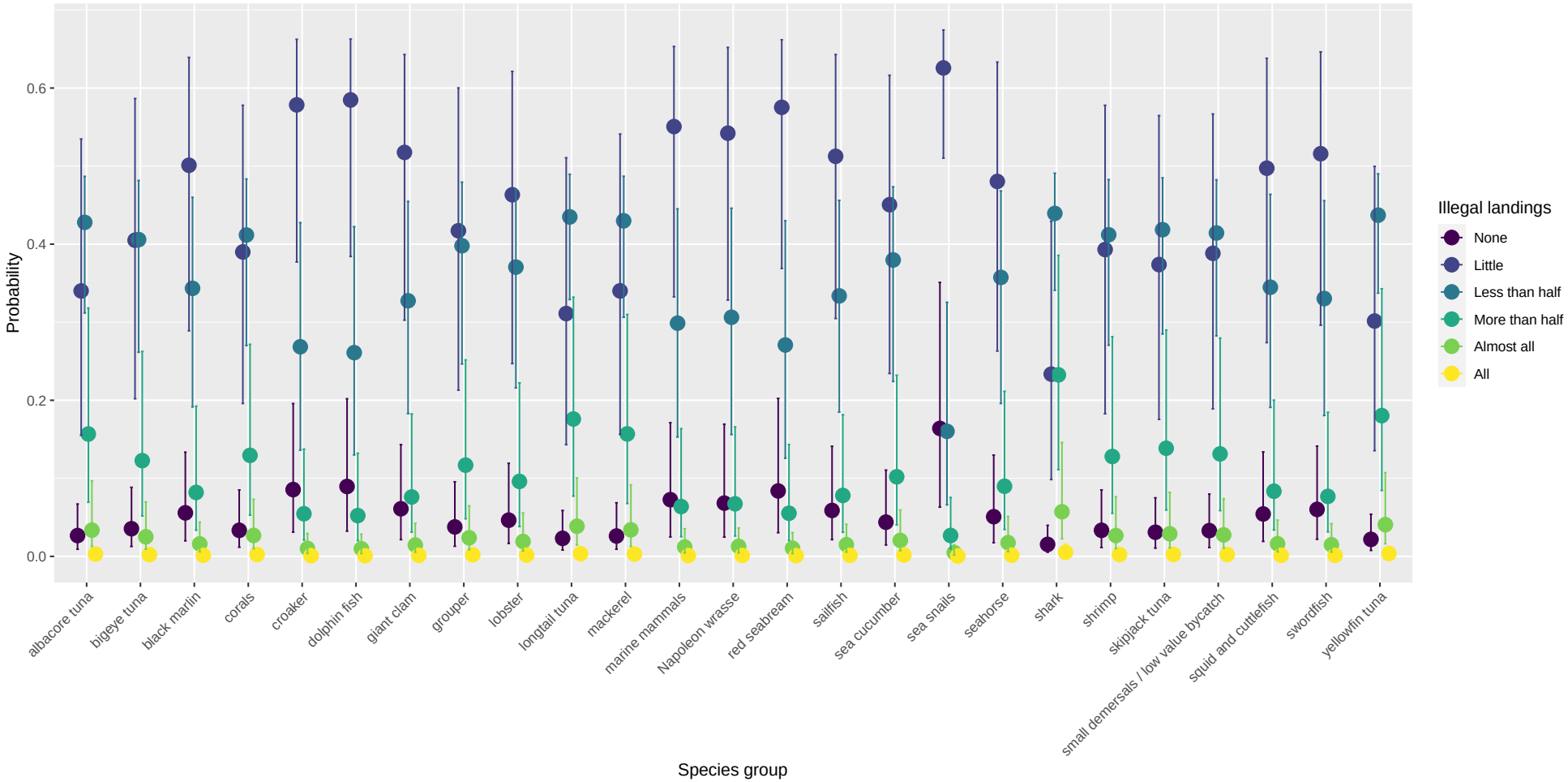

Figure 2.3: Predicted category of illegal landings for each species in *question A.3*. These predictions were based on the best-fitting statistical model for the responses. This model was used to standardize the survey data for experience, survey quality and respondent bias; it then predicted the consensus estimates for the probability of each frequency category for illegal landings for each species. Overall, the category probabilities summed to one and can be directly compared within and across species

Source: Current study.

The responses to *question A.3* were semiquantitative as one can interpret the categories as having numerical intervals. Using set notation, where "("signifies an inclusive boundary and "[" an exclusive boundary, one can write out the categories of illegal landings from *question A.3* as none: [0,0], little: (0,a), less than half: [a,0.5), more than half: (0.5,b), almost all: [b,1), and all: [1,1]. Here, it was assumed a lower boundary was generally inclusive and that the fixed values at either end were inclusive. Given this structure, one can then express the categories as numerical intervals. One challenge was that the value *a*, which is the boundary between category 2, 'little', and 3, 'less than half' was not known. Similarly, the value *b*, which defines the boundary between categories 4, 'more than half' and 5, 'almost all', was also unknown.

To estimate the values *a* and *b*, advantage was taken of the fact that the focal species questions included a question in which respondents were asked to estimate the level of illegal landings in their countries in percentages (*question B.3*). The percentages for these focal species were regressed onto the categorical scores for the same species from *question A.3*. This allowed for the connection of the values in the categories with unknown boundaries with the percentages scored for those same species by the same respondent. Using the fitted model from this relationship, the percentages were then predicted that would correspond to each category. *Question B.3* asked for these percentages by respondent country and thus it would be ideal to include a country effect in the model. It was intended to do this via the Internet protocol address associated with each survey. However, as response rates by countries were low and most responses came from respondents at a workshop in Kuala Lumpur in which participants came from several countries across the region, it was not possible to include this effect.

The estimated percentages of illegal landings in respondents' home countries were an underestimate of the levels of illegal landings they thought occurred across all species in *question A.3* (Figure 2.3). While the categories in *question A.3* ranged from 0 percent to 100 percent, respondents gave lower percentages for the same species based on landings in their home countries. Based on this, the scores from *question A.3* would benefit from an adjustment to represent the downward adjusted values.

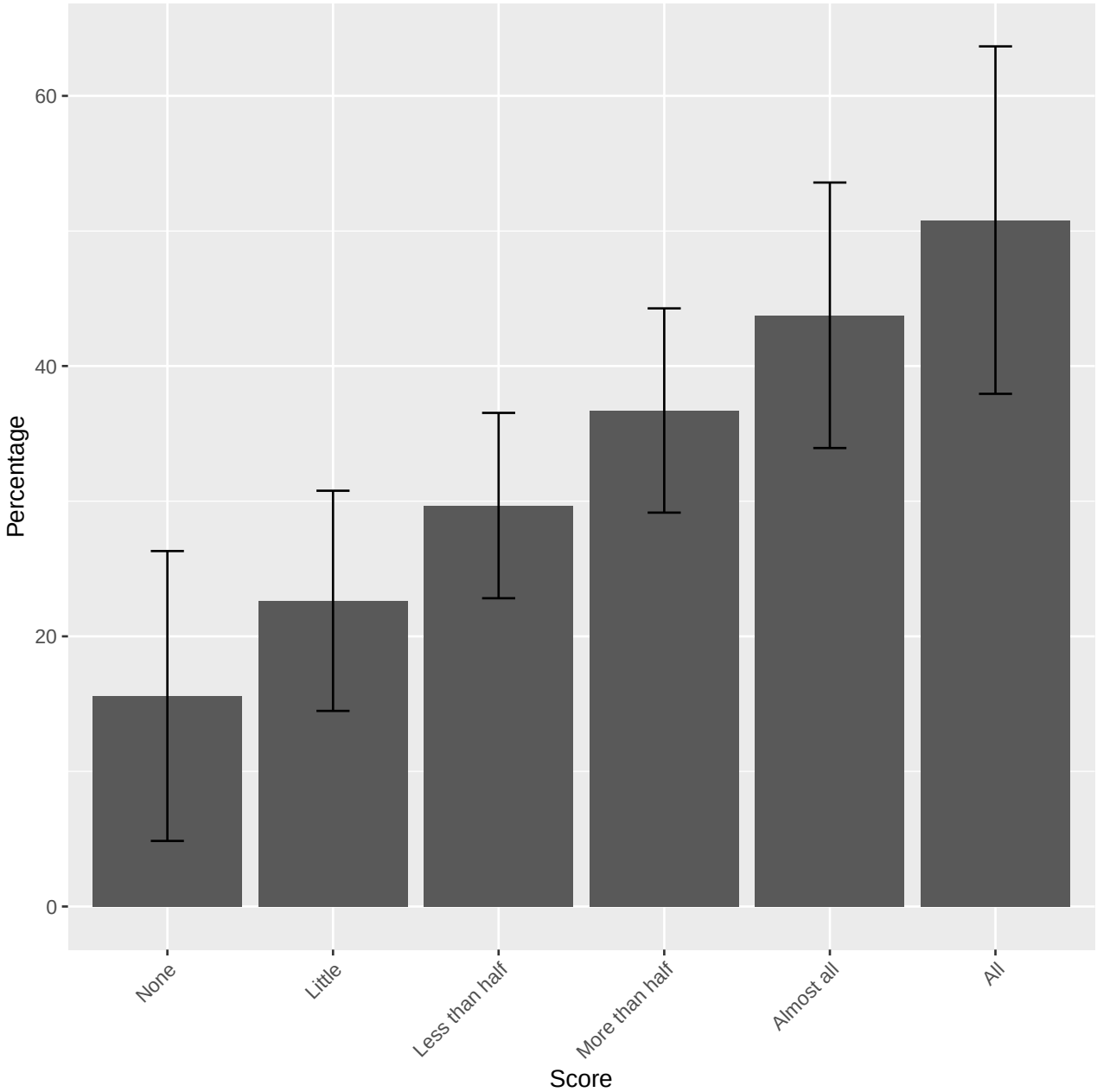

Figure 2.4: Standardized percentage values for focal species associated with categories for levels of illegal landings from the survey. Scores were taken from *question A.3*, while focal species percentages were taken from *question B.3.* Error bars show 95 percent confidence intervals. Bars show the expected value of the percentage of landings that were illegal, with error bars showing the standard errors in the estimated values

Source: Current study

2.4 Estimated illegal catches and catch values

Catch of each species by country and FAO major fishing area were extracted from the FAO Global Production Statistics (FAO, 2020b) and allocated to each of the six regions in Section 2.2. The major fishing areas were not perfectly aligned with the six regions of interest, with areas C, D and E also overlapping to some extent. As a result, the mapping of the catch from the larger FAO fishing areas to the smaller regions of interest was not absolutely precise. As the catch data only extended to 2017, values for 2018 and 2019 were extrapolated using linear regression using the data over the period 2010 to 2017.

Catch value is the product of catch volume and the unit price. Price information was collected from several sources (Appendix A5). Estimates of producer prices were available for many of the species from the *SEAFDEC Fishery Statistical Bulletin of Southeast Asia 2018* (SEAFDEC, 2020) and earlier issues, covering the period 2010 to 2017. For the catch of most other species, prices were derived from the FAO Fisheries Trade Statistics (FAO, 2020b), again covering the period 2010 to 2017. These were export prices, and *a priori,* would be expected to be higher than producer prices. A comparison of the export price and producer price for overlapping species suggested that this difference was generally less than 10 percent (and in some cases the reported producer prices were marginally higher than the derived export prices). For other species that could not be identified from these two sources, a range of other sources was used, including online wholesale prices and, for some species, prices reported in other reports. Estimated catch of this last group of species, however, contributed only a small proportion of the total catch and catch value. Details of these sources by species are given in Appendix A5. For the time series where prices were only available up to 2017, values for 2018 and 2019 were again extrapolated using linear regression using the data over the period 2010 to 2017. All prices were converted to US dollars and to 2019 real values based on the US Consumer Price Index (CPI).

The quantity of illegal catch was estimated based on the reported catch in each area of each species and the average percentage of total catch that was believed to be illegal was based on the scores provided by the survey respondents and the interpretation of these scores (Figure 2.4). The value of this catch was estimated by multiplying the quantity of the catch of each species by its price.

The estimated level of illegal catch in 2019 and its value is given in Table 2.3. The relative standard error (RSE) in Table 2.3 was derived as the standard error of the estimate expressed as a percentage of the mean. Information for subregion F could not be derived as no survey responses were received relating to this area. For the remaining five subregions, the total estimated illegal catch was around 6.6 MT, with an estimated value of USD 23.3 billion.

Table 2.3: Estimated quantity and value of illegal fishing by subregion, 2019. In general, one can assume that the 95 percent confidence interval on an estimate such as the quantities or values shown here was 1.96 times the standard error. Thus, a 10 percent RSE translates to a 95 percent confidence interval on the estimate that is approximately 19.6 percent of the value of the estimate

ZONE	SUBREGION DESCRIPTION	QUANTITY ('000 TONNES)		VALUE (USD MILLION)	
		MEAN	**RSE (%)**	**MEAN**	**RSE (%)**
A	Gulf of Oman, Arabian Sea, the Maldives	742.9	14	2 848.1	14
B	Bay of Bengal, Andaman Sea, the Gulf of Thailand	1 363.2	11	4 921.3	11
C	Gulf of Thailand, South China Sea	1 548.0	13	5 497.8	13
D	Arafura–Timor Sea, Banda Sea, Savu Sea	2 572.3	10	8 880.3	10
E	Sulu–Celebes Sea, Sulawesi Sea, Makassar Strait, Halmahera Strait	423.2	16	1 129.5	17
F	East China Sea, Yellow Sea	NA	NA	NA	NA

Source: Current study.

For comparison, FAO (2016a) estimated IUU catches in the 33 regional hotspots to be in the range of 2.0 MT to 2.5 MT in 2015, with an estimated value of USD 3.1 billion to USD 5.2 billion (equivalent to USD 3.3 billion to USD 5.5 billion in 2019 values based on the US CPI). Differences between the estimates may reflect difference in area considered (e.g. hotspots compared to the total region) and catch composition across the different areas resulting in differences in the average price received. Sumaila *et al.* (2020) estimated a total annual illegal and unreported catch of between 3.6 MT and 6.6 MT in the Asian region based on data covering the period 2005 to 2014, with a value ranging from USD 3.8 billion to USD 7.5 billion. While the magnitude of the catch is similar, the implicit price used by Sumaila *et al.* (2020) (averaging USD 1.05/kg to USD 1.13/kg) is substantially lower than the prices used in this study (averaging USD 3.50/kg), accounting for the differences in the value of illegal fishing. As noted above, prices used in this study were based on producer prices for key species, and export prices for most other species, with these export prices being found to be close to reported producer prices where a comparison could be made.

The estimate of illegal-landing volumes and values made by the BOBLME (2015) study covered 13 of the APFIC member countries (excluding Australia, China, France, Japan, Nepal, New Zealand, Republic of Korea, the United Kingdom and the United States) over the period 1990 to 2013. For the 13 APFIC members included in the study, it was estimated that 2.8 MT to 8.8 MT of fish were caught illegally each year, based on averages over the term of the study. For the 13 APFIC member countries covered by the study these catches translated into an average value of USD 3.5 billion to USD 11.5 billion in illegal catches annually (BOBLME, 2015).

Table 2.4: Estimated quantity and value of illegal fishing by species, 2019. In general, one can assume that the 95 percent confidence interval on an estimate such as the quantities or values shown here is 1.96 times the standard error. Thus, a 10 percent RSE translates to a 95 percent confidence interval on the estimate that is approximately 19.6 percent of the value of the estimate

SPECIES	QUANTITY ('000 TONNES)		VALUE (USD MILLION)	
	MEAN	**RSE (%)**	**MEAN**	**RSE (%)**
Fish	3 892.9	12	12 651.8	12
Shrimps	497.2	11	4 619.0	11
Squid	445.0	12	1 597.7	12
Mackerel	624.8	11	756.0	11
Skipjack tuna	484.7	12	668.9	12
Croakers	100.8	11	546.4	11
Yellowfin tuna	230.0	10	536.0	10
Shark	83.7	9	483.9	9
Groupers	82.7	10	307.5	10
Bigeye tuna	67.8	11	270.4	11
Lobsters	5.6	10	204.7	10
Sea cucumber	3.5	9	167.7	9
Longtail tuna	79.0	10	154.1	10
Napoleon wrasse	4.4	11	138.5	11
Dolphinfish	8.8	11	47.6	11
Albacore	17.3	15	38.5	15
Swordfish	7.9	13	36.9	13
Sea snails	0.9	15	35.2	15
Sailfish	8.4	13	10.8	13
Marlin	4.3	13	5.6	13

Source: Current study

As with the estimates by Sumaila *et al.* (2020), the volumes calculated in this study are approximately equivalent. However, the values estimated by the BOBLME study were roughly one-third of the estimates provided by this study. This is likely due in part to the BOBLME study using annual prices for the period 1990 to 2013, as opposed to inflation-adjusted prices. In addition, prices used for the various catch categories may be the source of some of the difference in the value estimates. The BOBLME study did not provide data on the prices used, aside from noting that their value of 'mixed catch' was USD 0.9/kg. However, using the average volume and value of illegal landings by country provided in the report, the mean price per kilogram was USD 1.71 across the 17 countries in the study, roughly half the price used in this study (USD 3.50/kg). Thus, adjusting the values for inflation and reflecting more accurate pricing data would bring the BOBLME estimates in line with the ones made in this study.

In terms of which species were contributing most to illegal fishing, non-specific fish species (i.e. all fish species other than those that had been identified individually) contributed over half of the volume and around one-third of the value of illegal catch in the region (Table 2.4).

In contrast, high-value species – such as Napoleon wrasse, sea cucumber and sea snails – contributed only a relatively small proportion to overall illegal fishing. Individually, the tuna species represented relatively small proportions of the total illegal catch in the region, but combined, represented over USD 1.6 billion in total value.

2.5 Change in hotspots since 2015

Table 2.5 shows the raw scores from each of the respondents for changes in status of hotspots that were identified in 2015, based on *question A.4* in Section 2.1. The number of responses ranged from 0 to 19 across hotspots, depending on the number of respondents selecting a particular region, and the proportion of respondents that chose to score a particular hotspot zone.

Table 2.5: Respondents' evaluation of current illegal activity in known hotspots from 2015. The map of hotspots from 2015 is shown in Figure 2.2. The map is based on the 2015 FAO study of illegal fishing hotspots across the APFIC region (FAO, 2016a)

ZONE	HOTSPOT	NUNBER RESPONSES	YES, STILL A HOTSPOT	NO LONGER A HOTSPOT	NOT SURE
Zone 1	SOMALIA AND YEMEN EEZ	1	0	1	0
Zone 2	EEZ BOUNDARIES BETWEEN PAKISTAN & ISLAMIC REPUBLIC OF IRAN	1	1	0	0
Zone 3	EEZ BOUNDARY BETWEEN PAKISTAN AND INDIA	1	1	0	0
Zone 4	LAKSHADWEEP ISLANDS (INDIA'S EEZ)	1	1	0	0
Zone 5	MALDIVES EEZ	1	1	0	0
Zone 6	CHAGOS ARCHIPELAGO	1	1	0	0
Zone 7	PALK BAY (WITHIN SRI LANKA'S EEZ)	1	0	0	1
Zone 11	ANDHRA PRADESH AND ORISSA STATES (WITHIN INDIA'S EEZ)	3	3	0	0
Zone 15	TUNA LOP VESSELS IN BAY OF BENGAL (WITHIN INDIA'S EEZ)	18	8	5	5
Zone 16	ANDAMAN AND NICOBAR ISLANDS (WITHIN INDIA'S EEZ)	19	4	6	9
Zone 17	MYANMAR EEZ (SOUTHERN WATERS BORDERING THAILAND)	19	8	3	8
Zone 18	TUNA LONGLINING AND TRANSSHIPMENT IN THE BAY OF BENGAL	18	9	4	5
Zone 19	MALACCA STRAIT (THAILAND, MALAYSIA AND INDONESIAN EEZs)	18	8	3	7
Zone 20	WEST COAST SUMATRA (INDONESIAN EEZ)	19	10	3	6
Zone 21	MALAYSIAN EEZ (NORTHEAST COAST PENINSULAR MALAYSIA)	18	4	2	12
Zone 22	GULF OF THAILAND (THAI EEZ)	18	3	2	13
Zone 23	CAMBODIAN EEZ	18	2	1	15
Zone 24	NATUNA SEA (WITHIN THE INDONESIAN EEZ)	5	3	0	2
Zone 25	SARAWAK (WITHIN MALAYSIA EEZ)	3	1	1	1
Zone 26	BRUNEI DARUSSALAAM EEZ	5	4	0	1
Zone 27	GULF OF TONKIN/BEIBU GULF	4	3	0	1
Zone 28	PALAWAN (WITHIN PHILIPPINES EEZ)	4	3	0	1
Zone 29	SCARBOROUGH SHOAL	3	1	0	2
Zone 30	TIMOR-LESTE EEZ	3	1	0	2
Zone 31	ARAFURA SEA (INDONESIAN EEZ)	4	1	0	3
Zone 32	PAPUA NEW GUINEA EEZ ('DOG LEG')	0	NA	NA	NA
Zone 33	ASHMORE REEF, SCOTT REEF, CARTIER ISL. (WITHIN AUSTRALIAN EEZ)	0	NA	NA	NA

Source: FAO (2016a).

A Bayesian regression model, with a random effect for each respondent and a regression weight for respondent quality as described in Section 2.3.2, was used to build a model of the scores for the change in hotspots since 2015. In the analysis the scores were treated as an ordinal variable, with the ordering 'no',

'unsure', 'yes'. In essence, it was assumed that unsure responses were agnostic in the choice between 'no' and 'yes'. Using this analysis, the most likely value of the change across all respondents was predicted, as shown in Table 2.6. Uncertainty around this response was also quantified, represented by using the lower 25th and upper 75th quantiles for the responses. These values bound the central 50 percent of the total probability of the responses, based on samples from the posterior predictive distributions from the model.

Table 2.6: Estimated change in hotspots since 2015

ZONE	NUMBER OF RESPONSES	CONSENSUS RESPONSE	LOWER 25TH QUARTILE	UPPER 75TH QUARTILE
Zone 1	1	No	No	Unsure
Zone 2	1	Yes	Yes	Yes
Zone 3	1	Yes	Yes	Yes
Zone 4	1	Yes	Yes	Yes
Zone 5	1	Yes	Yes	Yes
Zone 6	1	Yes	Yes	Yes
Zone 7	1	Unsure	Unsure	Yes
Zone 8	3	Yes	Unsure	Yes
Zone 9a	4	Yes	Yes	Yes
Zone 9b	3	Yes	Unsure	Yes
Zone 10	3	Yes	Unsure	Yes
Zone 11	5	Yes	Unsure	Yes
Zone 12	2	Unsure	Unsure	Yes
Zone 13	2	Unsure	Unsure	Yes
Zone 14	2	Unsure	Unsure	Yes
Zone 15	18	Unsure	Unsure	Yes
Zone 16	19	Unsure	Unsure	Unsure
Zone 17	20	Unsure	Unsure	Yes
Zone 18	18	Unsure	Unsure	Yes
Zone 19	18	Unsure	Unsure	Yes
Zone 20	19	Unsure	Unsure	Yes
Zone 21	18	Unsure	Unsure	Unsure
Zone 22	18	Unsure	Unsure	Unsure
Zone 23	18	Unsure	Unsure	Unsure
Zone 24	10	Yes	Unsure	Yes
Zone 25	6	Unsure	Unsure	Unsure
Zone 26	6	Yes	Yes	Yes
Zone 27	8	Yes	Unsure	Yes
Zone 28	4	Yes	Unsure	Yes
Zone 29	3	Unsure	Unsure	Yes
Zone 30	3	Unsure	Unsure	Yes
Zone 31	4	Unsure	Unsure	Yes

Source: Current study

Based on the analysis, 14 of the 31 locations identified in 2015 were predicted to remain hotspots in 2020. Only one hotspot (Zone 1) near the mouth of the Red Sea, was no longer thought to be a hotspot. The uncertainty around these estimates typically touches on the adjoining category, for instance the range for a

typical ‘yes’ answer was ‘unsure’ to ‘yes’. None of the zones had broader uncertainties. Given this, the remaining 16 zones for which it was possible to estimate scores had values lying between ‘unsure’ and ‘yes’, but the range around the estimates did not include ‘no’, suggesting that these 16 zones also remained hotspots potentially. As alluded to in Section 2.4, there were no responses for zones 32 and 33, and thus it was impossible to provide scores for these locations.

2.6 New hotspots identified

Prior to scoring previously identified hotspots, respondents were asked to identify up to 20 areas they believed to be hotspots by selecting locations on a dynamic version of the map for the region they chose (question A5, Section 2.1, or see Appendix A2). The number of locations selected by respondents varied from 1 to 20, the maximum permitted in the survey. The responses by fishery officers can most easily be visualized using a map of the locations selected by the respondents (Figure 2.5).

Comparing the selected regions with the map of previously identified hotspots in Figure 2.2, it can be seen that the unprompted locations selected by the respondents generally reflected those identified in 2015, with some notable new locations. In Figure 2.5, the very northern boundary of the Bay of Bengal, in particular along the Bangladesh coast and near the border with India was new. Similarly, the coastal region near Myanmar, along with the Gulf of Martaban, south of Yangon was not included in the 2015 estimates. The Gulf of Thailand and surrounding regions largely reflected the estimates from 2015, with zones 17 to 20 (Figure 2.2) frequently selected. However, respondents also highlighted the region off the coast of Viet Nam and the eastern end of the Malaysian EEZ north of Sabah Province, which were not highlighted in the 2015 study. Areas in the contested waters of the South China Sea were also highlighted, which had not been included in the previous estimates. The Sulu Sea largely reflected past estimates (zones 22 and 23, and 28 through 30, Figure 2.2), although respondents selected areas in the interior seas of the Philippines which had not been highlighted previously, including in the Bohol and Visayan seas. No points were selected in the areas around zones 32 and 33. However, no respondents selected this zone for scoring with regard to changes in its status as a hotspot. Thus, lack of selection should not be interpreted as a change in this case, due to low numbers of responses in that region. Areas in the South China Sea and Yellow Sea which had not previously been highlighted were selected, but again, there was only a single respondent for this region, so these locations should be interpreted cautiously. All the locations highlighted in 2015 in the southern portion of the APFIC region (zones 18 to 20, and 25 to 29) were again identified by respondents as being illegal-fishing hotspots. In addition, the northern Java Sea, near the southern coast of Kalimantan, Indonesia, and the high seas region north of Papua New Guinea and south of the Federated States of Micronesia were also identified as hotspots. Overall, the very high ranking of the regions in the Arafura, Timor and Banda seas likely reflects illegal-fishing-related activity in that region, but also potentially the concentration of a larger number of selections by respondents in this region.

There are several important caveats to keep in mind when evaluating Figure 2.5. First, the number of respondents varied significantly across regions. For instance, only a single respondent selected the Arabian Sea region (Figure 2.1, Region A) and the Philippine Sea (Figure 2.1, Region E) in the survey, as shown in Table 2.1. Second, respondents were able to select locations of their choosing, thus they could either spread their responses, or concentrate them in a single area. Third, respondents could select different numbers of locations. Thus, some respondents might have felt a single location was more important than others and selected that one, while other respondents might have represented the same pattern by putting up to 20 points near that area. Conversely, if a respondent spread selections geographically, that could indicate that one of the points was equivalent to a single point selected by another respondent. As an illustration of some of these issues, while the region near Timor-Leste, at the intersection of the Arafura, Timor and Banda seas was frequently selected in the map, this strongly highlighted area may in fact be similar to the northern Bay of Bengal, given that there were just over half as many respondents for the Bay of Bengal (Table 2.1).

To address these issues, we used a Poisson Point Process (PPP) model to estimate the distribution of selected locations across respondents (Youngman and Economou, 2020). The PPP model assumed that

there was an underlying process by which events, in this case selections of a location, occurred. The observations in the PPP model were the locations of the selections. In this case equal weight was assigned to each respondent, distributed evenly across all of the locations selected by that respondent.

Using this approach, if a respondent clicked many times in a close vicinity, this would have yielded a similar result to a respondent only providing one selection in that location but selecting no other points. This was a key feature in being able to address the fact that the number of selected locations varied between respondents, from 1 up to 20, with some respondents concentrating all their selections in a single area while others spread them more widely. All respondents in a given region were assumed to share an underlying spatial distribution of illegal-fishing occurrence. The analysis required at least two respondents to fit the model, otherwise there was no advantage over just using the direct observations.

Figure 2.6 shows the inferred surfaces from each of the PPP models. The numbers in the legends give the logarithm of the expected number of selections by respondents in any given location. A value of just over 1 suggested that a respondent should be expected to submit three selections in a location. A value of 3 suggested that a respondent should be expected to submit 20 selections in a given location. A value of less than 1 suggested that respondents on average would not select a location. The modelled selection rates from the PPP model only covered a subset of the total region, as the results displayed above were bounded by a bounding box on the latitude and longitude range of the locations that were selected by respondents.

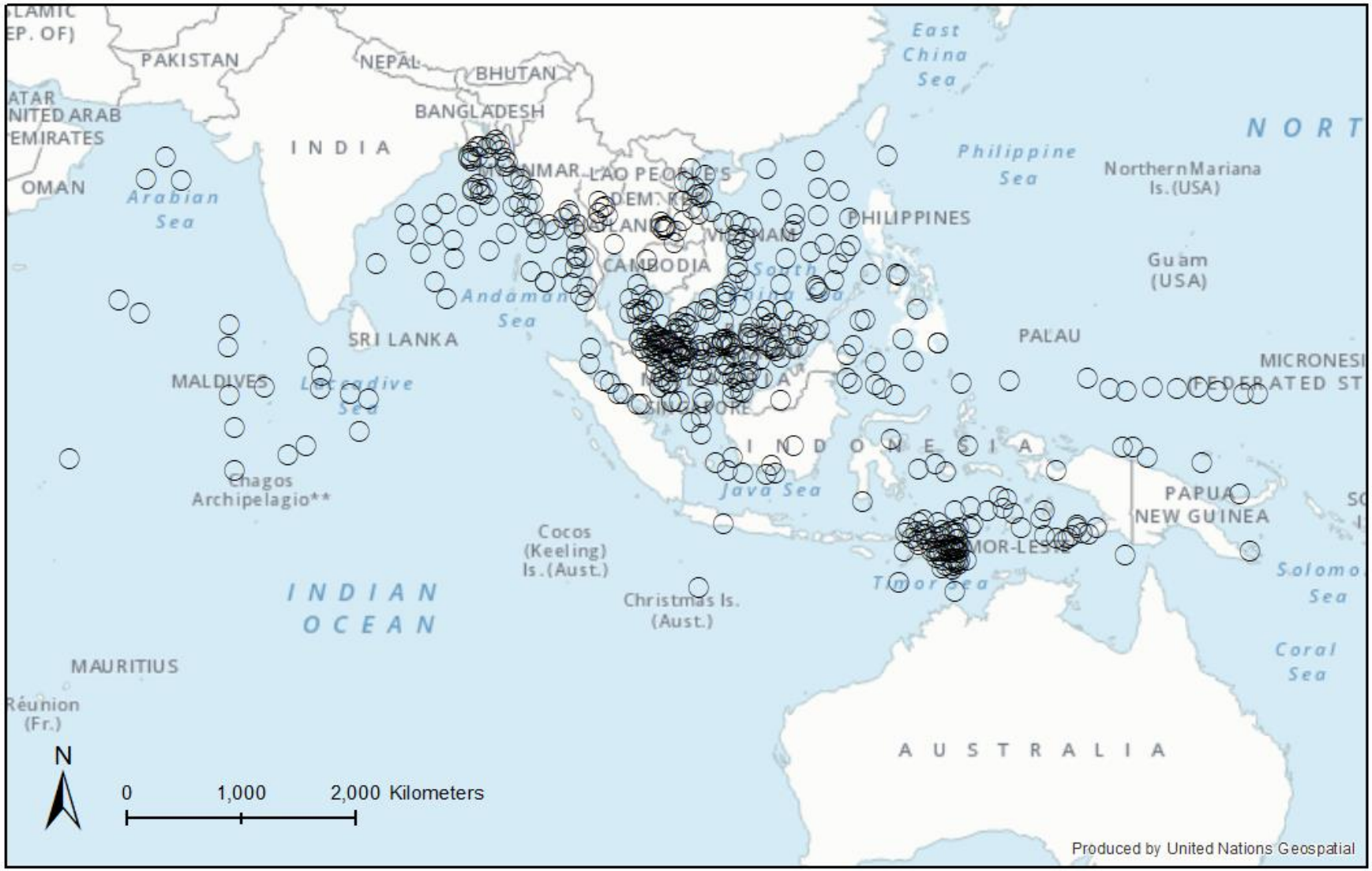

Figure 2.5: Hotspots identified in the regions of the APFIC area of competence and adjoining areas
Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021)

Comparing the standardized intensities (Figure 2.6) with the raw data (Figure 2.5) suggests a reinterpretation of the data. The southern portion of the Bay of Bengal appears to be much more likely to be selected across respondents than the raw data would suggest. Similarly, the South China Sea region along the EEZ boundary of Viet Nam appears to have much higher levels of illegal-fishing-related activity than the map of the raw data for the region might suggest.

The model for the region around the Philippines matches relatively closely to the raw data, due to a relatively consistent number and location of selections across respondents in that region. The standardized locations are notably different from the pattern in the raw data for Region D, stretching across the southern boundary of the 'APFIC area' (Figure 2.5; Panel D, Figure 2.6).

The very highly selected region in the lower central portion of the map (Panel D, Figure 2.6) of the raw data was downweighted significantly, likely due to many selections by relatively few individuals. In comparison, the eastern portion of the Celebes Sea, with North Sulawesi and North Maluku to the south and the Philippines to the north was highlighted as being relatively more likely to be selected.

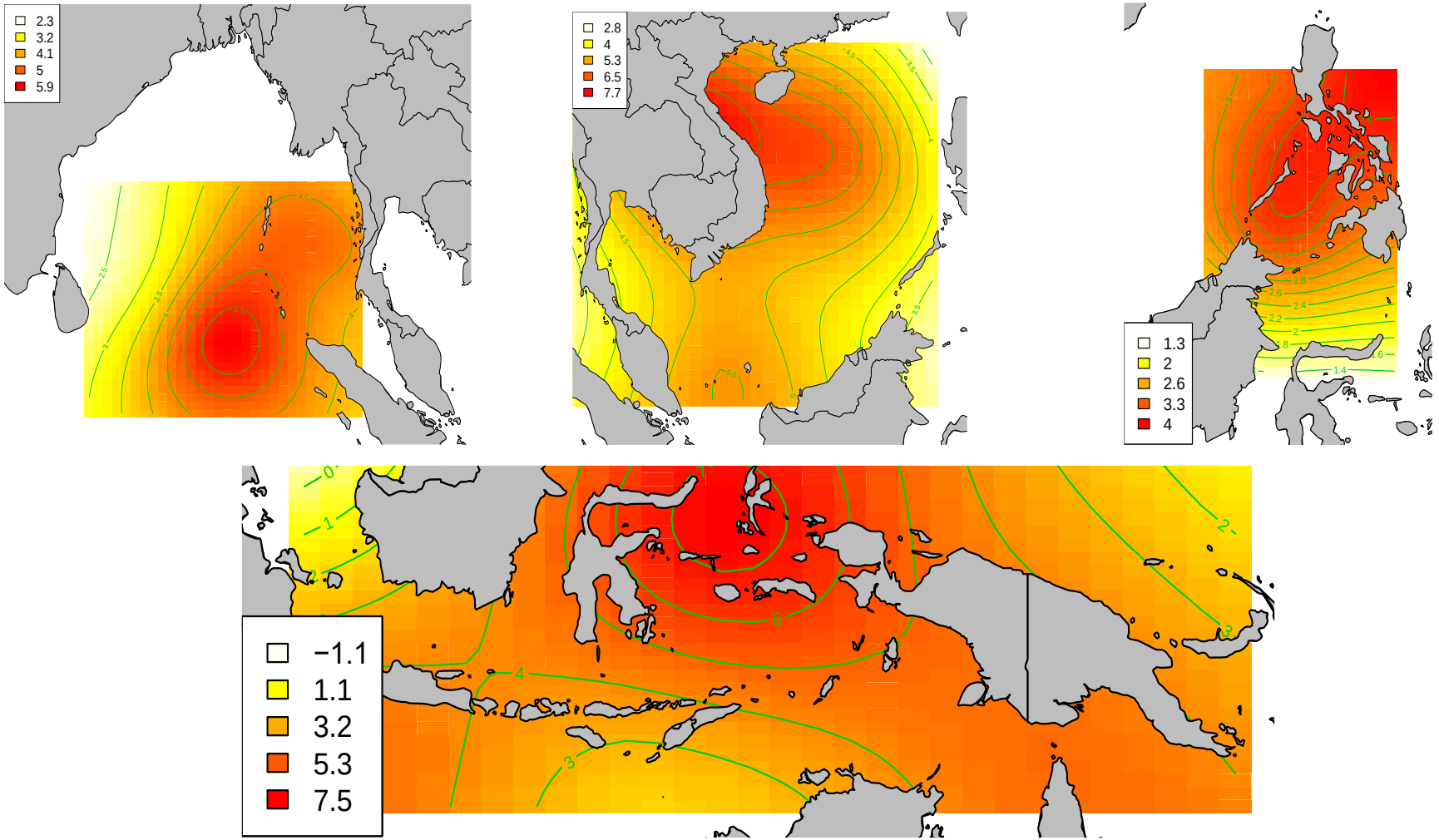

Figure 2.6: Estimated intensity of illegal-fishing-related activity across respondents. Legends show the natural logarithm of the expected number of respondents who would select a location

Map source: FAO, 2021. Conforms to Map No. 4170 Rev. 18.1 UNITED NATIONS (February 2020).
Source: Current study.

One challenge with the results in Figure 2.6 is that it is difficult to draw inference across the entire set of respondents. Regions used in the survey overlapped in some cases, and while standardizing within a survey region is useful to be able to see the pattern, it does not leverage the overlapping data across the regions. In order to address this issue, respondents across all the sampled regions were aggregated and the PPP model was refitted to the full dataset. Figure 2.7 shows the predicted pattern of illegal-fishing-related activity across all respondents. As in the figures above, the value in the legend is the logarithm of the rate in the PPP, which equates to the mean in any given location. Values less than 1 equate to an area not being selected, while 1 equates to an area being selected on average three times, and 3 the same area being selected 20 times, by a typical respondent.

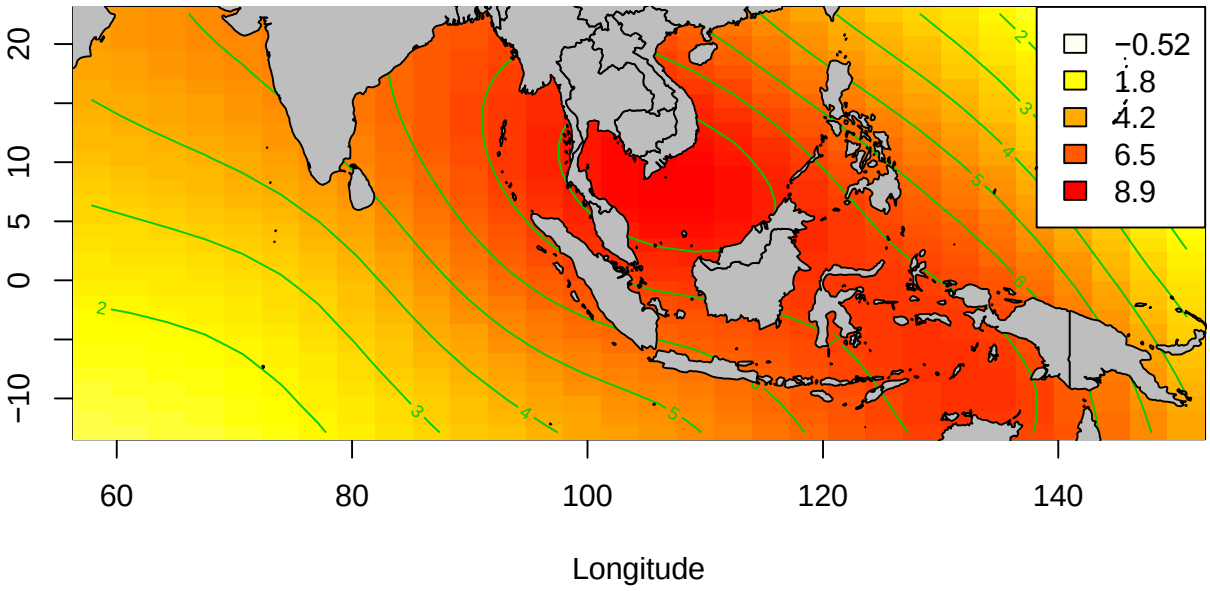

Figure 2.7: Intensity of illegal-fishing-related activity across all survey respondent data. The legend shows the natural logarithm of the expected number of selections by respondents in a location

Map source: FAO, 2021. Conforms to Map No. 4170 Rev. 18.1 UNITED NATIONS (February 2020)
Source: Current study.

The overall pattern across the aggregated regions is similar to the region by region estimates (Figure 2.6, Figure 2.7). The region between the Celebes Sea, the Gulf of Thailand and the western edge of the South China Sea has the highest level of predicted illegal-fishing activity. The southwestern portion of the Bay of Bengal remains relatively high, with similar levels to the other elevated regions. The Java Sea conversely is relatively low.

These maps should be interpreted with caution in areas where there were few respondents. They do include all the responses from each region, as shown in Table 2.1. However, there was only a single response in the Gulf of Oman (Figure 2.1, Region A) and no responses in the East China Sea/Yellow Sea (Figure 2.1, Region F). Similarly, the maps and the models that underlie them ignore a number of important features that could be included. For instance, incorporating variables such as proximity to international borders, proximity to disputed areas and other relevant features would likely improve the models, and thus make the resulting maps more informative. However, to date, the analysis is limited by the number of survey responses. Higher response rates, and a more even coverage of responses across the 'APFIC area' would likely allow significant improvement in the analysis.

2.7 Focal species

All survey respondents were presented with three species that were relevant for the region they selected and asked a number of detailed questions around illegal fishing for each of these species. They were also asked to nominate a fourth species for inclusion in these questions (see Section 2.1, Part B). The preselected focal species included in the questionnaire varied by region and were selected based on their importance as commercial species in terms of volume and value, and relevance for illegal fishing in the region based on the unpublished 2015 APFIC study (FAO, 2016a). The preselected focal species chosen per region are shown in Table 2.7.

The fourth focal species chosen by survey respondents, to add to the three preselections, varied widely across respondents, with a range of species having four or fewer nominations. Parentheses in Table 2.8 give the number of times respondents nominated a species, in cases where it was a preselected focal species in other regions, but not in the region for which they were responding.

Table 2.7: Focal species presented to respondents for each geographical subregion

ZONE	SUBREGION DESCRIPTION	FOCAL SPECIES
A	Gulf of Oman, Arabian Sea, the Maldives	Indian mackerel Skipjack tuna Croakers/drums
B	Bay of Bengal, Andaman Sea, Gulf of Thailand	Indian mackerel Skipjack tuna Croakers/drums
C	Gulf of Thailand, South China Sea	Indian mackerel Skipjack tuna Shark species
D	Arafura–Timor Sea, Banda Sea, Savu Sea	Yellowfin tuna Skipjack tuna Shark species
E	Sulu–Celebes Sea, Sulawesi Sea, Makassar Strait, Halmahera Strait	Yellowfin tuna Albacore tuna Shark species
F	East China Sea, Yellow Sea	Shrimps Skipjack tuna Groupers

Source: Current study

Table 2.8: Total selections of focal species

FOCAL SPECIES	NUMBER OF SELECTIONS
Indian mackerel	39 (1)
Yellowfin tuna	48 (8)
Skipjack tuna	43 (2)
Shark species	39 (1)
Marine mammals	4
Small demersal species/low-value bycatch	4
Corals	3
Squid and cuttlefish	3
Albacore tuna	2
Bigeye tuna	2
Groupers	2
Longtail tuna	2
Black marlin	1
Giant clams	1
Napoleon wrasse	1
Sailfish	1
Sea cucumbers	1
Seahorses	1
Swordfish	1
Croakers/drums	0
Dorado/dolphinfish	0
Lobsters	0
Red seabream	0
Sea snails	0
Shrimps	0

Source: Current study

The frequency of nominations for particular species provides some information on expected illegal-fishing-related activity for those species. For instance, neither shrimps nor lobsters were nominated, suggesting that perceived illegal fishing has relatively less impact on those species across the region. In contrast, yellowfin tuna was the most frequently nominated, followed by mammals and small demersal species, suggesting impacts might be higher for those species groups.

It is worth noting that the selections do no imply whether the species or group is the target for the fishing or a by-product group. Thus, the small demersal species/low-value bycatch category could be a mix of targeted demersal species and bycatch during trawling operations. However, in practice, it is likely that most of the species are either targets or part of a mixed species target.

After selecting a fourth species or group, respondents then provided information for each of these focal species across a set of questions including the basis of their knowledge, the relative ranking of the species

in terms of illegal-fishing impact, the percentage of landings that involved illegal activity, the relative role of small- and large-scale vessels, the types of breaches of regulations, the administrative level of the relevant regulations, the entities involved in the breaches, the infrastructure used in the illegal activities and the market the product was destined for (see *questions B1* to *B9*, Section 2.1). Here an analysis of a selected set of these responses is provided, including the level of illegal landings, the administrative level of regulations violated, entities participating in the illegal activity and the frequency of different types of violations. In each case the estimates were based on standardized values, accounting for respondent bias and quality.

In general, region-specific estimates cannot be provided due to the low number of survey responses. Thus, all estimates are based on the responses across the full APFIC area of competence.

2.7.1 Perceived landings that involve illegal activity

Respondents were asked their opinion on what percentage of annual landings in their countries involved illegal activity (*question B.4* in Section 2.1 – see Appendix A2 for exact text). The results for six species are shown in Figure 2.8. These responses were standardized using a beta regression model (Brooks *et al.,* 2017), with a random effect for respondent bias and a regression weight to account for response quality, as described in Section 2.3.1. After a model selection process based on Akaike Information Criteria, the best model for the data was used to standardize the responses.

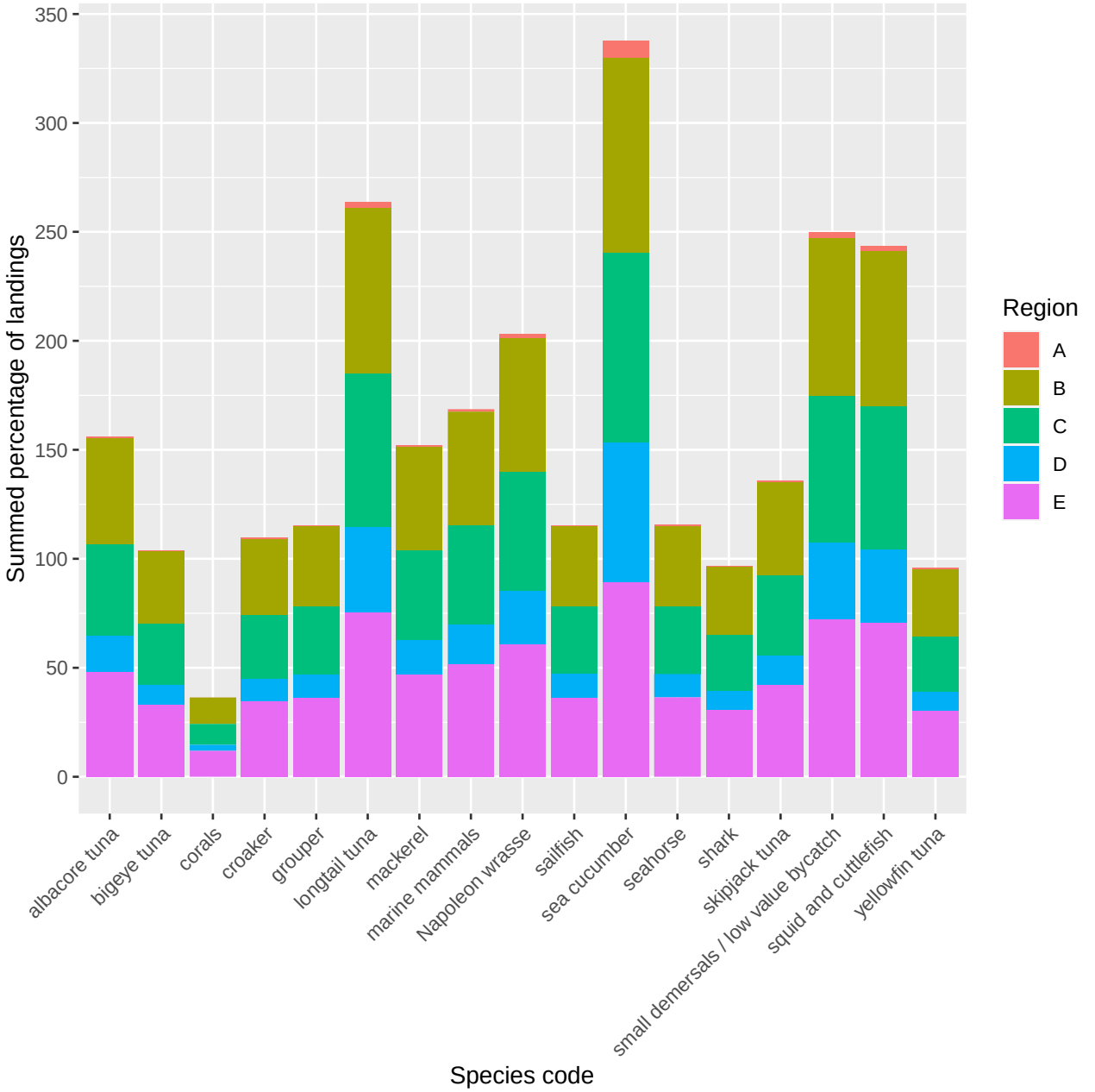

Figure 2.8: Perceived percentage of landings that involve illegal activity for 4 focal species in each region. The sample sizes for each species are shown in Table 2.8. The bar colours correspond to the region specified by the respondent in the survey (Figure 2.1). Coloured sections of the bars represent the percentage of landings in each region and thus are each bounded between 0 and 100. For example, if all regions had 100 percent illegal landings, the corresponding bar for that species would be 500 percent high

Source: Current study.

The final model used to standardize the responses included terms for the respondent's knowledge of illegal fishing with respect to the species, the region they were responding for and the species for which they provided scores (Wood, 2017). Figure 2.8 shows the standardized percentage of landings thought to be illegal for the species including both pre-identified and nominated species.

Species varied widely in the proportion of their landings that were predicted to be illegal. Sea cucumber (bêche-de-mer) was by far predicted to have the highest proportion of illegal landings across regions. Regions differed significantly in the predicted percentage of illegal landings across species, with Region A (Western Indian Ocean) having substantially lower levels than the other regions, followed by Region D (Arafura, Timor, Banda and Savu seas). Region E (Sulu–Celebes, Sulawesi seas, Makassar and Halmahera Straits), Region C (Gulf of Thailand and South China Sea) and Region B (Bay of Bengal, Andaman Sea, Malacca Strait) were predicted to have much higher levels, increasing slightly from Region E to Region C and reaching a maximum in Region B. There were not enough survey responses to allow modelling of the interaction among regions and species, and thus the differences for a species across regions were only partially captured here.

Predictions for regions and species with relatively few observations should be treated with caution. The score respondents gave for knowledge (*question B.1*, Section 2.1) was important to include in the model. This was sometimes omitted by respondents for the number of initial observations by region and the species was further reduced (Table 2.1, Table 2.8). Region A was based on only four responses, which were the least of any region, and some species, notably longtail tuna, sea cucumber, seahorse, sailfish and Napoleon wrasse, depended on a single response.

2.7.2 Frequency of contravention of regulations at different levels

Respondents were asked to select which level(s) of regulation they believed were being violated, for the focal species they nominated, across national regulations, bilateral agreements or international conventions (see *question B.6*, Section 2.1 or Appendix A2 for exact text). Using a logistic regression model, the pattern for the type of regulation breached across all of the focal species was evaluated, including the pre-identified and the respondent-nominated ones. This analysis included the effect of respondent knowledge of the species, the identity of the species, the type of violation and an interaction term between species and type of violation. Bias among respondents was accounted for using a random intercept term and responses from each respondent were weighted according to the quality, as outlined in Section 2.3.1. Respondent knowledge had relatively little effect on the distribution of responses and was frequently missing from the data, thus it was excluded from the final analysis model.

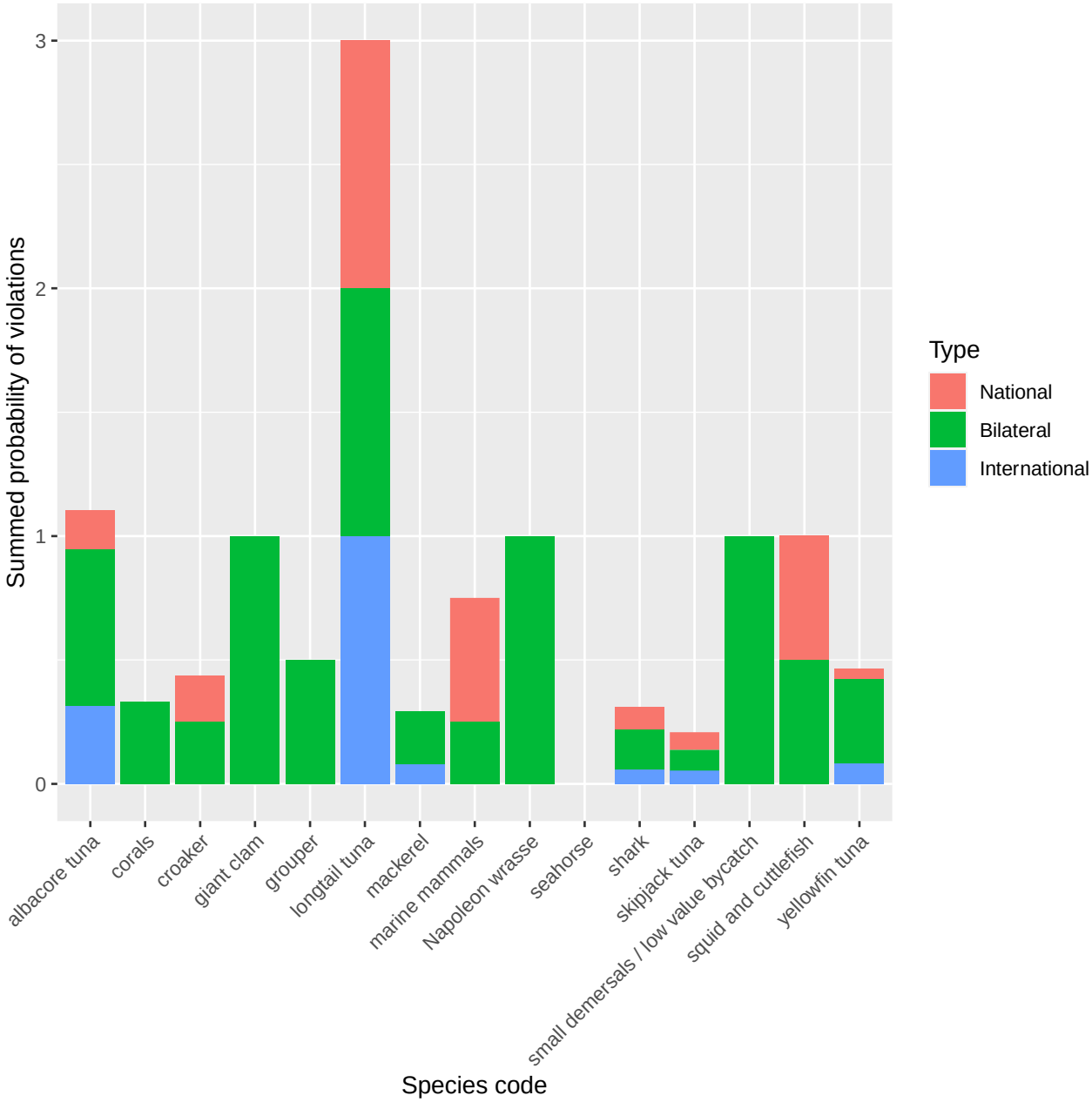

Figure 2.9: Probability of violation of regulations at national, bilateral and international levels. The bar colours correspond to the level of regulation. Examples of regulation might include area restrictions at the national scale, joint management area rules or access agreements at the bilateral level and RFMO conservation measures at the international level. Colour sections of the bars represent probabilities of violations and thus are each bounded between 0 and 1. The height of each bar overall shows the sum of these probabilities across the three regulatory levels. Thus, if the respondents expected regulations at all three levels to be consistently violated, the bar would have a summed probability of 3

Source: Current study

Figure 2.9 shows the frequency of violations for the species including both pre-identified and nominated species. Longtail tuna had the highest level of predicted violations across all regulatory structures. The most common type of violation across species was related to bilateral regulations. Relatively speaking, violations of international agreements were less common than those of national regulations. Some species such as seahorses had responses, but all respondents selected 'unsure' as the response, leading to inclusion of

their responses, but no information as to the relative frequency of contraventions across regulatory schemes.

2.7.3 Entities participating in illegal activity

Respondents were asked to select the entities in the supply chain that they believed were involved in illegal activity, including fishers, processors, purchasers, exporters, wholesalers and retailers (see *question B.7*, Section 2.1 or Appendix A2 for exact text). A similar logistic regression model to that used for *question B.7* was used, again incorporating knowledge, species and entities involved in illegal fishing, along with a random effect for respondents and a regression weight for the quality of response to standardize the responses across the entities involved. Figure 2.10 shows the predicted values across the focal species based on the fitted regression model.

In this case knowledge of the species, from *question B.1* (Section 2.1), had no statistical effect on the responses and thus was excluded from the statistical model. Respondents who gave a positive answer for at least one of the supply chain participants were considered to have provided negative answers for the remaining ones if they were left blank.

The results from the analysis model suggested that participation by various entities in the supply chain and the level of involvement for various species were independent. Thus, purchasers appeared to be the most common participants in illegal activities across all species. Similarly, particular species appeared to be largely illegal or legal. For instance, marine mammals tended to be illegal at all stages in the supply chain. While this may be obvious in the case of marine mammals, other species groups such as small demersal species and low-value bycatch, which could be legally caught or sold in some cases, also appeared to have relatively high illegality across the supply chain. Turning to the relative frequency of different supply chain players in terms of participation in the supply of illegal products, in order of increasing involvement with illegal products, the model suggested the order: fishers < exporters < wholesalers < retailers < processors << purchasers. Coefficients in the model suggested that there were effectively two groups in terms of participation in illegal activities. Purchasers, who were much more likely to be involved in illegal activities, versus the remaining entities, who were less likely to be involved and were relatively similar to each other.

A small number of species also appeared to be much more likely to be involved in illegal activities, including marine mammals, small demersals and bycatch, and squid and cuttlefish. Surprisingly, entities selected for sharks and seahorses came out as relatively less frequently involved in illegal activities. In the case of seahorses, this estimate depended on a single response for seahorses, and so might not be as reliable as other taxa with higher numbers of responses. However, in the case of sharks there were 39 responses, so the estimates should be more reliable. It may be that purchasers were commonly selected as participating in illegal activities in the case of sharks, and so there was not an overall high likelihood of all entities being selected for sharks, which would lead to a high shark estimate, but instead the effect showed up in the term for processors as they were particularly likely to be selected for sharks, but also for other species.

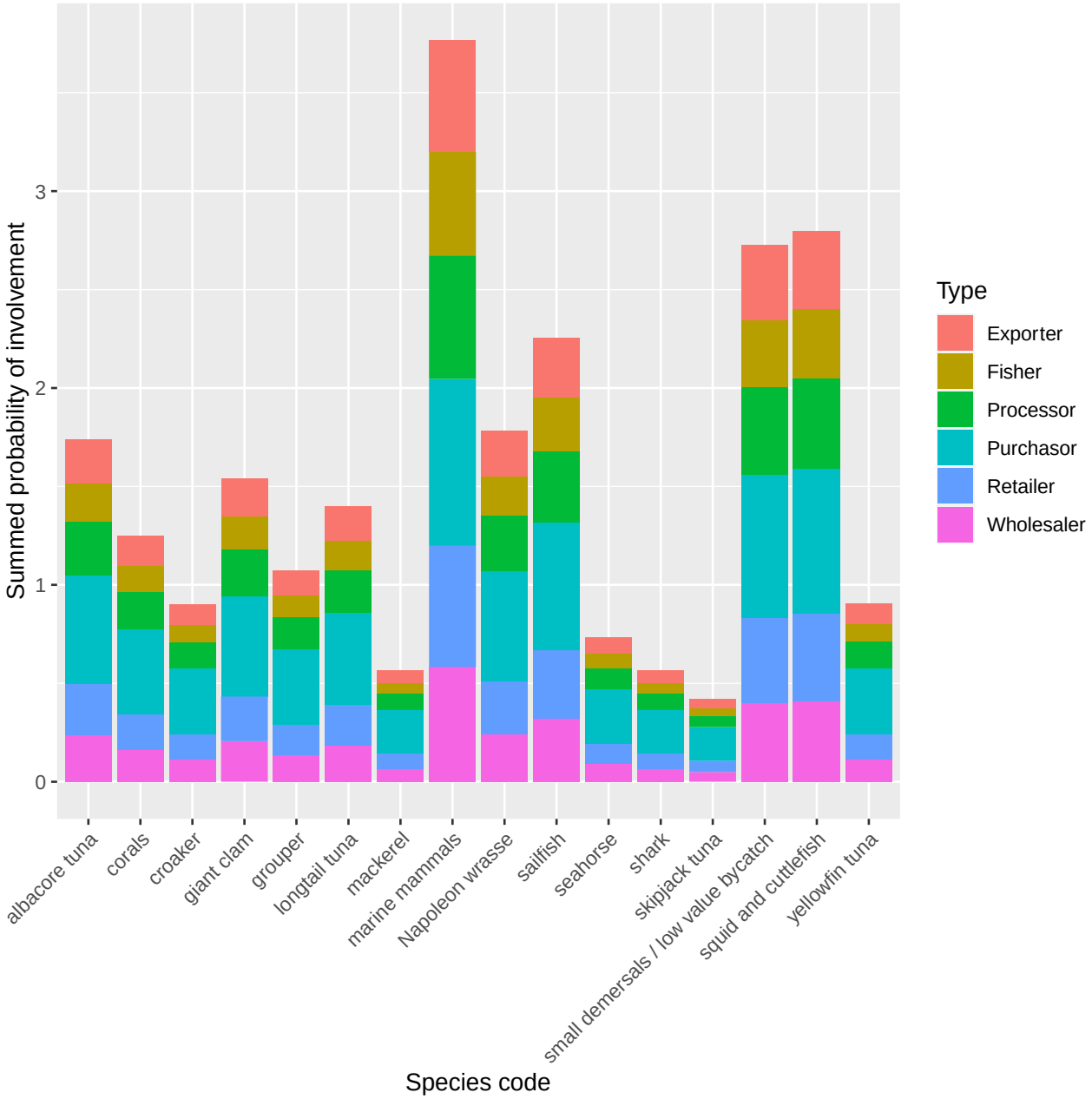

Figure 2.10: Probability of participation in illegal activities by different actors in the supply chain. Colour sections of the bars represent probabilities of participation by an entity and thus are each bounded between 0 and 1. The height of each bar overall shows the sum of these probabilities across the six entity types involved in the supply chain for a species. Thus, if the respondents expected consistent participation in illegal activities by all of the entities, the bar would have a summed probability of 6

Source: Current study

2.7.4 Frequency of different types of infractions

Respondents were asked to score the frequency of different types of infractions, according to the categories: 'Never', 'Sometimes', 'Mostly', or 'Always', for the focal species they nominated (see *question B.5*, Section 2.1 or Appendix A2 for exact text). This information was only collected for the respondent-nominated species in the survey but separated by small-scale and industrial vessels. The statistical model used to analyse these data was similar to the logistic regression models used above, however, knowledge,

infraction type, species and vessel class were all important in the model, along with the interaction between species and vessel class.

Figure 2.11 shows the frequencies predicted by the statistical model for small-scale vessels. Figure 2.12 shows the same information for industrial vessels.

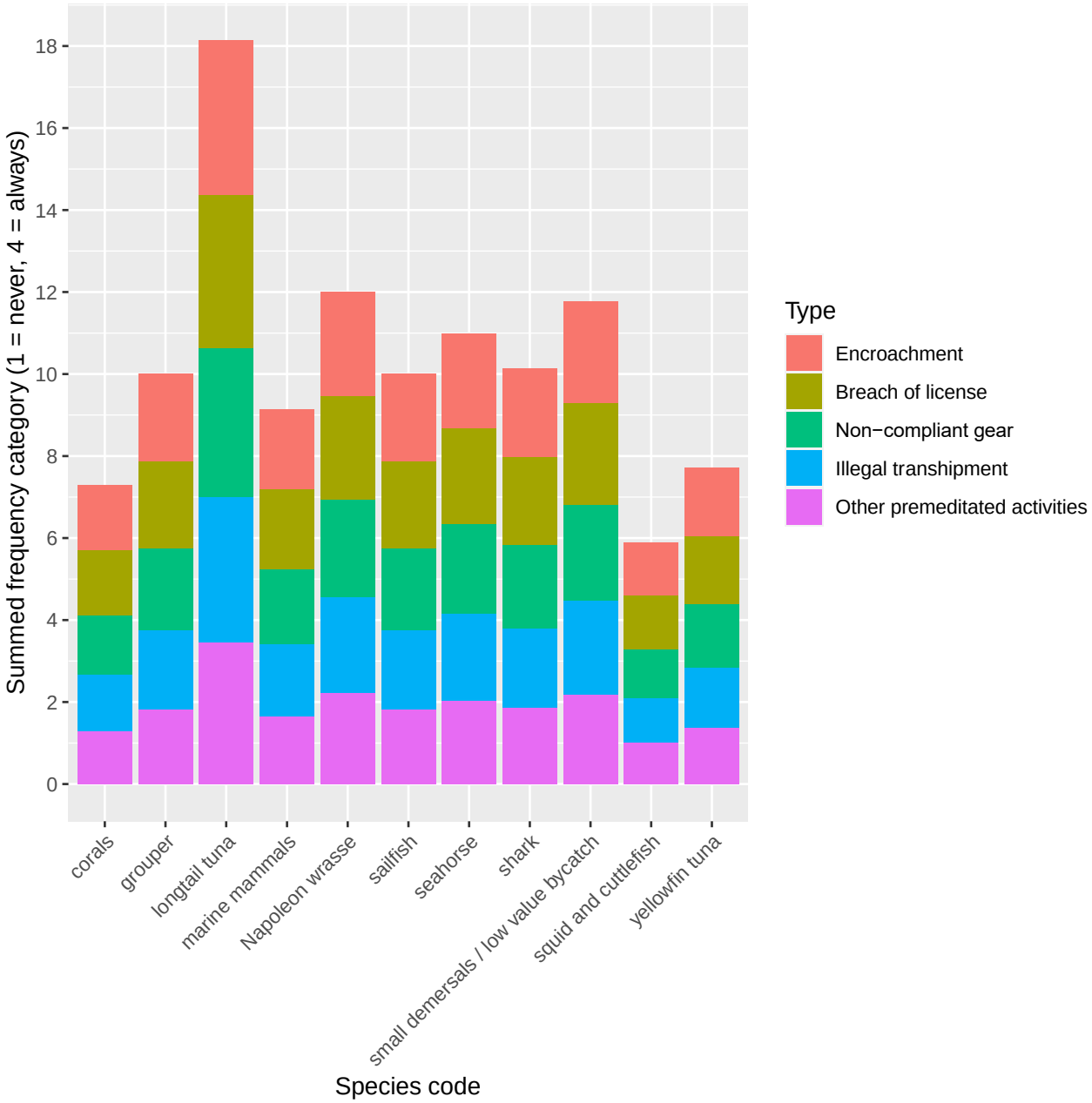

Figure 2.11: Frequency of different types of infractions by small-scale vessels (<12 m). Respondents scored frequencies as 1 of 4 levels, 1: 'Never', 2: 'Sometimes', 3: 'Mostly', 4: 'Always'. Colour sections of the bars represent the value of the participation scores and are thus each a value between 1 and 4. The height of each bar overall shows the sum of these scores across the five types of violation for a species/species grouping. Thus, if the respondents expected consistent violations of each type for a species, the bar would have a summed value of 20

Source: Current study

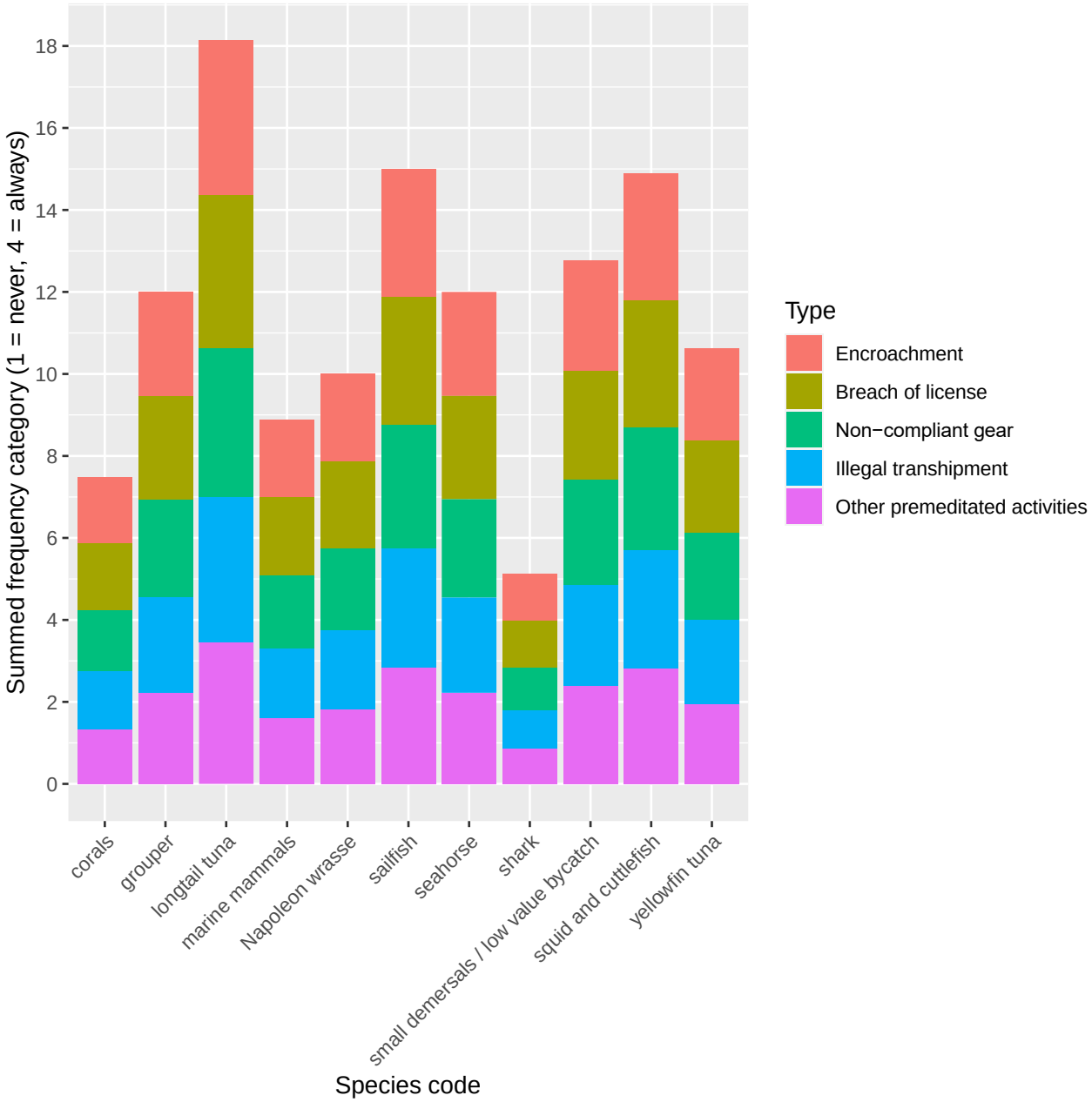

Figure 2.12: Frequency of different types of infractions by industrial vessels (<12 m). Respondents scored frequencies as 1 of 4 levels, 1: 'Never', 2: 'Sometimes', 3: 'Mostly', 4: 'Always'. Colour sections of the bars represent the value of the participation scores and are thus each a value between 1 and 4. The height of each bar overall shows the sum of these scores across the five types of violation for a species. Thus, if the respondents expected consistent violations of each type for a species, the bar would have a summed value of 20

Source: Current study

In both small-scale and industrial sectors, encroachment and breach of licence conditions were the most common infractions and relatively similar in frequency, followed by non-compliant gear, illegal transhipment and other premeditated activities each spaced out from the other at slightly lower frequencies. There was no statistically significant difference between small-scale and industrial vessels in their ranking of the potential infractions. Overall, industrial vessels were slightly more likely to have infractions, across all types.

Due to the need to include knowledge in the analysis (*question B.1,* Section 2.1), which was less completely filled out than other components of the survey, the number of responses available for fitting the model for this question was reduced. This resulted in some species not being able to be included, where there were no respondents scoring their knowledge for that species. In addition to this caveat, it is important to keep in mind that the responses analysed here were from the nominated species only (Table 2.8). This means that they did not include, for instance, the large number of shark responses from regions where shark was one of the pre-identified focal species in the survey. This also explains why there were some differences among the results for this question and those for the previous question. For instance, the high estimate for longtail tuna was based on two responses, which were used in both this and the preceding sections, as they were from nominated species. However, the estimates for sharks could be substantially different, as the dataset in the preceding sections was much larger for that species.

Among the nominated species with generated estimates, longtail tuna were, again, very likely to have relatively high levels of infractions, in comparison with other species. Sharks were relatively low in frequency by comparison, although sharks were more likely to be caught in violation of regulations by small-scale vessels in comparison with industrial vessels. Conversely, squid were relatively frequently linked to infractions for industrial vessels, but much less so for small-scale vessels.

3 Interviews

A selected number of professionals currently involved in the fisheries industry in the APFIC region were invited to participate in a confidential interview. This initial set of interviewees was also asked to nominate appropriate contacts who they thought might be useful to interview. Those contacts were then contacted for potential participation. In addition, some respondents from the online survey who had volunteered their names and contact details were approached to participate in interviews.

Interviews were undertaken with full ethics approval and with all interviewees signing a consent form. All interviews were conducted by CSIRO researchers via Skype or videoconferencing. Interviews were audio-recorded for transcription and reference purposes to help ensure accuracy of the data. Once transcribed, the audio files were destroyed.

Information gathered during these interviews has been aggregated and presented in such way that the respondent cannot be directly identified. The identity of all participants was kept completely confidential with personal data destroyed once responses were aggregated.

3.1 Interview design

The interview used a semistructured design, based on a standard set of questions (see Appendix A4 for full text). Answers were open-ended, with the interviewees allowed to elaborate as they saw fit. The interviews began by gathering demographic information about the participants including name, occupation, years of experience and geographical regions where they had experience with fisheries. This was important as it enabled the responses to be weighted according to the interviewees' experience and their roles. This background section was followed by two sets of questions. The first focused on identification of new illegal-fishing hotspots and review of previously identified locations and the second on a set of open-ended questions around a specific geographic area of expertise.

1. For the identification of new illegal-fishing hotspots and review of previously identified ones, the interview used the same structure as used in the Fisheries Officer Surveys (see Section 2.1). Interviewees were asked to select the subregion in which they worked from the following six options (see Figure 2.1):

    a. Gulf of Oman, Pakistan, West India, Arabian Sea and the Maldives.
    b. Bay of Bengal, Andaman Sea, Malacca Strait.
    c. Gulf of Thailand, South China Sea.
    d. Arafura–Timor Sea, Banda Sea, Savu Sea.
    e. Sulu–Celebes Sea, Sulawesi Sea, Makassar Strait, Halmahera Strait.
    f. East China Sea, Yellow Sea.

2. Interviewees were then shown a map of their selected region and asked to click on the map to designate areas which they believed were hotspot areas for illegal fishing. Interviewees could select from one up to 20 locations within the designated area as a hotspot.
3. Subsequently, interviewees were shown a map of the hotspots in that region (Figure 2.2), identified in the unpublished 2015 APFIC study (FAO, 2016a), and asked to score each hotspot as 'no' longer a hotspot, 'yes' still a hotspot or 'unsure'.

Within the region nominated in the first component of the interview, interviewees were then asked to identify a specific geographic area for further discussion based on their experience. Interviewees were asked approximately 20 open-ended questions covering the following topics (see full interview questions in Appendix A4):

1. The interviewee's general knowledge of illegal-fishing practices in the area and key ports;
2. Questions specific to the actors – vessel types, gear types and drivers;
3. Knowledge of target species including catch volumes, market prices, market forces at play; and
4. An assessment of existing governance practices and policies relating to fisheries management and enforcement, and their efficacy – including what is working and what is not.

3.2 Respondents

Interviewees (N = 12) included scientists, NGO workers, consultants to the fisheries industry and former government officials. Cumulatively, they had 220 years of experience in the industry with a median of 20.5 years' experience. Interviews averaged 40 to 50 minutes in length and were conducted via videoconferencing.

3.3 Identification of illegal-fishing hotspots and review of previous estimates

The unprompted nominations of illegal-fishing hotspots from the clickable map presented to the interviewees generally reflected those obtained through the surveys (Figure 2.5, Figure 3.1). There were some minor differences, likely due in large part to the geographic regions nominated by the respondents and interviewees. Interviewees included one respondent knowledgeable about the East China Sea and the Sea of Japan, while there were no other survey responses returned from this region. Conversely, there were survey responses in the western Indian Ocean and the northern portion of the South China Sea, although there were no interview responses from this region. Thus, some differences, such as the density of points selected in the South China Sea, were likely due primarily to the geographic distribution of respondents and interviewees, as opposed to differences in illegal fishing. The Arafura–Timor Sea by contrast was one region where there was some difference among the interviews and survey datasets, with respondents covering both areas. The interview responses did not highlight this area as strongly, suggesting that fisheries officials surveyed might have had differing views from the more diverse group providing responses to interviews.

Similarly, these unprompted responses were in concordance with areas identified in the 2015 APFIC study (Figure 3.1). Three areas not identified in that earlier work that were highlighted by interviewees included the Java Sea, the interior waters of the Philippine Archipelago and the northeastern edge of the Andaman sea (Figure 3.1).

When interviewees were then asked to score locations identified in the 2015 APFIC study (FAO, 2016a) as hotspots, in terms of whether they were still a hotspot, no longer a hotspot or the respondent was uncertain, only one of the 27 locations was no longer thought to be an illegal-fishing hotspot (Table 3.1). In this case, of the two respondents providing scoring, one responded 'unsure' and the second that it was no longer a hotspot. Sixteen of the remaining 27 locations had at least one respondent scoring them as still a hotspot. Overall, the interviewees painted a similar picture in terms of change in previously identified hotspots, with the vast majority continuing to have issues with illegal fishing.

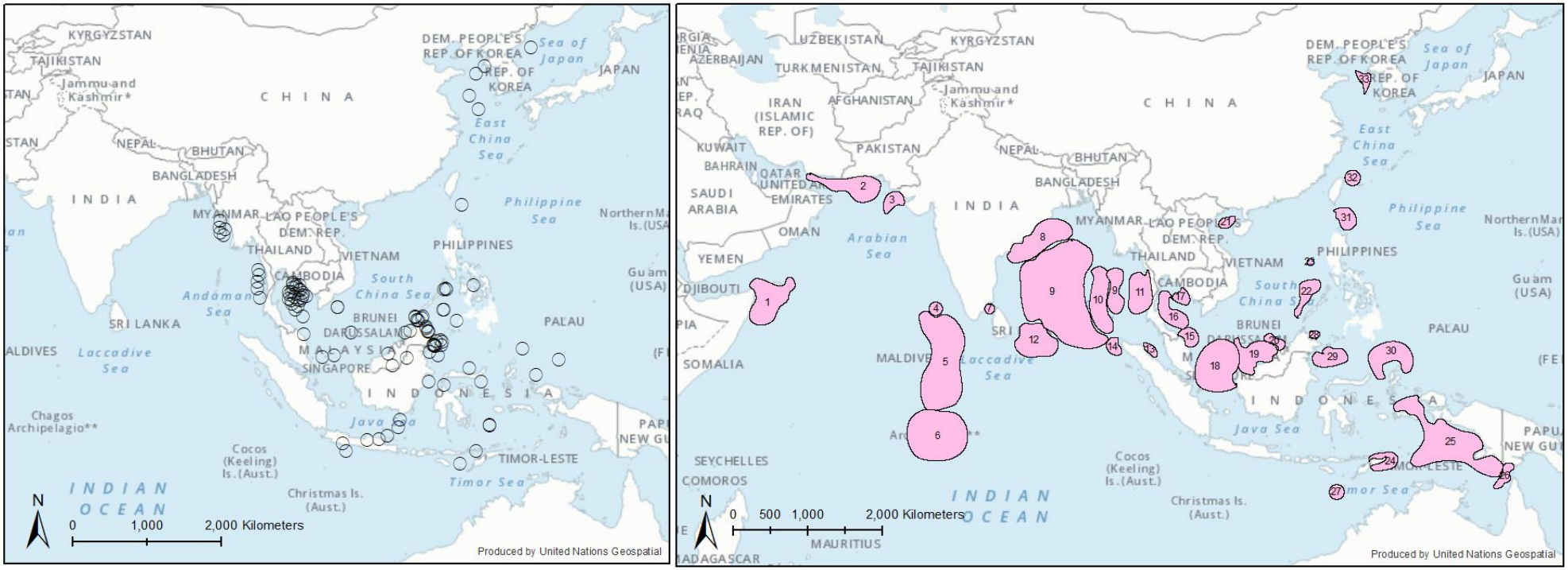

Figure 3.1: Illegal-fishing hotspots across the APFIC region as indicated by interviewees in this study and those previously identified in the 2015 APFIC study (FAO, 2016a). The left panel shows the locations of illegal-fishing hotspots from interviewees in this study. The right panel shows the hotspots identified by APFIC in 2015 (FAO, 2016a)

Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021). **Note:** Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Table 3.1: Interviewee scores for whether illegal-fishing hotspots from 2015 remained as hotspots. See Figure 3.1 for a map of zone locations.

ZONE	YES	NO	NOT SURE
7			1
8			1
9a			1
9b			1
10			1
11	1		
12			1
13	1		
14			1
15	2		1
16	1		2
17	2		2
18	2		1
19	1		2
20	1		2
21			3
22	1		2
23			3
24	2		1
25	3		
26	2		1
27	1		2
28	1		1
29	2		
30	1		
31		1	1
32			1

Source: Current study

3.4 Interview responses for geographically focused discussions

All information received through interviewees has been de-identified, aggregated and grouped according to the region of expertise. As a result of the geographic knowledge of those interviewed, this chapter will report on the following regions:

1. Bay of Bengal and Andaman Sea.
2. Gulf of Thailand.
3. Sulu Sea and Celebes seas.
4. Arafura Sea, Banda Sea, Timor Sea region.
5. Bismarck Sea and Solomon Sea.
6. Japan Sea and North Pacific fisheries.

3.4.1 Bay of Bengal and Andaman Sea

Within the eastern Bay of Bengal and Andaman Sea there are high levels of illegal fishing, especially in coastal fisheries. Although some areas have reportedly good levels of oversight, regulatory structures are poorly designed for small-scale commercial fishers, in some cases leaving them with few options but to illegally fish in inshore waters. One such example is the prohibitive cost of offshore licences for one of the nations in the region, making offshore fishing inaccessible for 90 percent of the vessels in the national fishing fleet. This lack of affordability leaves the medium-scale and small-scale vessels fishing in inshore waters, which vary from 5 nautical miles (NM) to 10 NM from the coast. This activity is illegal, but very common given these smaller operators have few choices but to operate illegally inshore. Figure 3.1 shows the areas identified by interviewees as illegal-fishing hotspots.

The industrial fleet in this same context – trawlers, gillnetters, purse seiners and squid seiners, composed of 25-m to 30-m vessels with large inboard engines – are less likely to break regulations in this area. It is estimated that these vessels represent only 10 percent of the fleet, and yet they have access to 90 percent of the waters in which to fish.

Overfishing in the region is also reportedly reducing the efficiency of targeting specific species and high catch of juveniles in inshore zones is contributing to already depleted and damaged stocks. For instance, in the case of the compression of the vessels under 25 m mentioned above, depletion is a serious concern. While inshore waters might in general be fairly productive, and capable of supporting relatively intense fishing, the compression of a large fleet in this limited area is causing significant depletion, impacting stocks and also supporting recruitment areas.

The nature of port ownership in the region, whether they are privately owned or government operated, appears to be a key factor in determining the success and transparency of operations. Privately-owned ports in the region appear to be the norm in some areas. As these privately-owned ports (often a cooperative of vessel owners) take commission of final sales, the recording, weighing, grading and auctioning of catch is detailed and comprehensive. However, incorporation of these data into the management system is limited and appears to be poorly linked to monitoring of the fisheries overall. Ports close to borders, as with many border regions, provide some opportunity for leakages in the system. In some cases, these ports are heavily patrolled and are a required stop accepting entry or servicing of vessels wanting to export across the border, however, the quality of these controls is unclear. Otherwise, foreign encroachment is an uncommon infraction as penalties for foreign fishers in the region appear to be severe.

Cross-border flows of illegally-harvested fish appear to occur, with significant volumes landed in ports near the borders and moving southward toward the major seafood-exporting countries in the region. Based on reports this export primarily moves by sea, and many of the vessels are inspected prior to departure. Corruption is reportedly endemic, leading to ineffective controls on exports in some cases and inequity in allocation of resources among industry sectors in others.

The most important driver for illegal fishing in the eastern Bay of Bengal and Andaman Sea was reportedly the regulatory framework, with an unsuitable framework causing conflict between the industry and small-scale fishers for livelihoods; this has led to ambiguous reporting from private port operators and a regulatory bias in favour of the industrial sector creating significant pressure on medium-scale and small-scale operators to fish illegally.

3.4.2 Gulf of Thailand

Areas within the Gulf of Thailand which were identified by interviewees as hotspots for illegal activity are shown in Figure 3.1 and include the Cambodian waters, particularly near the border with Thailand, along with several points along the maritime boundaries among the countries in the region, and one point in the Riau Archipelago to the south in Indonesian waters.

Within the Gulf of Thailand, various key illegal activities were reportedly common across the region including use of illegal gear, unlicensed fishing, fishing in protected areas and blast fishing. Child labour was also reportedly an issue, with children between 14 years and 17 years (and some as young as 11 years) often involved in illegal practices, although often purportedly as family members helping on vessels and gaining experience. NGOs in the region have a strong focus on working with these children on the ground to ensure their safety.

Various gear types are used across the region. Bottom trawling in areas less than 20-m deep is illegal in much of the region, yet it is still a frequent activity, often with the use of catch-all tiny mesh. Pair trawls and electric trawls, both frequently prohibited, are also used. Fishing in protected areas, such as around seagrass beds, coral reefs and in inshore exclusion zones is also common.

Overfishing is also regarded as a key issue in the Gulf of Thailand. All indications are that most species, with the exception of shrimps, are experiencing a population decline, especially in the waters of Viet Nam. Although specific vessels aim to target specific species (such as purse seiners targeting pelagic finfish and trawlers targeting shrimp and crab), the depleted stocks have resulted in 'trash' fish becoming the primary target for most vessels operating in the region. Due to years of targeting sharks, both overall and for fins, they are now almost completely absent in the region.

The key ports in the region are reportedly low on oversight, with minimal surveillance and checks of vessels or crew, and informal coastal sites, which may have significant infrastructure, also reportedly to be commonly used for offloading illegal catches.

Generally, the lack of political clarity around some borders and weak enforcement at numerous ports and at sea, are the key drivers in the region for illegal fishing. Regionally, this poor oversight, weak deterrence and low likelihood of detection results in large-scale illegal fishing across the region, evident through the various activities of encroachment (sometimes attributed to border disputes), gear misuse, child labour and transhipment. Weak governance provides a setting that does not deter illegal activity and provides little incentive to seek alternative, less profitable, but legal, land-based livelihoods.

However, it is important to note that there is a changing and evolving landscape in the region and a range of new management tools is being implemented across the countries including patrols such as the covert vessel 'Poseidon' of Thailand, and VMS tracking being rolled out in Viet Nam. Collaborative management is also emerging, with a Joint Development area near the border of Thailand and Malaysia allowing citizens from both countries to fish there.

3.4.3 Sulu Sea and Celebes Sea

The Sulu Sea is an area of great contention, with various claims over the waters. Historical practices and strong cultural ties among at least four countries continue to create challenges in the border regions. Human trafficking and piracy are thought to be present in the region and reportedly connected to other more common illegal-fishing practices. Regional governments are actively working to combat these challenges and develop an overarching fishing policy to address the issues.

Key illegal-fishing activities in this region include encroachment, unlicensed activities, illegal transhipment, blast fishing, fishing of protected species and corruption. Intrusion of large commercial vessels into inshore regions is one key form of encroachment. Large foreign vessels of up to 30 gross tonnes (GRT) are known to fish in the region, staying at sea for weeks or months, and transhipping their catch. Outrigger canoes powered by small outboard engines, known as 'pump boats,' also contribute to illegal fishing in the region, particularly in inshore areas inaccessible to patrols – though widespread, they are illegal, unregistered and assumed to be unlicensed.

In addition to unauthorized gear being used, blast fishing and poison fishing are common, especially for reef fish. Chlorine is used to stun fish and slow their movements, making catch easier. Various species are targeted in the region, including groupers, Napoleon wrasse, turtles, tuna, sharks, scallops and squid. Several of these, including turtles, are targeted for the live trade market.

There are many informal landing sites along the coastline in addition to key landing ports in the region. Enforcement varies: navy or marine police may be responsible and mandated to enforce law; in some areas local government may be responsible; in one area a community group or volunteer group is particularly active and a key source of funnelling information to the enforcement groups. On some levels however, both institutional and cultural thinking treats illegal fishing as a petty crime, with enforcement of fisheries law having a low priority compared with other illegal activity on the water. Cross-country collaboration in the development of fishing policy is having some success and aids enforcement efforts. Ultimately, enforcement is hindered by inadequate economic resources which result in lack of human resources, fuel and equipment.

Various key drivers underpin illegal fishing in this region – the economic incentive for live fish trade is high and the reported views of vessel operators that the region is an easy place to access valuable species with low risk. These high returns and low risk of interception are synergistic with historical practices and cultural activities that are part of what is now viewed as illegal fishing. Fishing as a traditional livelihood has been important in the region for centuries. However, while much of the capture of live reef fish for instance may be by small vessels, these are economic activities driven by market demand. Thus, changing practice regulations is likely to be challenging, as traditional local fishing by small-scale and medium-scale vessels is intertwined with high-value exports, such as for the Asian live fish market.

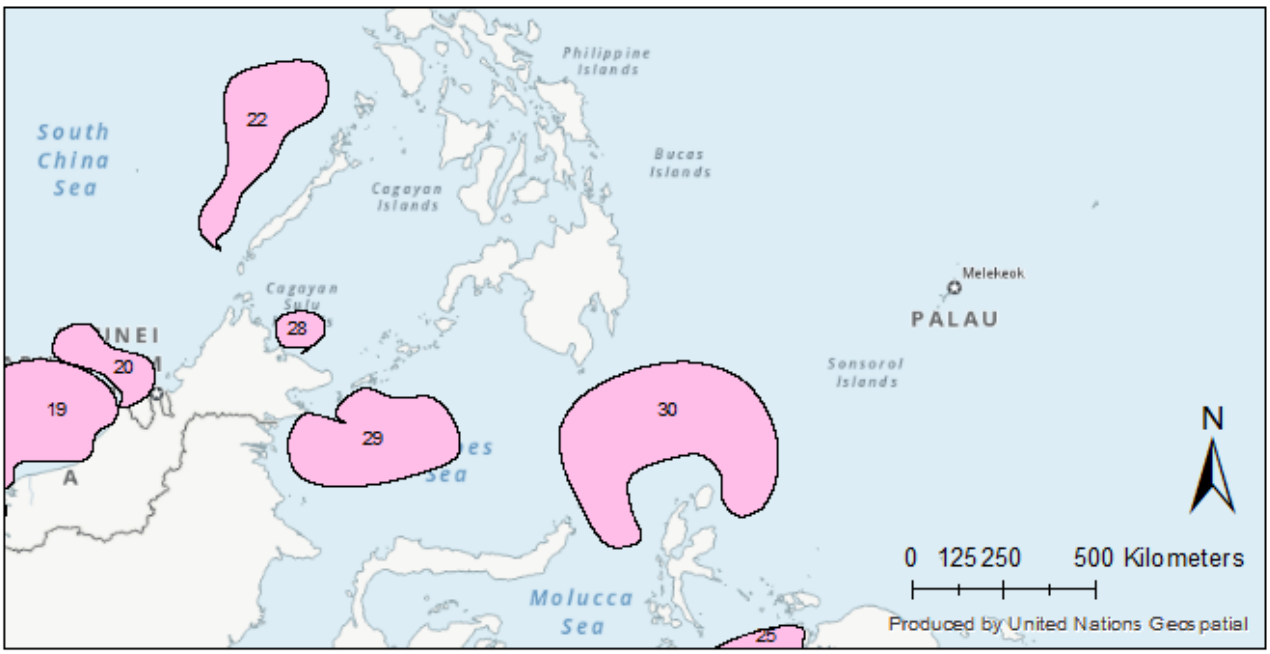

Figure 3.2: Illegal-fishing hotspots in the Sulu Sea area indicated by FAO (2016)
Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021)

Interviewees were asked to identify areas that are current hotspots for illegal activity in this area and the areas selected are shown in Figure 3.1. They were then asked to review hotspots that were indicated in the APFIC 2015 study (FAO, 2016a) shown in Figure 3.2. Indications were that Zone 29 in the Celebes Sea is considered to still be an illegal-fishing hotspot.

3.4.4 Arafura Sea, Banda Sea, Timor Sea region

This region is split by predominantly small-scale community fishing with low compliance and illegal practices such as blast and cyanide fishing in the Banda and Timor seas as well as the Arafura Sea which is dominated by larger vessels. The local fishing fleet is very small and dominated by low-powered vessels, with a heavy reliance on shore fishing through the use of cast nets and gleaning.

Traditional fishing methods vary across the region and are a key driver of illegal fishing. Fishing in marine protected areas is not uncommon. Use of mini-trawl (or baby trawl) has become more common in the region due to recent regulatory changes banning trawling. This method of trawling is destructive to sea floor ecosystems but is considered by many local groups as a traditional practice. In other regions, poison fishing is also considered a traditional fishing method; in these areas the roots and fruits from local trees are used to stun fish. Though reef fish are highly prized, economics often force small-scale fishers to take whatever is available. Sea cucumber and turtles are two key high-value target species for the region.

Activity in the Arafura Sea is dominated by a mix of small-scale and larger vessels. This region is one of the largest prawn-fishing regions in the world. The border regions are historically an illegal-fishing hotspot; however, activity has changed in recent years with regulatory changes from neighbouring countries.

This region is a hotbed for a wide range of illegal-fishing activities. The relatively low wealth of communities combined with relative isolation are key drivers for continued illegal fishing. Local fishing communities have called for bans on poisoning, as they perceive it as a practice used mainly by inland farmers who come to the coast to fish if their crops fail. Maintaining livelihoods and lack of alternatives often drive small-scale fishing efforts while lack of oversight and capacity for enforcement in the region has historically enabled illegal fishing by larger commercial vessels. Where illegal activities are more effectively managed, the effectiveness seems to be a result of alignment with cultural norms.

Interviewees then identified the areas shown in Figure 3.1 as current hotspots for illegal activity in this area. Interviewees were asked to review hotspots from 2015 (shown in Figure 3.3). All three interviewees unanimously suggested Zone 25 was still a hotspot of illegal activity. Two interviewees suggested Zones 24 and 26 remained as hotspots, while only one ranked Zone 27 as still a hotspot. None of the four zones identified in 2015 were ranked as no longer a hotspot.

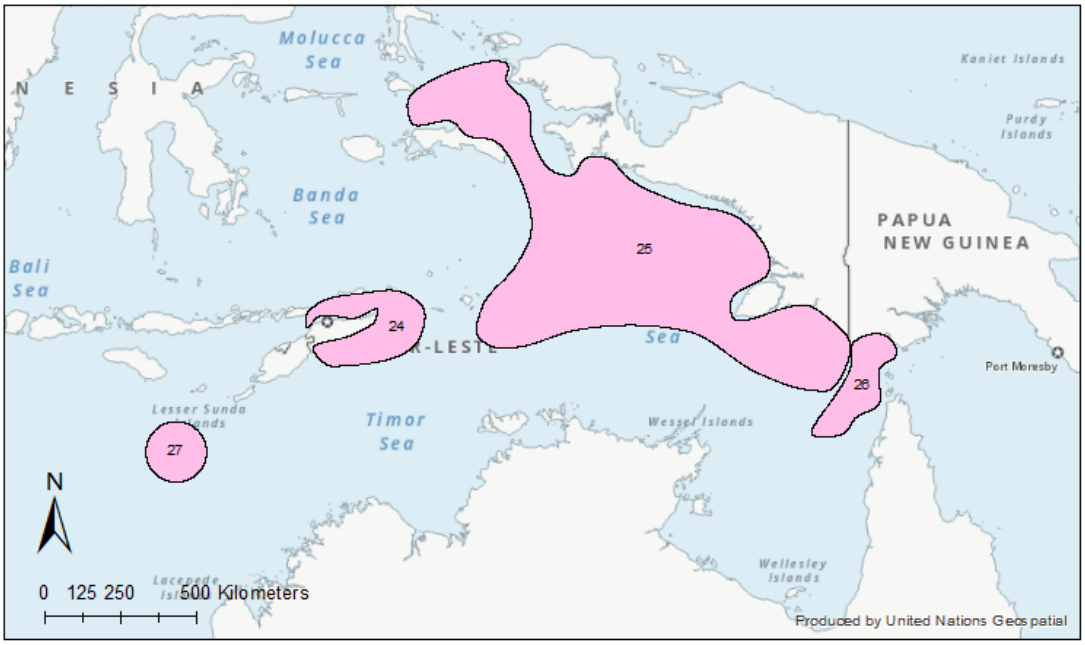

Figure 3.3: Hotspots in the Arafura Sea region as indicated in the 2015 FAO study on illegal fishing in the APFIC region

Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021)

3.4.5 Bismarck Sea and Solomon Sea

This region is predominantly a very large tuna fishery, with a large share of the global catch of skipjack tuna (*Katsuwonus pelamis*) coming from this region.

This area is comparatively well regulated, due in part to the Parties to the Nauru Agreement (PNA) which outlines terms and conditions for tuna purse seine fishing licences in the waters of its eight member countries (which include Papua New Guinea and the Solomon Islands). Any fishing undertaken in these waters requires a licence according to PNA regulations. Vessels must also purchase a 'vessel day pass' which is used for monitoring; the pass can be purchased directly from the Pacific Community (SPC) in Noumea or the Pacific Islands Forum Fishing Agency (FFA) in the Solomon Islands, or on the open market. This is considered a well-managed operation; however, it is known to be misused by vessels falsely displaying the flag of a PNA member nation despite having no actual link to that flag state.

Other illegal infractions in this region are fishing without a valid licence, using non-compliant gear and transhipment. In one known hotspot, it is estimated that 90 percent of all vessels are engaged in some form of illegal activity, most of which is thought to be large-scale illegal-fishing practices, with little to no involvement from local fishers. Industrial longline vessels in particular are thought to be problematic. Often, these vessels will be licensed to fish in the Western and Central Pacific Fisheries Commission zone. They are known to move into coastal state EEZs to fish, returning to the high seas to tranship catch, refuel and resupply, allowing them to remain in the area operating in this fashion for long periods.

Aside from the tuna fishery, foreign boats in the area are thought to target swordfish and sharks, as well as the sedentary species such as giant clam and bêche-de-mer. Underreporting is an issue in the region. There are an estimated 1 000 foreign vessels visiting the region annually, but it is thought that only 10 percent of these vessels are reporting their catches. These catches are thought to be significant. For instance, foreign longline vessels operating illegally in the region are thought to remain for up to a year, with catches on the order of 20 tonnes over that period, transhipped in nearby high seas areas. These longline vessels are often licensed in the Western Central Pacific Fisheries Commission and frequently declare any swordfish and sharks as bycatch; whether this is actually targeted fishing is unclear. Shark fins in particular are in high demand, are highly lucrative and take up little space on board, making them a prized commodity.

Enforcement in the region is mixed, with some domestic efforts and collaborative monitoring operations from regional authorities using a mix of patrol vessels and aircraft. Local fishers and authorities are known to be very protective of their fisheries and corruption is believed to be rare. There has been a recent decline in visits from foreign fleets, possibly due to diplomatic pressure applied between 2015 and 2018, through the international tuna forums and through bilateral talks. According to one of our interviewees, strong penalties are also thought to be a contributing deterrent – the sharp decline in Vietnamese vessels detected in the area coincided with the lengthy jail sentences for fishers apprehended by Papua New Guinea authorities. Enforcement is generally absent across the high seas' regions due to lack of resources; however there are periodic campaigns by the regional tuna management agencies.

3.4.6 Sea of Japan and western boundary of the North Pacific fisheries

Interviews for this region were limited to a single respondent, whose primary focus was in Japanese national waters, although he had broader experience. Based on the interview, illegal activities are present in the region, however, unregulated and unreported fishing activities may be of greater concern. It is believed that there is an almost complete lack of accurate landings' data, which impacts the ability to manage fisheries in the region sustainably. Domestic fishing in this region is predominantly purse seine inshore, gillnet, and pole and line fishing. As with other regions, small vessels often fish at night for delivery in time to morning markets. The domestic fishery in this region employs around 150 000 fishers, 95 percent of whom are engaged in small coastal fisheries; large industrial fishers are responsible for only around 5 percent of landings.

In the nearshore zones the target species are shrimps, prawns and high-value demersal species such as bream. Red snapper and migrating fish such as king fish are targeted but are less valuable.

Encroachment is a key issue in domestic waters, most often from neighbours nearby but vessels flying flags of convenience are also seen in local waters.

The key drivers for this region appear to be gaps in regulatory measures and reporting, which lead to overfishing. Conditions relating to gear use, vessel types or engine types and so forth are not strictly enforced.

A key issue raised by the interviewee was that there is little fishery data collection, either at sea or on land, due to the perceived burden by the industry and strong links to historical informal management systems. This lack of fishery monitoring data fundamentally hampers fishery management and sustainability.

The interviewee identified the areas shown in Figure 3.1 as current hotspots for illegal activity in this area. The interviewee was asked to review hotspots from 2015 (shown in Figure 3.1). The interviewee scored Zone 33 as remaining a hotspot for illegal fishing and was uncertain about the status of Zone 32.

3.4.7 Summary

Across the 12 key informants interviewed some consistent themes emerged. Integration of monitoring information was a relatively consistent shortcoming, with lack of accurate measurement and responsive management leading to fish stock depletion from the eastern edge of the Bay of Bengal to the Sea of Japan. Encroachment was a consistent issue across many of the interviews both by industrial vessels into inshore regions where they are prohibited and also by foreign vessels. Similarly, use of prohibited gears or destructive methods appeared to be widespread. Blast fishing, use of pair trawls and push nets, and widespread use of very fine trawls, purse seines and gillnets were all common themes. These violations, like encroachment, are likely to be driven by stock depletion.

Countries across the region are taking innovative steps to increase their monitoring, control and surveillance of fishing activity, both with respect to their flagged fleets and those of foreign vessels. For instance, both Thailand and Papua New Guinea use fishing industry vessels as covert patrol vessels. Penalties for illegal fishing are increasing across the region, as governments shift their perception of illegal fishing from petty crime, to a more significant legal infraction worthy of interdiction effort and legal

processes. In some cases, penalties for illegal fishing by foreign vessels have become more stringent, with interviewees suggesting that these penalties have reduced foreign incursions into the countries imposing them.

A key consideration in addressing illegal fishing across the region is the alignment of regulations with existing industry structure and recognition that misalignments will result in high levels of violation and require direct government intervention to address them.

For instance, one interviewee noted that in the eastern Bay of Bengal, small-scale commercial operators are forced to fish illegally due to the cost of offshore licences and limits on where inshore vessels can operate. Comprising most of the fishing fleet in the country concerned, this misalignment leaves the national fishing fleet largely non-compliant.

Similarly, prohibitions on industrial trawling in the Arafura Sea region have led to widespread adoption of trawl nets by small commercial vessels, as the smaller nets are not covered by the regulation. Widespread non-compliance, such as in these cases, suggests that careful thought should be given to regulatory reform. In the absence of thoughtful reform, existing widely established practices may inadvertently spawn high levels of non-compliance and require significant investment to address them.

Finally, transgressions near borders and linkages to official corruption were a common story. This was not highlighted in any specific region in this report, due to the potential links to interviewees. However, corruption among regulatory and enforcement agencies was perceived to be common. This pattern exacerbates the higher levels of illegal fishing near borders, as there are often opportunities for lucrative but unauthorized cross-border trade. Careful attention and oversight of regulatory and enforcement agencies and their staff in these regions, and other areas where low oversight and high-value fisheries overlap, will be key for addressing illegal fishing in the region.

Linked to this effort with enforcement officials is the need to ensure they are aware of which fishing activities are illegal. In several cases, interviewees suggested that enforcement officers consider illegal-fishing offences as petty crime, due to their coverage under fishery legislation and regulations, rather than the criminal code, even though the level of sanctions may be comparable in some cases. The perception of illegal-fishing activity as petty crime may also contribute to lax enforcement and possibly, collusion with fishers engaged in the illegal activity.

As a component of the interviews, each respondent was asked to review the zones identified as illegal-fishing hotspots in the 2015 APFIC study (Table 3.1, Figure 3.1). The interviewees did not cover all of the regions identified for this analysis (Figure 2.1), and thus only a limited summary of changes over time for a limited number of the zones is presented. However, only one respondent suggested that a previous hotspot was no longer a hotspot, and this only applied to Zone 31 at the northern tip of the Philippines. All other hotspots appeared to remain hotspots, as previously identified. In addition to these existing locations, three additional locations were nominated by interviewees as illegal-fishing hotspots, the Java Sea, the interior waters of the Philippine Archipelago and the northeastern edge of the Andaman Sea.

4 Media analysis

The aim of the media analysis was to gain insights as to the extent of different types of illegal-fishing activities in the region, as well as insights on which groups were involved in these activities and some indication of the scale of the different incidents. Publicly available reports of illegal fishing reported in the media were searched and analysed for information on illegal-fishing related activity in the APFIC region. The aim was to undertake a systematic review of the media reports on illegal fishing for this project.

A review of available media outlets and mechanisms to access reliable grey literature sources as well as bibliometric databases identified three key sources of media reports which were combined to provide a broad overview of the types and scale of activities being undertaken in the region. The media analysis builds on similar methods used in the 2015 study on illegal fishing in the APFIC region (FAO, 2016a), using similar categorization, but a more rigorous approach to media collection and analysis.

4.1 Data sources

A dataset of verified media-reported illegal-fishing incidents was provided to CSIRO by the Liberty Asia organization. Liberty Asia is a registered charitable organization that works to provide new coordinated response solutions to reduce slavery and human trafficking in Asia. As part of its media monitoring, it also records incidences relating to illegal fishing. Any records relevant to our study of illegal fishing in the APFIC region and Asia more generally were extracted from its media database. The media reports were either published in English or an English version was curated by the data source.

In addition to Liberty Asia, two further sources of suitable illegal-fishing media reports were identified. First, media reports were collected through Google News alert. Google News has arguably the most expansive primary search engine. The second source was the ProQuest © academic portal which features access to many databases and is a good source of high-quality grey literature sources. These three sources, Liberty Asia media reports, Google News and ProQuest, were combined into a set of unique illegal-fishing incidents, synthesizing information across multiple reports when required in each of the three media sources. By combining these three sources of data, 329 illegal-fishing incidents were collated from the media reporting over the whole project period from 1 January 2015 until 15 August 2019.

For data to qualify for inclusion in the study, the media article must have been reporting a relatively contemporary illegal-fishing incident and not a historical incident (i.e. from many years earlier). The article needed to be reporting an apprehension in the APFIC countries (with a few logical exceptions) within the time period of interest from 2015 until the end of our media incident data collection period (August 2019).

Table 4.1: Data sources and time range

DATA SOURCES	PERIOD COVERED	VERIFIED SOURCES	TYPES OF MEDIA	NUMBER OF INCIDENTS
Liberty Asia	1 January 2015 to 30 April 2019	All	Not specified	83
ProQuest	1 January 2016 to 31 December 2018	Most	Hardcopy and online news media including government and official publications, newspapers, reports	160
Google News	14 February 2019 to 15 August 2019	Some	Online news media indexed by Google	86
Total number of illegal-fishing incidents				**329**

Sources: Liberty Asia, ProQuest and Google News.

4.1.1 Google News alert

Incidences identified during the project were found through a Google News alert. A daily alert for news articles that included the search string 'illegal fish*' was established. The asterisk '*' was termed a wildcard in the search string and had the effect on the search of returning all articles with the term that started with illegal fish and might include a number of different endings. For example, the search also returned detection of the terms illegal fishing, illegal fisheries, illegal fishers and so forth. Reports were limited to English language media.

4.1.2 ProQuest search

The ProQuest search covered 45 different databases. The source types included newspapers, reports, government and official publications as well as 'Other Sources', but the document type of 'Theses' was excluded. The same search string of 'illegal fish*' was used as in the Google News alert. Reports were either in English or based on English translations.

Once the search was completed, records from certain locations were excluded. The locations excluded from the search results (in no particular order) were: the United States, the United Kingdom, Uganda, Tanzania, Kenya, Canada, Europe, California (USA), France, Ireland, New York (USA), Nigeria, Panama, New England (USA), South America, Oregon (USA), Ukraine, Los Angeles (USA), Oman, Spain, Bolsa Chica (USA), Egypt, Mozambique, Norway, Santa Barbara (USA), Canberra (Australia), Monterey Bay (USA), Virginia (USA), and Antarctica.

Finally, the ProQuest source media records were exported to EndNote for the classification process (described in more detail below).

4.2 Data preparation – filtering and coding

The information was extracted from the media articles that reported illegal-fishing incidents and prepared for analysis in several stages. After the raw data were sourced, analysts then filtered the data to extract only data relevant to illegal-fishing incidents reported. Once this was achieved, the data were checked to ensure no duplicate reports remained. Then for each of the illegal-fishing incidents in the data, analysts recorded information from the reports about the incident so that the reports could be classified and categorized ready for detailed analysis.

4.2.1 Filtering for illegal-fishing incidents

As the search term was general rather than specific, the media articles needed filtering to ensure that they were actually reporting about an illegal-fishing incident in a country of interest (in one of the APFIC zones). Articles that instead referred to broad IUU assessments, reports or efforts to reduce illegal fishing were not included in the incident analysis phase as they were not related to specific illegal-fishing incidents. The filtering of nearly 10 000 potential media articles resulted in the identification of 329 unique illegal-fishing incidents in our areas of interest. As mentioned previously the media reports were either published in English or an English version was curated by the data source.

4.2.2 Removal of duplicate reports

During the filtering process, duplicate reports of the same incident were identified and removed.

Occasionally multiple reports of the same incident were identified based on the date of the incident. On a few occasions a duplicate incident was identified based on the vessel name; at other times via the media article titles. Some syndicated media outlets printed the same article in different media outlets but the media report itself was duplicated. A visual check of article titles enabled us to remove these duplicates.

Prior to removing a duplicate, both the duplicated articles were checked to ensure the media article with the most information was retained for analysis. In some cases, extra information was gleaned from the duplicate record and included in the original that was retained.

4.2.3 Classification of media-reported incidents

For each incident identified in the media, the information in the media report was carefully considered and the incidents were classified accordingly. Standard information for each of the incidents was recorded, including the source URL, the date of the illegal-fishing incident and a country location (or high seas area). The source information included the media outlet, type of article, author and article headline. The date of the media report and the infraction for each incident were also recorded. Our analysts added a subheading using plain English (layman's terms) to record an additional summary of the incident.

For each incident, information about the boat or boats involved was recorded. If a vessel name was included in the article this was transcribed into our dataset. Where identified in the incident report, how many people were detained and how many boats were involved in the incident were also recorded.

If individuals were detained, then the information about their nationality, gender and age was included (if available). In a few cases no individuals were detailed but instead an organization was named as the entity that had made the illegal-fishing infraction. In these cases, the organization name was recorded.

Based on the article it was determined which infraction type or types (multiple infractions) were relevant for that incident. The infraction types and broad definitions are given in Table 4.2 and build on the classification used in the 2015 APFIC study on illegal fishing (FAO, 2016a).

The status of each illegal-fishing incident was determined based on the information in the media articles and then entered into the dataset. Case status classifications included the following: arrested, blacklisted, convicted, deceased, detained, escaped, fined, investigated, operator charged, prosecuted, repatriated, seized or sunk. Where available, information about each illegal-fishing vessel and the type of fishing was noted and included the following details: vessel flag, home port, fishing gear type, net length and person-to-boat ratio (calculated from the number of persons and boats).

Table 4.2: Classification and description of infraction types, based on categories used in the 2015 study of illegal fishing in the APFIC region (FAO, 2016a)

INFRACTION	DESCRIPTION OF INFRACTION TYPE
Encroachment	Fishing in another country's territorial waters
Breach of licence conditions	Exceeding permitted catch, or using gear not licensed to use
Non-compliant gear	Net type, bomb fishing, etc., regardless of where the offence takes place or the species involved
Illegal transhipment	Any mention of transhipment or refrigerated cargo ships in the article
Premeditated activity	Evidence of premeditated activity related to illegal fishing
Bomb fishing	Using any explosive device to catch fish
Protected area	Fishing in a marine protected area or inland protected area
Protected species	Fishing a protected species
Corruption	Governments/officials accepting bribes
Fake documentation	Possessing fake papers, licences or vessel flag
Unlicensed activity	Not having correct permission/licences for the activity

Source: Current study.

For each incident, information about the illegal catch itself was detailed. The species caught (multiples in some cases), quantities and weights of catch (in tonnes) and economic values of the catch (converted to US

dollars) were recorded if stated in the article. Some incidents were reported to be cross-boundary, meaning illegal activity involved components in both the source country and the market country. These incidents were counted as separate incidents. Finally, a record of whether any threatened species was included in the illegal catch was made and if so, the species name was transcribed.

4.3 Summary of media data

The analysis returned data on 329 unique incidents of illegal-fishing activity. Of these, 304 occurred in 23 national marine jurisdictions, with 25 separate incidents reported on the high seas (mainly the North Pacific region, but also the Southern Ocean and around Micronesia).

Sri Lanka and Indonesia were the most active in reporting incidents of illegal-fishing activities within their jurisdictions, with 75 and 48 incidents reports respectively – together making up more than one-third of all reported incidents.

These represented incidents identified in the raw data and were not weighted for reporting bias. That is, countries with higher levels of surveillance and enforcement activities and greater media interest in marine affairs were likely to have more reports than countries less involved in detecting or reporting illegal fishing. Hence, the number of incidents reported may not be proportional to the level of illegal-fishing activity in the country.

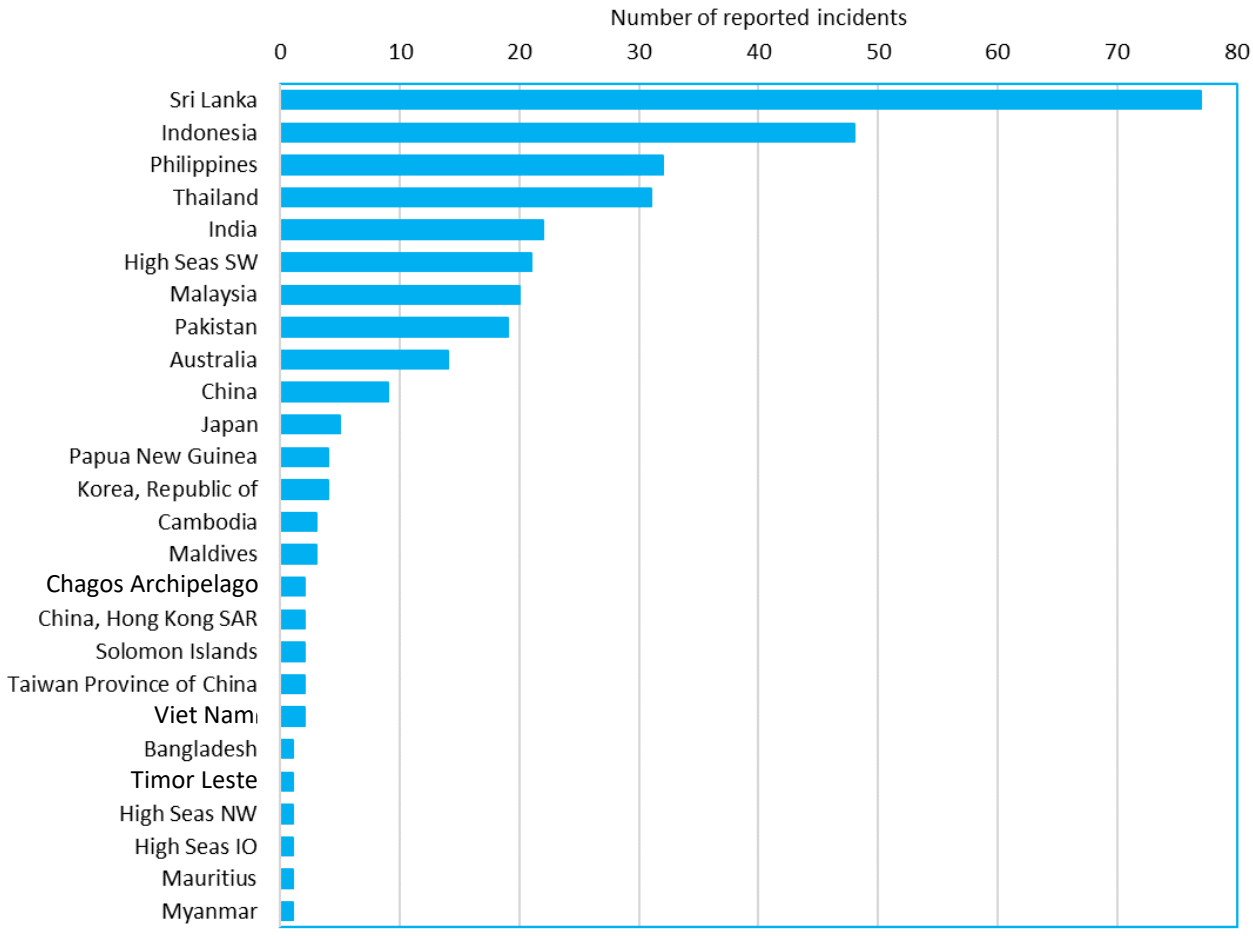

Figure 4.1: Location of reported incidents (total incidents reported = 329)

Source: Current Study

The reports included the involvement of 14 named organizations, 4 504 people and 346 vessels. Of these, 300 vessels hailed from 21 flag states; the flag state was unspecified for 40 reported vessels; and a further

six vessels were deemed stateless. Fishers from India were most commonly reported as being involved in illegal-fishing activities, with reports of 1 655 individuals involved in 54 separate incidents, 30 of which occurred in the Sri Lankan jurisdiction. The next most common nationality to be reported came from Viet Nam, with 936 persons involved in 38 separate incidents in 9 jurisdictions.

We collected data on nine specific types of infraction (Table 4.2): encroachment; breach of licence conditions; unlicensed activities; use of non-compliant gear; bomb fishing; fishing in a protected area; fishing for a protected species; illegal transhipment; use of fake documentation; and contravention other/not-specified (NS).

Many incidents involved more than one type of infraction, meaning that a total of 491 separate infractions were reported. Encroachment was reported in 204 out of 329 incidents. The next most common infraction was non-compliant gear, with 119 instances, followed by protected species fishing, with 61 incidents.

Detailed statistics are provided in Appendixes 6 to 10.

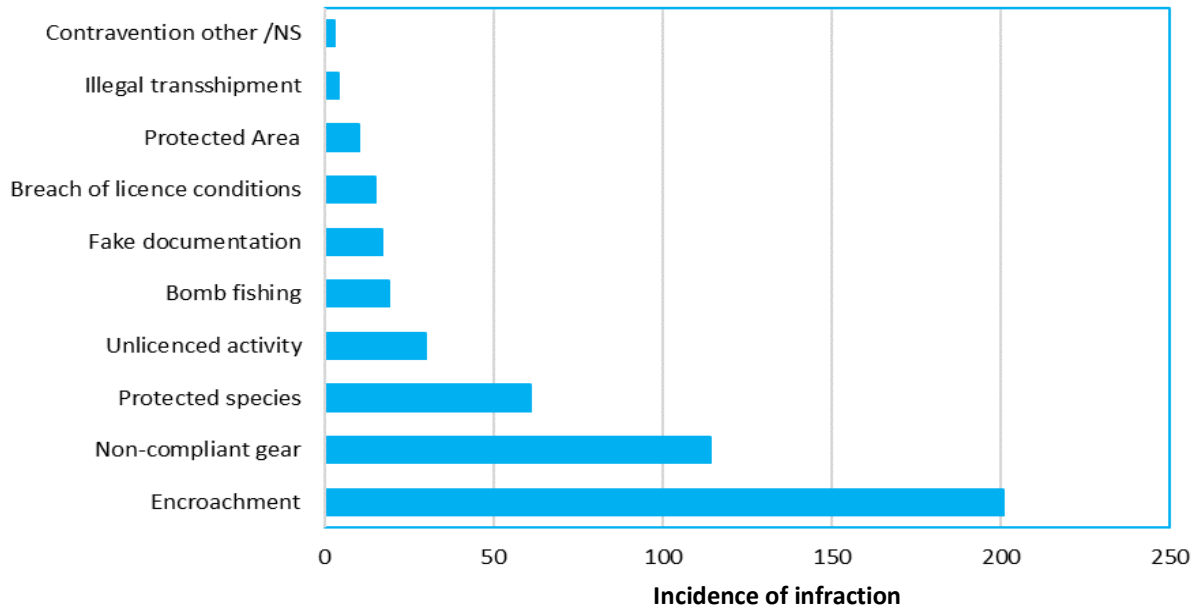

Figure 4.2: Incidence of infractions in the 329 illegal-fishing incidents

Source: Current study

4.4 Media analysis results

4.4.1 Catch estimation

Information on the type, and where available, quantity of catches was also collected from media reports. Two separate data sub-sets were developed. The first set of media reports (94 records, or 27 percent of the total reports) provided information on catches of different species as well as quantity of catches. For most reports involving fish species, the catch could only be identified at a relatively generic level (e.g. 'Fish'), although a small number of reports identified the species that was targeted.

The second set included the remainder of the reports for which the quantity of catches was not provided. For most of them (70 percent), the type of catch was also not mentioned, but the fishing gear was more frequently mentioned (48 percent of records). Only around one-third of reports did not include species caught or gear used. Where gear information was available, information from other reports in the same location with the same flag vessel using the same fishing gear was used to estimate the main species caught. Where neither species nor gear were mentioned, the location and flags of the vessels fishing were used to estimate the main species caught (based on similar records where this information was available). The distribution of these reports containing catch details (species and quantity) was similar to that of the derived dataset as a whole in terms of main species groups identified (Figure 4.3), although the derived dataset contained a higher proportion of 'Fish' incidents.

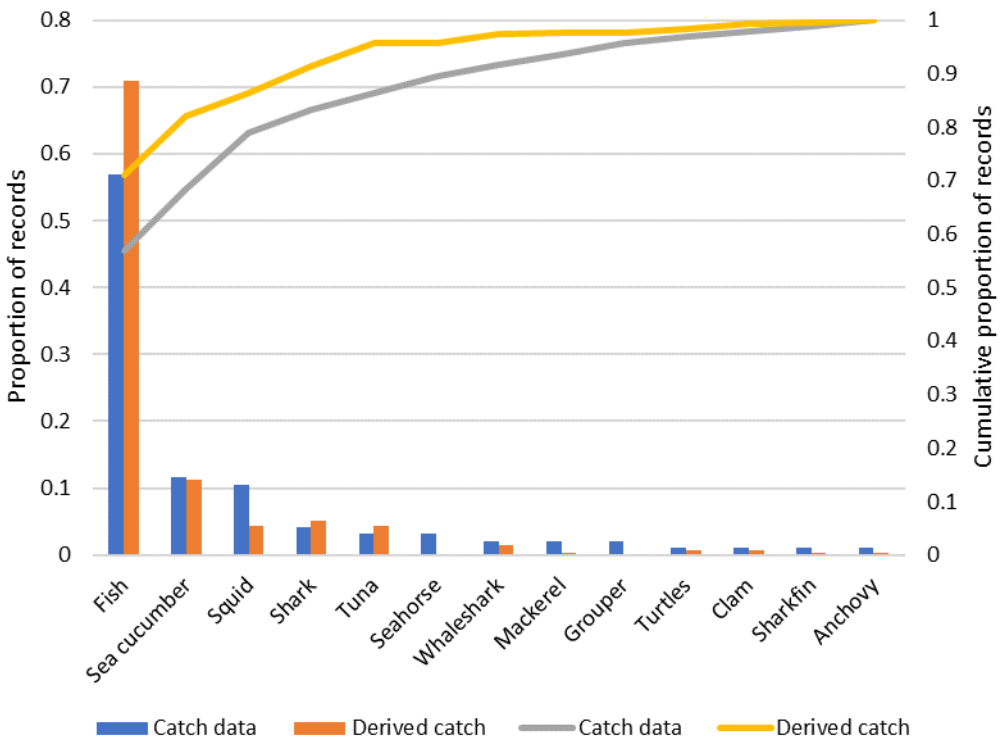

Figure 4.3: Distribution and cumulative distribution of reports with species details and those for which species catch was derived

Source: Current study

4.4.2 Revenue estimate

A small number of reports (around 3 percent) provided estimates of the value of catch directly, but these tended to be final market values (i.e. reflecting retail or restaurant prices) and did not reflect the value likely received by the fishers; hence they could not be compared with legal production values. Instead, the values of the activities were estimated using standardized prices for consistency.

Price information was collected from several sources (see Appendix A5). All prices were converted to US dollars and to 2019 real values based on the CPI.

These prices were applied to the catch estimates in each report of the sub-set reporting catch details to derive an estimated value of the catches with each of these reported illegal-fishing incidents. Several records were excluded from the analysis, particularly those that involved trade of endangered species (e.g. arowana, Irrawaddy river dolphin, totoaba and crocodiles) due to lack of reliable price information and rarity of the records in the dataset. Records involving seizure of vessels taking toothfish were also excluded. While the seizures took place in the Asia-Pacific region, the catches came from areas outside the 'APFIC area'.

4.4.3 Regression tree

A regression tree was developed using the information available in the 94 reports where catch value could be estimated. As each incident involved a different number of vessels, the value was divided by vessel number to give an estimate of the average value per vessel. The regression tree included the species involved, location of the incident, flags of the vessels involved and the relative size of the vessels involved (small, medium, large or very large, based on the estimated number of crew involved).

Regression trees are clustering techniques that group together data with similar characteristics and outcomes based on an analysis of variance (ANOVA). They provide a means of predicting outcomes in other situations with similar characteristics. They differ from 'normal' regression models in that they do not produce continuous predictions, but instead produce a finite number of possible outcomes (the number depending on the specification of the model). This also allows greater flexibility in the estimation process, as the same functional form does not need to apply at every level of the regression tree.

The regression tree was derived using the 'rpart package' (Therneau and Atkinson, 2019) in R (R Core Team, 2018). The minimum size of any terminal node was set at 5 and the complexity parameter was set at cp=0.000001. This was a very small complexity parameter, the implications of which will be discussed below. However, it provided for a more heterogenous regression tree than higher values of complexity parameter (cp) would produce.

The derived regression tree is shown in Figure 4.4, with the data being grouped into 11 nodes from 10 splits. Unlike predictions from regression models (which estimate the 'actual' value of the dependent variable given the independent variables), the regression tree allocates the 'average' revenue from the observed group within each node to each vessel that meets the criteria for that node. As a result, goodness-of-fit measures were generally lower than standard regression models but might be more appropriate in instances where extrapolation to areas outside the data used to develop the model was required. For example, not all locations/flag/species combinations were available in the dataset used to develop the regression tree model, but similarities could be assumed for adjacent regions.

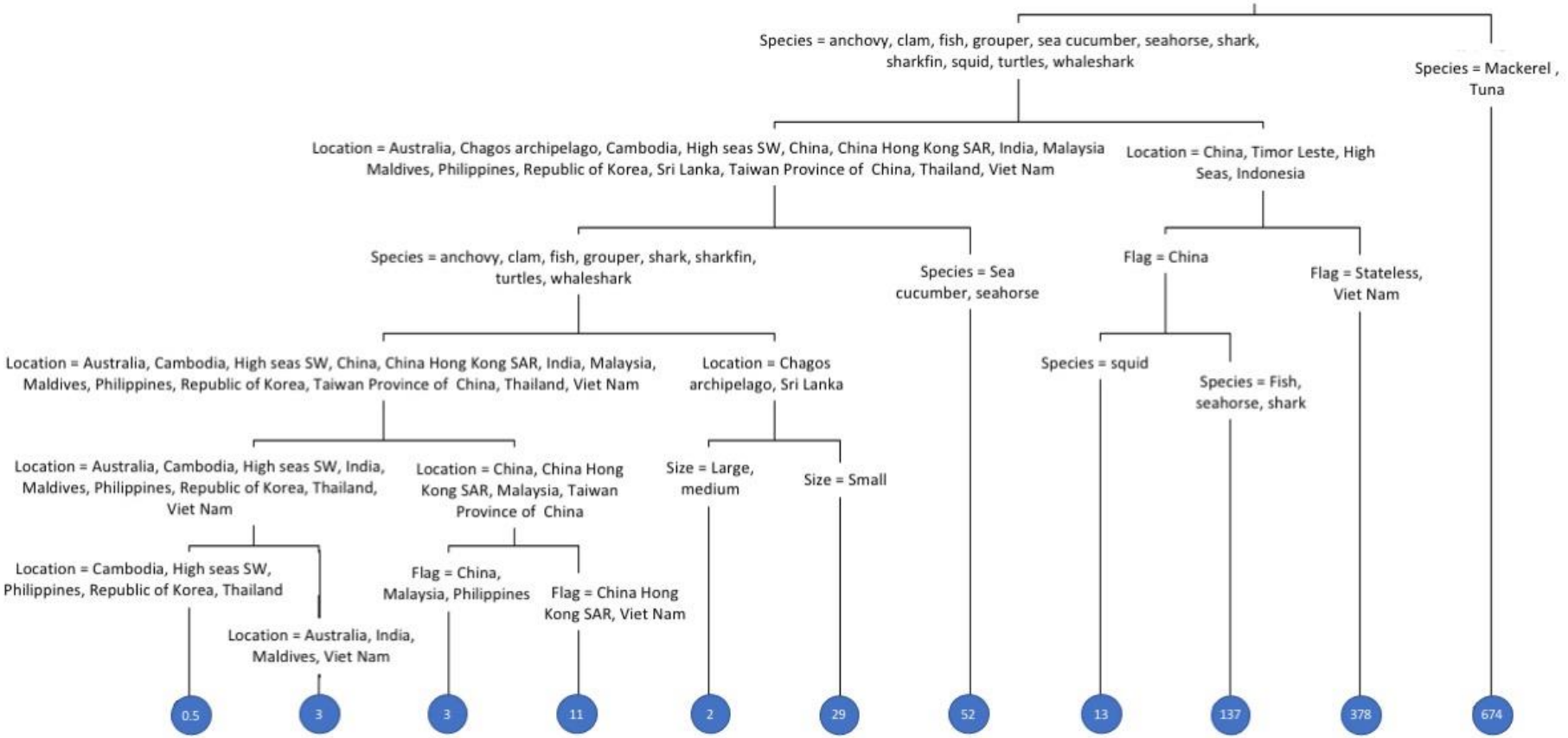

Figure 4.4: Distribution and cumulative distribution of reports with catch details and derived catch

Source: Current study.

A measure of the relative error at each split of the tree was estimated as a guide to optimal tree size (Figure 4.5). From this, the improvement in model fit was negligible beyond the fourth split.

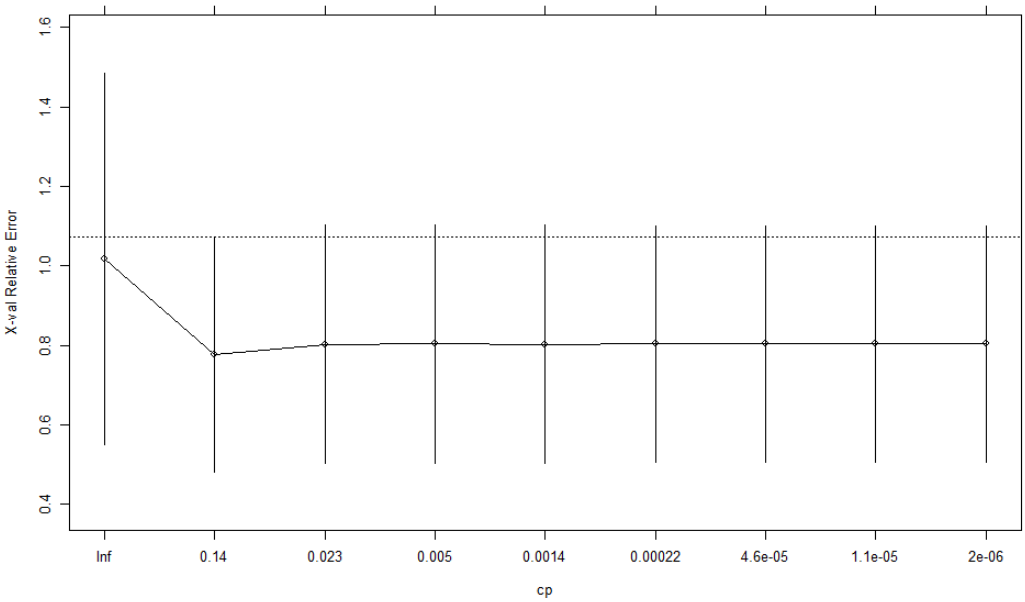

Figure 4.5: Reduction in relative estimation error with each additional split

Source: Current study

Given the limited apparent improvement in the model via the use of a lower cp, a sensitivity analysis using a more 'pruned' tree was undertaken. The cp was set at cp=0.000001 in the base model, which meant that the regression tree algorithm would continue to look for branches even if they only resulted in a very small improvement. The analysis was also repeated using cp=0.001, which resulted in a regression tree with eight nodes (instead of 11 in the base model), and cp=0.01, which resulted in only four nodes.

While the correlation between the estimated values from all three analyses was high (Figure 4.7), this was largely driven by the high-value estimates; all three models were able to produce similar estimates for the high-value records. However, as the complexity decreased (i.e. the cp increased), the lower value estimates were affected. Given that most records were at the lower value end of the distribution, there are benefits in using the model with the lowest cp to better distinguish among these values.

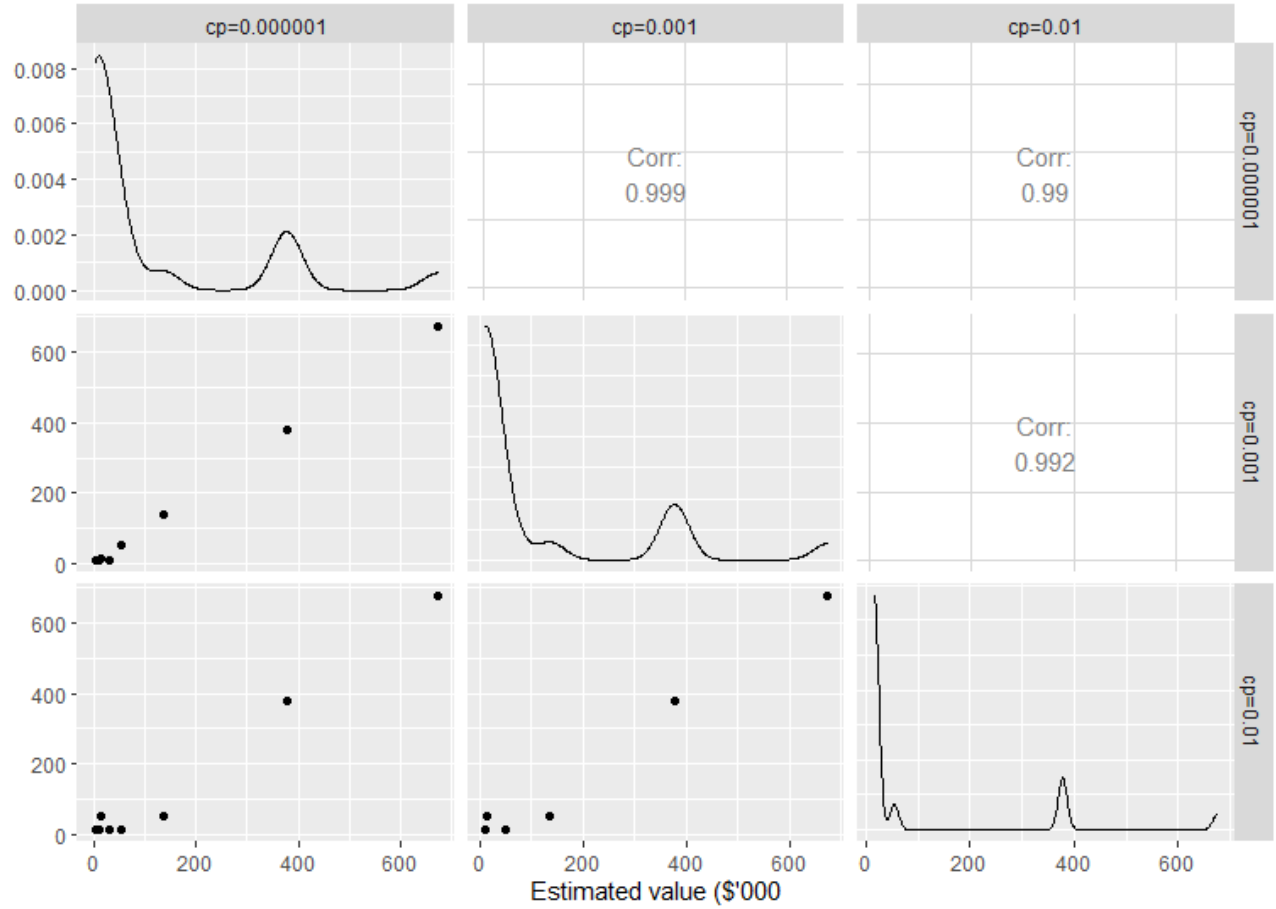

Figure 4.6: Correlation between estimates using different complexity parameters

Source: Current study

As such, the full model (Figure 4.4) was retained for the analysis as it provided the greatest flexibility. The regression tree in Figure 4.4 was hence applied to the remainder of the data (235 observations) to estimate the value of the activity based on year, location, flag, species and boat size. The species caught were not always specified, so they were estimated based on gear type and what other reports had been noted for the same or adjacent location and gear type. The estimated value was then multiplied by the number of vessels involved to provide an estimate of the total value of the incident.

4.4.4 Estimates of illegal-fishing values

The distribution of the estimated values associated with each reported illegal-fishing incident for each of the locations identified in the media analysis is shown in Table 4.3. As noted earlier, these were the estimated values of reported incidents and related to the trip on which they were intercepted; how many other times the vessel engaged in illegal fishing over the year was unknown, as was the number of other vessels engaging in illegal fishing that were not intercepted. The estimates in Table 4.3 cover 2014 to 2019 and have been inflated to 2019 equivalent values.

Table 4.3: Distribution of estimates of the value of each reported illegal-fishing event, 2014 to 2019 (USD'000)

LOCATION	NUMBER OF RECORDS	MEAN	MEDIAN	MAX	STANDARD DEVIATION
Australia	14	166.0	14.5	1 448.3	359.7
Bangladesh	1	682.4	682.4	682.4	-
Chagos Archipelago	2	548.6	674.4	941.7	468.9
Cambodia	3	5.0	1.4	13.1	7.1
China, People's Republic of	9	330.7	274.5	1 133.4	368.0
China, Hong Kong SAR	2	9.4	9.4	18.6	13.0
High Seas (Indian Ocean)	1	675.5	675.5	1 348.8	952.2
High Seas (Northwest Pacific)	1	258.7	13.3	1 357.5	447.5
High Seas (Southwest Pacific)	21	1.4	1.4	1.4	-
India	22	39.1	14.4	263.0	62.9
Indonesia	48	1 385.5	755.6	14 356.8	2 232.2
Japan	5	1.6	1.3	2.6	0.6
Korea, Republic of	4	1.4	1.3	2.6	0.9
Malaysia	20	24.7	7.0	272.7	58.4
Maldives	3	835.1	993.8	1 348.8	635.0
Pakistan	19	17.4	8.8	65.0	18.9
Papua New Guinea	4	629.7	377.8	1 133.4	436.3
Philippines	32	46.8	1.3	674.4	167.8
Solomon Islands	2	755.6	755.6	1 133.4	534.3
Sri Lanka	77	72.9	29.4	848.0	157.6
Taiwan Province of China	2	5.6	3.5	9.7	3.6
Thailand	31	18.1	2.6	155.2	38.8
Timor-Leste	1	1 257.6	1 257.6	1 257.6	-
Viet Nam	2	4.7	4.7	6.6	2.7

Source: Current study.

In many cases, the median value of the catch from an illegal-fishing trip was relatively small. Reported incidents with values exceeding USD 1 million were seen in eight of the locations, with the maximum incident having an estimated value of around USD 14.3 million. This involved 38 medium-sized vessels (with 228 individuals) from Viet Nam caught fishing illegally in Indonesian waters.

The estimated values were allocated to either the domestic fleet of each country or a foreign fleet based on the flag of the vessel. For most of the countries examined, illegal fishing by the domestic fleet represented less than 25 percent of the total reported illegal fishing (by value). This suggested that for most countries, reported illegal fishing was undertaken mostly by foreign vessels operating illegally in their waters. For six of the countries examined, between 50 percent and 75 percent of illegal fishing (by value) was undertaken by domestic vessels, and for the remaining four countries (reported), illegal fishing was fully undertaken by the domestic fleets.

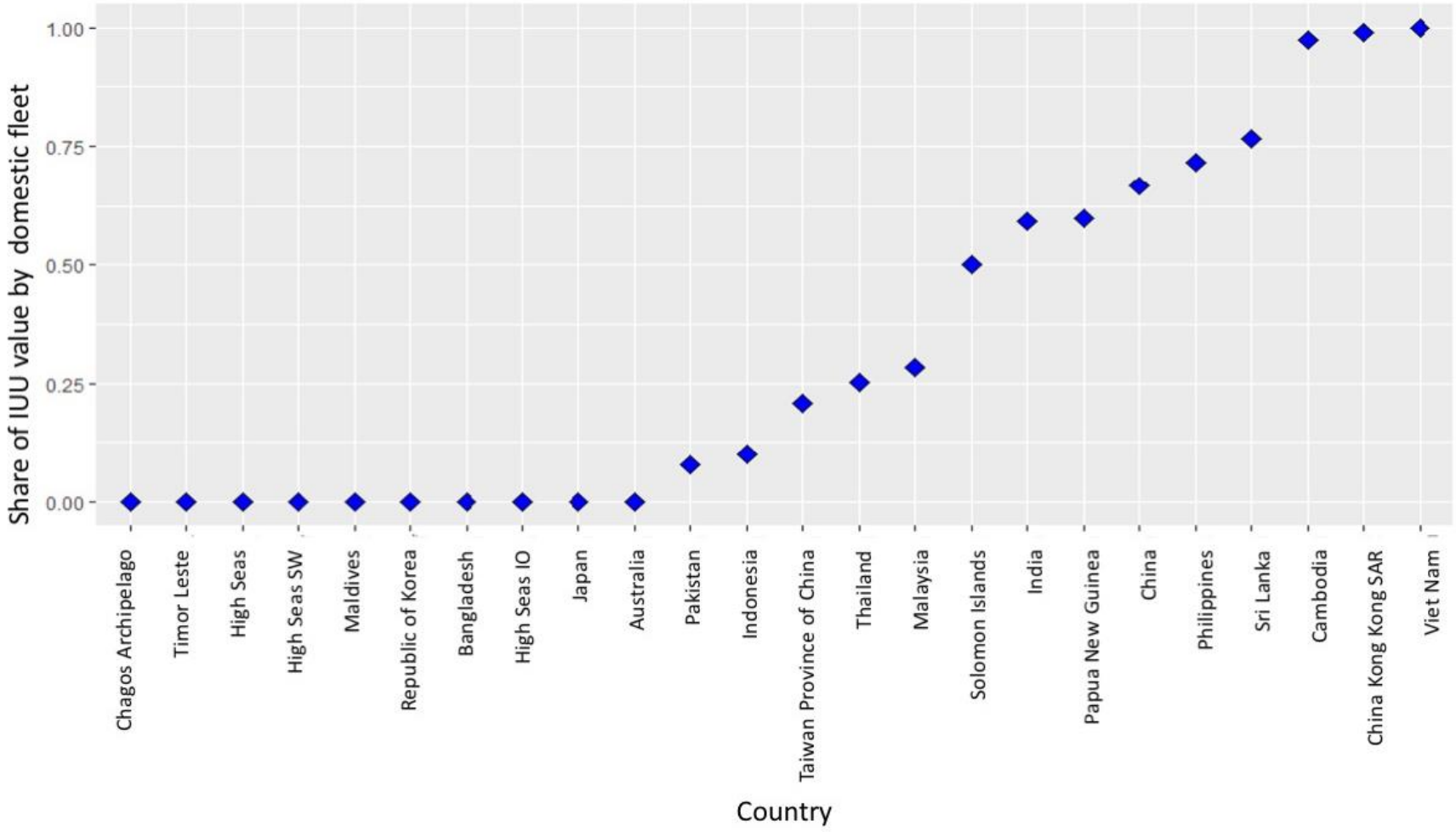

Figure 4.7: Proportion of illegal fishing undertaken by the domestic fishing fleets

Source: Current study.

5 Case studies

In this section, three case studies are presented in which information gleaned through surveys, media reports and conversations with fisheries experts (see sections 2, 3 and 4) are synthesized and highlighted. These case studies highlighted the following patterns, which are consistent with findings noted from other information sources:

- Foreign incursions and unauthorized gear often target high-value species (Palk Bay and Palk Strait, Sri Lanka case study, section 5.1);
- Illegal-fishing activities are often associated with border regions (Timor-Leste case study, section 5.2); and
- The live seafood trade (Sulu Sea case study, section 5.3).

5.1 Palk Bay and Palk Strait, Sri Lanka

In the wider review of the Bay of Bengal, the Sri Lanka EEZ was primarily subject to illegal-fishing incursions by boats from India. The Palk Bay area was identified in the previous APFIC report as a hotspot of illegal activity. Furthermore, the area was identified as the main source of livelihood for over 250 000 Indian fishers who outnumbered the Sri Lankan fishers by nearly ten times. Fishing is an important part of life in Sri Lanka and includes traditional fishing without boats (Figure 5.1, left panel) as well as fishing from unpowered and powered vessels. FAO statistics showed that Sri Lanka has 290 167 fishers and their powered vessel fleet more than doubled in numbers from 12 620 boats in 1995 to 30 903 boats in 2016 (FAO, 2018c). Over the same period, unpowered fishing boat numbers stayed relatively consistent with an estimated total number at just under 19 764 in 2016 (FAO, 2018c).

Figure 5.1: Sri Lankan artisanal fishers
Photograph: ©A Thomsett, reproduced with permission.

While Sri Lanka is an APFIC member country, the area in question between northern Sri Lanka and Southern India is under an 'Area of competence without specified limits' for which there is a joint management and use area. In such areas, unlicensed fishing in a country's EEZ by boats from neighbouring countries commonly occurs; in this case, by neighbouring India (BOBLME, 2015).

Figure 5.2: Palk Bay fishery hotspot
Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021)

Palk Bay was named as a hotspot in the 2015 study of illegal fishing in the APFIC region (FAO, 2016a). However, Palk Strait covers the broader Sri Lankan EEZ area that the authors refer to. This area is also referred to in some media reports as the Northern Seas area. The Palk Strait hotspot is a small section within the FAO Bay of Bengal subarea that is estimated to account for 9 percent of global marine fishery catch with 7 185 319 tonnes annually (FAO, 2016a). The value and volume of IUU catches estimated for the Palk Strait portion of the Sri Lanka EEZ was ranked fifth highest across the APFIC region. The authors estimated an IUU catch of 61 200 tonnes and a related economic value of USD 153 million to USD 750 million *per annum* (based on an average value of USD 2.40/kg).

This study focuses on 74 identified media incidents that were reported in Sri Lanka. Of these, almost 80 percent of the incidents (N=58) were in the Palk Bay/Strait hotspot area (Figure 5.2). Several of the media reports cited the Sri Lankan Navy's Fast Attack Craft intercepting the illegal-fishing operations. The addition of this high-speed, long range vessel seems to have increased Sri Lanka's monitoring capacity and in turn, has led to the detection of higher levels of illegal-fishing activities. Once detected, the boats and crews are escorted by the Fast Attack Craft to other navy vessels for escort into port. This system allows the Fast Attack Craft to return to patrols and make multiple detentions in one evening.

5.1.1 Infraction summary

Two common types of infractions were reported in the media, and they correspond and confirm the findings of those reported previously by FAO (2016). The first type of infraction was incursions of the Sri Lankan EEZ (boundary line shown in Figure 5.2) by Indian fishers without authorization, usually via trawling. Most of the media-reported incidents were 'country boats' i.e. vessels with usually four to six fishers on

board. In contrast, larger commercial trawlers were reported to typically have a crew of eight to ten persons.

The second common infraction scenario involved local Sri Lankans fishing from either powered small boats or unpowered dinghies. These local fishers typically use dive equipment (with or without compressed air tanks) during the night to target sea cucumbers, fish and sometimes conch. Night diving is banned in Sri Lanka. Some incidents mentioned the confiscation of dive masks and compressed air tanks associated with catches of large numbers of sea cucumbers. For example, in one case three fishers had 929 sea cucumbers. Media reports of infractions by local fishers involved the use of banned microfilament nets and explosives.

We found only one report within our data to support evidence of the final type of illegal-fishing activity previously reported by FAO (2016a) for this hotspot – smuggling contraband and drugs. One other interesting observation was that many of the newspaper reports included both an Indian trawler infraction and local fisher infractions. It may be that smuggling has declined in the region, or it is possible that reporting rates have decreased due to interactions among governments within the region.

How much illegal fishing is occurring in this hotspot lacks a definitive answer. However, clues can be found in the newspaper article which mentioned that on one evening alone nearly 3 000 Indian fishers in 500 boats returned to shore without catches after being chased away by the Sri Lankan Navy. Navy personnel reportedly opened fire in the air to drive off the large group of Indian fishers, damaging trawling nets and other fishing equipment (Asian Tribune, 2017).

5.1.2 Target species

The target species for the infractions by local fishers varied and were dependent on equipment type (e.g. the use of dive equipment or nets). In the case of diving infractions, the target species reported in the media articles was sea cucumber. In addition, conch and fish were reported as confiscated by fisheries officers. Local fishers using nets, sometimes in powered boats but also in unpowered dinghies, were also reported in the media as having fish on board. No species were detailed in any of the media reports. Illegal-fishing infractions by Indian fishers were all reported to be from shrimp (prawn) trawlers. In all cases, the incidents involved bottom or pair trawling.

The 2015 APFIC IUU review report noted that this hotspot was an area known for targeting ETP species, including turtles, dugongs, dolphins, sea snakes, seahorses, and, to a lesser extent, sea cucumber (FAO, 2016a). The media reports analysed for this area mentioned confiscated catches of sea cucumber but no interactions of any of the other aforementioned species. Hence, it is unclear whether the lack of reports regarding ETP species was due to declining abundance of already impacted species (previous IUU had led to depleted stocks), though it would seem reasonable to assume that this was at least part of the reason.

Several reports included fishers who had caught conch along with sea cucumbers. This suggests that conch is an additional species impacted in this hotspot. Whale shark could be added to the list of potentially impacted ETP species in this hotspot as well. This is based on a media report of a fisher arrested in the process of moving the whale shark he had caught with a tractor (which was also confiscated in the process) (Anonymous, 2016).

5.1.3 Trawling ban and evidence of cross-border cooperation

Multiple media reports mentioned Sri Lanka's ban on trawling and night diving. One report seemed to suggest that the night diving bans meant that locals were not commercially involved in the fishery and therefore they were unable to assist authorities in the detection of Indian fishing vessels making incursions into Sri Lanka's EEZ.

When searching for media reports of specific illegal-fishing incidents many articles were found that described the release of Indian fishers from Sri Lankan prisons and court-ordered releases of impounded Indian country boats. Although there remains a lack of definitive agreement between the two countries and still no bilateral Palk Bay Management Authority, it seems that Sri Lanka will now present arrested

Indian fishers to court and then release them so they can return home (rather than imprison them). A media example stated “Meanwhile, 51 Indian fishermen from Tamil Nadu, who were languishing in Sri Lankan prisons, were released on Saturday as per a decision taken at a high-level meeting between the two countries earlier this week. While 39 of the fishermen were produced before a court in Jaffna, the remaining 12 were produced before a court in Vavuniya, before being released” (Hindustan times, 2017)

5.1.4 Summary

The Palk Bay Sri Lankan EEZ continues to be a hotspot location for illegal fishing from neighbouring southern India as well as local fishers using banned fishing gear or diving at night. Furthermore, there is thought to be significant underreporting of catches in Sri Lanka estimated to range between 26 026 tonnes to 273 278 tonnes (BOBLME, 2015). The media articles analysed provide evidence that the Sri Lankan Navy has increased its effectiveness in detecting both types of illegal fishing with its Fast Attack Craft and continues to actively enforce the EEZ boundary.

5.2 Timor-Leste

Timor-Leste is a young nation which gained independence from Indonesia in 2004. It borders the poorest region of Indonesia on the island of Timor. After achieving independence, Timor-Leste fishing regulations were modelled on those of Mozambique. Some think that the regulations may not necessarily be compatible with local needs.

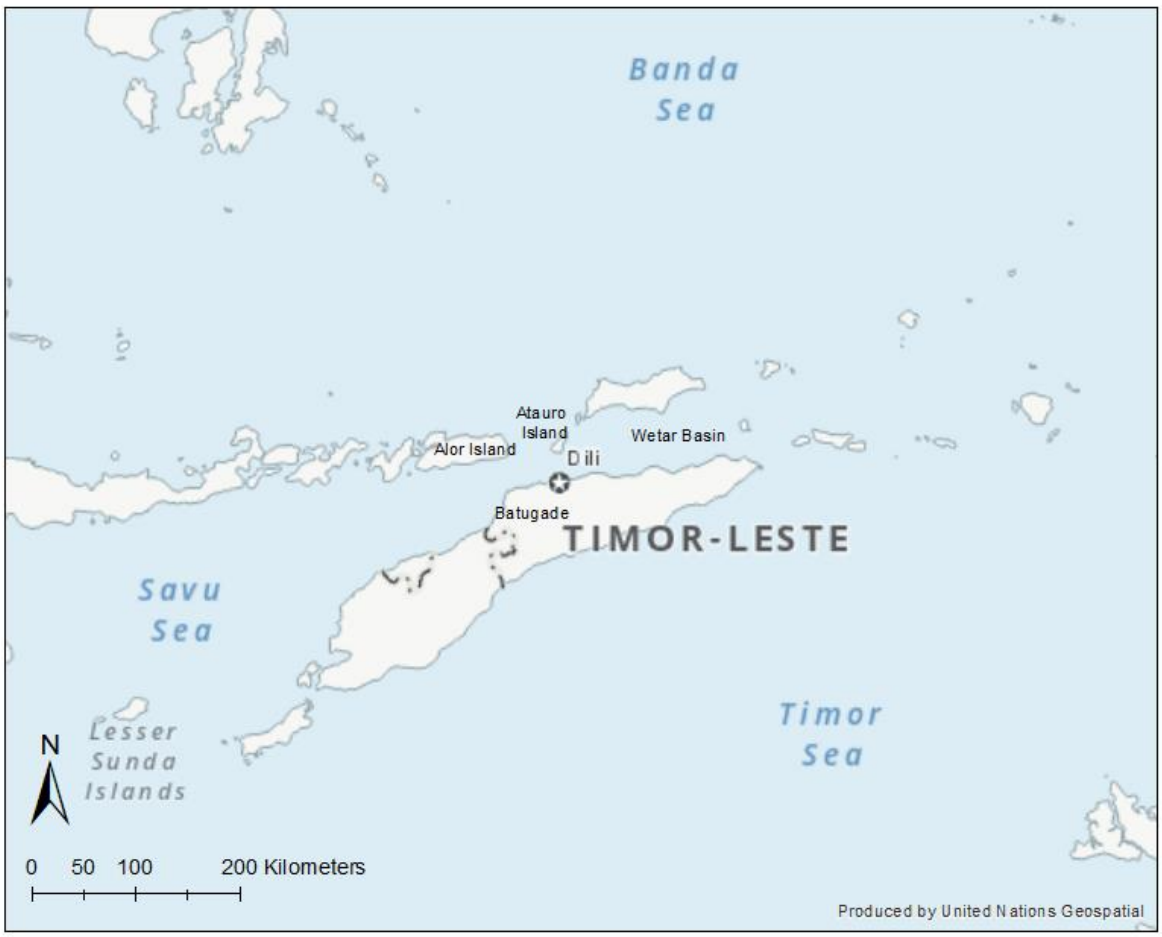

Figure 5.3: Case Study 2 locality – Timor-Leste
Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021)

The Timor-Leste EEZ covers an area of 52 060 km^2 with an additional area of 13 254 km^2 defined as territorial sea and 6 362 km^2 as a contiguous zone (BOBLME, 2015). In 2013, 'No Take Zones' (NTZs) totalling an area of 207 km^2 were established within important coral reef habitats to conserve reef fish spawning sites, enable fisheries replenishment and protect key dive and snorkelling sites for tourism purposes (Coral Triangle Initiative, 2013). Timor-Leste's EEZ is surrounded to the north, east and west by Indonesia and has a border to the south with Australia (Figure 5.3).

The Timor-Leste fisheries department has a very small budget and limited capacity to patrol or enforce fisheries legislation in its own waters. Illegal activities in Timor-Leste seem to be managed more effectively through cultural norms. For example, blast fishing has been made culturally unacceptable by traditional elders, and incidence is rare. Community-level monitoring is high; however, authorities often do not have resources available with which to respond to reports of illegal activity. The country's two government patrol vessels are seldom operational.

5.2.1 Infraction summary

Employment options are limited on both sides of the border between Timor-Leste and Indonesia. Many Indonesians previously worked for large foreign fishing vessels which are no longer allowed to fish in Indonesian waters. This has caused huge displacement in local communities of Timor and Timor-Leste.

Although it commonly occurs, reef fishing in Timor-Leste is banned under Article 91 of the Fisheries Decree Law of East Timor (Democratic Republic of Timor-Leste Government, 2004). Around 30 percent of fishing in Timor-Leste involves fishing from the shore using very fine cast nets (targeting sardines) or gleaning (a fishing practice traditionally undertaken by women). Traditional fishing methods in Timor-Leste include poisoning, using the roots and fruits from a local tree, and scare methods to corral fish into nets. The domestic fishing fleet is very small. Interviewee(s) estimated there were perhaps 300 vessels owned by fishers in Timor-Leste, with fewer than ten vessels in total having an inboard motor. Fishing in marine-protected areas is not uncommon. Blast fishing is known to occur around the island of Alor. While trawling is banned under Article 87 of the Fisheries Decree Law of 2004, fishers sometimes use 'mini trawl' or 'baby trawl' which are very destructive to sea floor ecosystems (Democratic Republic of Timor-Leste Government, 2004). Responses to our online survey for this region however suggested that illegal activities were more often carried out by larger scale, organized operators. These data are supported by information received in both surveys and our interviews with experts.

There was conflicting information about the presence of foreign vessels in the waters of Timor-Leste. One source suggested that due to lack of enforcement, large foreign vessels were actively fishing using trawl nets. Another source said that one Chinese fleet has received a permit to fish in the Timor-Leste EEZ but there was little activity otherwise. The media analysis confirmed that Chinese fleets have a recent history of shark finning in Timor-Leste waters and that penalties are low (ABC News, 2018). It is worth noting that the Fisheries Decree Law does not prescribe any penalties other than revocation of permits. Foreign vessels are thought to fish mostly on the southern side of Timor-Leste, in the Timor Sea.

5.2.2 Target species

Responses to the survey conducted suggested that species of concern in these waters included albacore tuna, bigeye tuna, grouper and black marlin. Of these, albacore tuna was noted as being most susceptible to illegal activities. The Wetar Strait contains a high biomass of small fish species, particularly fusiliers. Turtles are targeted for human consumption both in Indonesia and Timor-Leste in the Timor Sea.

5.2.3 Cross-border collaboration

Few foreign vessels in the region and the lack of a strong domestic fishing fleet in Timor-Leste have provided an opportunity for nearby Indonesian fishers to exploit their waters. Incursions by Indonesian

vessels typically take place on small vessels (5-m to 6-m long) with up to ten crew. They commonly use handlines and target reef fish.

Near Batugade, and the area around Atauro and Wetar islands, an informal arrangement between Indonesia and Timor-Leste allows Timor-Leste fishers to fish in the waters owned by Indonesia and vice versa. Local police reportedly allow this to occur. FADs are not illegal in Timor-Leste, so local fishers invite Indonesian fishers to use their FADs in Timor-Leste waters in return for a share of the catch. Batugade is an important port for trade, particularly for fuel and collaborative fishing arrangements. It has also been reported that some Indonesian purse seine fishers work with Timor-Leste fishers in the region.

5.2.4 Summary

Many of the issues raised in FAO (2016) appear to be relevant for Timor-Leste. The local fishing fleet is small and has limited capacity. Foreign fishing is mainly undertaken by small-scale Indonesian vessels; target species are mainly tuna and small pelagics and activities usually include trawling or purse seine fishing. Timor-Leste has very little capacity to patrol or enforce its fisheries laws.

5.3 Sulu Sea live seafood trade

The Sulu Sea region, including the northern reaches of the Celebes Sea, is a hotspot for the live trade of marine creatures into China, Hong Kong SAR. This area is considered an easy place to access valuable species such as grouper, Napoleon wrasse, coral trout and turtle. Reef fish are often caught through the use of poisons such as chlorine, which is used to stun fish, slowing their movement so they can be caught alive.

Figure 5.4: The Sulu Sea and Celebes Sea area is a hotspot for the live seafood trade
Base map source: United Nations Geospatial https://www.un.org/geospatial/mapsgeo/webservices (January, 2021)

Both media (Business Mirror, 2018) and survey data show that live corals are also harvested in this body of water. The market for live corals appears to be marine aquarium hobbyists, although corals are also dried and painted for sale as exotic souvenirs.

Vessels in the region are mostly trawlers, purse seiners, longliners and pump boats. Larger vessels of up to 30 GRT will stay at sea for weeks to months and tranship their catches. There are 11 known China, Hong Kong SAR-flagged vessels that collect live fish from the Sulu Sea region for import into China, Hong Kong SAR. These vessels are registered and have permits for cultured fish. However, they have been found to be importing Napoleon wrasse and other species. There is a high incidence of transhipment in the live seafood trade.

5.3.1 Market forces and drivers

We understand a large portion of the live trade is offloaded in Aberdeen Harbour, China, Hong Kong SAR. This is an unmonitored, 24-hour port. Under China, Hong Kong SAR law, the fishers' transport vessels are not required to declare live fish on arrival as they are not considered seafood. Under CITES, however, protected species such as Napoleon wrasse should be declared. Based on anecdotal reports, it is believed that enforcement of the law against transport of protected species only occurs when the trade arrives by air. It is worth noting that foreign flagged vessels are required by law to declare their catches when offloading in China, Hong Kong SAR, while domestic flagged vessels have less stringent requirements.

Some live reef fish are placed in aquaculture facilities in China, Hong Kong SAR for nurturing until they can be sold as larger specimens or transported to mainland China. Fish are purchased by wealthy consumers and the economic return is high. Retail figures for Napoleon wrasse in China, Hong Kong SAR indicate that market sales are two or three times the declared imported volume. Live Napoleon wrasse and leopard coral trout are most commonly sold for USD 100 to USD 200/kg for what are mostly small/juvenile fish of 500 g to 700 g. Larger specimens sell for several hundred dollars more.

Turtles are a valuable live commodity, driven by a lack of protection law enforcement in the local region and high financial return. Local fishers are reportedly hired by organized foreign syndicates to catch live turtles and stockpile animals in secret locations on offshore islands. Once a decent number has been gathered, the foreign counterpart returns to collect the live animals. Estimates of numbers or value of this trade have proven difficult to determine. Turtle eggs are also considered a traditional delicacy for wealthy locals in China, Hong Kong SAR and elsewhere.

5.3.2 Summary

The nature of illegal activity noted for this area appears to have expanded beyond that found by FAO (see locations 22 and 28, Appendix A1) in 2015 (FAO, 2016a). Turtles are still a valuable live trade pursued primarily by purchasers for Chinese and China, Hong Kong SAR markets; live reef fish trade appears to be increasing with corresponding high demand in China and China, Hong Kong SAR. Loopholes in regulations for live trade import into China, Hong Kong SAR appear to be facilitating illegal activities.

6 Discussion

6.1 Illegal fishing and its value in the APFIC area of competence

Surveys with fisheries officers throughout the APFIC region suggested that illegal landings generally comprised less than half of the total landings across the 25 species evaluated in this study. Some taxa, such as sea snails (*Trochus* spp.) appeared to have relatively lower illegal landings, while others such as tunas and mackerel were relatively higher. Across all 25 species, sharks were clearly estimated to have the highest proportion of their landings that were illegal, reaching 50 percent or more of the total landings.

Using FAO-reported catches and prices drawn from SEAFDEC and FAO trade statistics, the level of illegal catches for 2019 was estimated using these data across all areas, except for the South China and Yellow seas, as totalling 6.6 MT, with an estimated value of USD 23.3 billion. This was greater than the previous estimates of FAO (2016) that focused on estimating the volume and value of illegal catch only in the identified hotspots. In comparison, this study estimates values for the region as a whole.

The study results are also greater than those recently published by Sumaila *et al.* (2020), who estimated a total annual IUU catch of between 3.6 MT and 6.6 MT in the Asia region, based on data covering the period 2005 to 2014, with values ranging from USD 3.8 billion to USD 7.5 billion. While the estimate in this study largely coincides with that of Sumaila *et al.* (2020) in terms of volume, this study differs by a factor of three in terms of value. This is due to the relatively low prices assumed by Sumaila *et al.* (2020) of USD 1.05/kg to USD 1.13/kg, in comparison with the higher prices found in this study (averaging USD 3.50/kg). This highlights the importance of having good estimates of both species and price involved in the IUU activity.

As in other studies, the species contributing most to illegal landings is the non-specific fish species category (i.e. all fish species other than those that have been identified species-wise), contributing over half the volume and around one-third of the value of illegal landings in the region. In contrast, high-value species – such as Napoleon wrasse, sea cucumber and sea snails – contribute only a very small proportion to overall illegal landings. Individually the tuna species represent a small proportion of the total illegal landings in the region, but combined, represent over USD 1.6 billion in total value.

The distribution of hotspots for illegal fishing across the APFIC region strongly reflects the estimates made by APFIC in 2015 (FAO, 2016a). Survey respondents covered 31 of the 33 hotspots, of which 45 percent was scored as definitely still hotspots, while another 52 percent was unclear but potentially still hotspots. Only one location, at the intersection of the Red Sea and the Indian Ocean, was scored as no longer a hotspot. The respondents also had an unprompted opportunity to identify areas with high levels of illegal fishing. These too were consistent with the previously identified hotspots, but highlighted some additional areas including the southeast Bay of Bengal, the region at the border of Viet Nam's EEZ and the South China Sea, and the region in the Celebes Sea, between the Philippines and Indonesia. Interviews with key informants further validated the ongoing existence of the illegal-fishing hotspots identified in the 2015 APFIC study. Across 27 of the 33 hotspots covered in the interviews, only one was scored as no longer an illegal-fishing hotspot.

Survey respondents provided more in-depth information on four species in a region within the 'APFIC area' that they selected. This information highlighted some general issues, with species landed from fisheries in regions A, B and C, running from the Bay of Bengal eastward to the Philippine Sea having elevated percentages of illegal landings. This is consistent with the results from the hotspot mapping. Similarly, species such as sea cucumbers and groups such as mixed demersal species and low-value bycatch had particularly elevated levels of illegal landings across regions.

In terms of violations and regulatory contraventions, both the survey and the interviews highlighted encroachment, breach of licence conditions and use of prohibited gears as the most common violations. Across both datasets, the regulations most often contravened were bilateral arrangements, while

international arrangements were the least violated. Border regions were highlighted in particular by interviewees as high-risk areas for illegal fishing. In other cases, structural misalignment between regulations and industry characteristics was proposed to lead to widespread illegal fishing. In some cases, participants suggested that large components of national fleets were operating illegally due to these misalignments.

The media analysis highlighted similar issues for non-compliance that were raised in interview and survey sources, with encroachment and non-compliant fishing gear being the two most commonly reported infractions. The most common taxa reported were again similar to the survey results, including generic fish, sea cucumber, squid and sharks. The media data also provided an opportunity to explore patterns within individual fishing trips by vessels apprehended for illegal fishing. Overall, values were estimated for vessels apprehended in 26 countries which were connected to the 'APFIC area'. Most of the estimated values were relatively small, with only 8 out of 317 records having a value greater than USD 1 million. These values were used to estimate the relative contribution of domestic and foreign fleets operating in the region to IUU fishing. Based on this analysis, domestic fleets in the region represented less than 25 percent of the illegal fishing (by value) for most countries, with most IUU fishing being undertaken by foreign vessels. However, for five to ten of the countries, their domestic fleet was estimated to account for a larger share of illegal fishing, ranging from 50 percent to 100 percent.

The three case studies highlighted similar issues to those noted in the other information sources. The Palk Bay and Palk Strait in Sri Lanka suffer from unauthorized gears and foreign incursions, targeting demersal species and sea cucumbers among other taxa. They are linked to a border region, with some bilateral management in place. While it is clear that surveillance and interdiction are increasing and becoming more effective, this remains a clear hotspot and reflects many of the broad patterns noted in the other data sources. The case study for Timor-Leste highlights the frequency of illegal fishing near border regions and the challenges with managing large, well-funded foreign fleets. In this case, supporting the economic analysis of vessel activities, suggesting that foreign fleets are a significant issue in the APFIC region. The Sulu Sea case study focuses on the live seafood trade, highlighting some of the issues with protected species identified in survey analysis. It also provides a perspective on the contexts where transhipment is likely to be important. Overall, transhipment did not emerge as a major issue in the survey, media or interview analyses. However, in contexts where there are relatively small volumes of high-value marine products, transhipment may be a significant contributor to illegal fishing. Linking poorly controlled ports near markets to harvesting operations in remote locations is a clear indication of contexts in which transhipment will be a major issue.

6.2 Key issues and gaps related to illegal fishing

Based on the data and analyses compiled, illegal fishing in the 'APFIC area' remains a significant issue. A variety of data sources, including responses from fisheries officers, interviews with key informants and analysis of media across the region indicate that many of the historic hotspots for illegal fishing remain, and a number of areas previously unidentified in regional-level analyses may be relevant.

A dominant theme across the information compiled was the commonality of illegal fishing and related issues near border regions. In some cases, these appear to result from a lack of clarity around the location of the border or sovereignty over waters in the region. The South China Sea border with Viet Nam's EEZ is a key case in point. International disagreement over borders in the region is reflected in the activities of vessels among the disputants and is reflected across the data sources in maps from the surveys, media reports and estimates of illegal activity by flag states. On a smaller scale, historic patterns and lack of strong enforcement near border zones can lead to increased levels of encroachment. Palk Bay and Palk Strait provide a clear example, albeit potentially a changing one with the increase in enforcement by Sri Lanka. At an even finer scale, historic cultural connections, particularly in regions where there are discrepancies in wealth or capital investment in fisheries exacerbate illegal fishing near borders. For instance, there are close ties across the Indonesian and Timor-Leste border on the northern coast of Timor. This leads to

significant cross-border fishing activity, which is technically illegal, but potentially tacitly sanctioned on both sides of the borders by many of the stakeholders involved.

Bilateral arrangements between countries, which are often linked to shared resources at border zones, are also a likely contributor to illegal fishing near borders. Survey respondents ranked these regulations as the most frequently violated by vessels engaged in illegal fishing. In many cases, these arrangements may function to support access by foreign vessels, which are relatively well funded, to resources that countries with less well-developed fleets struggle to harvest. However, these bilateral agreements often involve partners who have differences in resources more broadly, making enforcement of regulations around the agreement challenging. For instance, the licensing of Chinese vessels in Timor-Leste waters recently ended with the seizure of a number of vessels with illegally caught sharks on board. Timor-Leste was in the challenging position of managing an offshore industrial fleet with no patrol boats of its own and lack of a functioning national VMS, leaving it with little control or oversight over the operations of the vessels at sea.

The survey, interview and media analyses all highlighted the role of fish buyers or purchasers in illegal fishing across the APFIC region. Purchasers were ranked as the most likely players in the supply chain to be involved in illegal fishing based on the results of the online survey with fisheries officers. Interviewees frequently discussed the role of buyers from major processing and market states in generating demand for products, including from illegal-fishing sources. Buyers often appear to operate in private ports or other facilities, which are difficult to monitor, further increasing the potential for their involvement in illegal fishing. While much technological investment is being made to address behaviours of vessels at sea, such as investment in patrol vessels or installation of VMS, monitoring and surveillance of purchasing agents appear to be much more limited and do not appear to be expanding in a similar manner.

The most common violations found across the surveys, interviews and media analyses were encroachment, breach of licence conditions and use of prohibited gears. These violations appear to be strongly tied to shifting economic returns, likely due to depletion of target species stocks. For instance, trawling in inshore waters is often prohibited, due to impacts on recruitment processes and competition with small-scale fisheries – this appears to be a common regional problem. These vessels may be pursuing increased profitability. However, given the potential for enforcement action in some cases, it is more likely that they are fleeing unprofitable fishing grounds rather than seeking abnormally large financial returns by violating regulations. Similarly, breaches of licence conditions and use of prohibited gears appear to be at least partially linked to decreasing catches in existing areas of operation, again likely driven by depletion. This is an important consideration. If vessels are violating regulations due to loss of profitability resulting from depletion and there is no strategy for vessel owners to exit from their capital investment in unprofitable fisheries, increasing enforcement effort is unlikely to be an effective strategy to reduce illegal fishing. The case of arrest of Vietnamese vessels in Papua New Guinea, discussed in the interview section, suggests that penalties can dissuade illegal activities in some cases. In that case, the penalties required were significant, including imprisonment for 17 years.

Alignment between regulatory systems and industry structure was another key issue leading to high levels of illegal fishing in some regions. For instance, one interviewee suggested that the entire small-scale sector in one country operated illegally, due to regulations that left them unable to access or afford to fish in the grounds that were available to them. The upshot of this situation is that the vast majority of the vessels nationally operate illegally, the relatively small industrial sector monopolizes most of the resources and the fisheries agency faces an embedded culture of non-compliance. In a different vein, the industry structure of the live fish trade discussed in the Sulu Sea case study is poorly linked to the regulatory structure of the transhipment vessels overseen by customs officials in China, Hong Kong SAR. The implication is that inspections are not conducted by trained fisheries officers, custom inspectors have no mandate to address fisheries issues and, in the absence of oversight, the industry has expanded from permitted activities into similar illegal, but highly lucrative ones.

Complementing the issue discussed above about violation of bilateral agreements, international agreements were much less frequently violated. Similarly, species managed under international agreements appeared to have lower rates of illegal landings. For instance, while tunas generally have high values, they are consistently ranked as having lower proportions of illegal catches or landings than other

species such as sea cucumbers across the datasets. In this case, both are commonly exported, both have high values in export markets, and both can be taken by small-scale or industrial vessels. Clearly there are many differences among the species which may play into differences in illegal landings, but the predominance of international management arrangements is clearly one factor that may be involved. Many of the tunas are managed by regional fisheries management organizations, while sea cucumber is typically managed by national governments. BOBLME (2015) found a similar pattern, with much lower rates of illegal and unreported fishing in countries that had predominantly internationally managed fisheries, such as the Maldives. The likely explanation is not the presence of international management *per se*, but instead the increased focus that national governments bring to addressing illegal fishing when it is linked to international obligations.

6.3 The role of changing technologies

Technologies for addressing fisheries monitoring and surveillance are developing rapidly. While VMS have been in existence for decades, expansion of these technologies to include sensors on winches, fish holds and navigation equipment have increased the ability of fisheries agencies to monitor fishing activities. One major recent advance has been the use of onboard cameras, in some cases with real-time video transmission via satellite data links. Thailand has implemented such a system as part of its programme of fisheries reforms on the fish carrier vessels operating in international waters. This system allows the national surveillance centre to monitor transhipments in real time.

Data handling and processing technologies are also evolving rapidly. Cloud-based storage and processing of data has opened the potential for real-time integration of data from electronic logbooks, inspector reports, VMS, and catch and landing documentation. Many of the countries in the APFIC region are in the process of implementing these systems and integrating them across data types to varying extents. For instance, the fisheries agency in the Philippines is implementing a cloud-based integrated data system for monitoring its industrial tuna vessels.

New analytical approaches and further development of existing tools have facilitated better surveillance capacity across many of the countries in the region. Integrating data from satellite remote sensing with VMS has increased the potential for identifying non-compliant vessels, including foreign vessels that are not using a VMS transponder.

Electronic monitoring approaches are spreading from the industrial sector to the small-scale sector. Various commercial providers have developed VMS, even integrating gear sensors and cameras, for small-scale vessels. These moves have brought drives to innovate, such as the use of the VMS themselves as a network to transfer data among vessels and back to the monitoring agency. The Philippines has used such a system on 90 small-scale vessels successfully in several regions, increasing both the safety of the vessels and the compliance monitoring of their activities (Anonymous, 2020b).

While these technologies open new horizons for oversight of vessels at sea, they also raise a number of challenges. They can be very expensive to operate on an ongoing basis, particularly in cases where fisheries agencies have limited operating budgets. Satellite radar for instance can cost USD 2 000 to USD 3 000 for a single satellite scene. Depending on the resolution required, this can equate to a very small area (e.g. a rectangle of only 25 km to 50 km length) Use of this sort of technology at large scales is thus often prohibitively expensive. Technologies also significantly increase the skills' requirements of fisheries agency staff, with shortcomings often leading to outsourcing to international providers from the private sector. While efficient in some cases, countries with little technological experience may be vulnerable to exploitation by private sector providers. In some cases, these providers can be linked to foreign aid, leading to long-term debts generated by investment in equipment that fisheries agencies struggle to operationalize. Finally, technological solutions need to be evaluated in the context where they are being applied. For instance, Myanmar is considering adopting a national VMS. However, the Myanmar Government currently has a port out – port in inspection regime that includes every trip by every industrial vessel in the country. Catch statistics are collected at ports, which are closely regulated by the government. Thus, while a VMS may be useful, Myanmar could achieve high levels of oversight through its port

inspection system without incurring the substantial cost of implementing a real-time VMS and supporting national surveillance centre.

In a similar vein there is some discussion in the region of implementing VMS on small-scale vessels. While this a reasonable goal for an industrial fleet with a few thousand motorized vessels with reliable power and communication systems, it may be prohibitive in the context of a national small-scale fleet. Small-scale vessels are unlikely to have reliable power, may vary widely in how often they operate and are likely to number in the tens to hundreds of thousands, creating a significant data management and oversight challenge. In the case of small-scale vessels, shore-based monitoring or surveillance of high risk at sea locations may be much more cost-effective than vessel-based electronic monitoring.

This report has primarily focused on illegal fishing and largely on activities at sea or at port. However, technological innovations are also entering the fisheries supply chain at later stages. Traceability systems are being developed and implemented in a number of cases, from industrial purse seine fisheries to small-scale handline fisheries. These systems, like many of the VMS, are most common in fisheries that are exporting to international markets, particularly in the United States and Europe, where regulatory changes are requiring increasing monitoring and surveillance as a component of permitting imports. These systems involve a wide range of technologies, from databases and electronic data entry tools that track products through the supply chain to the use of genetic and other biological sampling to verify sources, species and other key information. To date, these systems are much less widespread than traditional vessel monitoring.

6.4 Recommendations emerging from this report

Based on the information presented in this report, eight recommendations are presented for consideration by APFIC and its member countries.

1. The Commission should continue to focus effort on addressing IUU fishing in the area of competence. While progress has been made in many contexts, the analysis suggests that illegal fishing is still a significant issue in the region, affecting many of the countries, stocks and international waters.
2. The Commission and its members could adopt a cost-effective and transparent benchmarking system to validate improvements and identify problem areas. Anecdotally, several interviewees discussed the decrease in foreign incursions by Vietnamese vessels for instance. This is due to a mixture of strong interventions by the Viet Nam Government, pressure and support by other governments in the region, and increased detection and interdiction activities with significant penalties by coastal states. However, at the moment there is no established mechanism for tracking this regional improvement, nor recognizing the efforts of the Viet Nam Government.
    - Developing a cost-effective and transparent system by which APFIC and its members could periodically update their estimates of IUU fishing would be a very useful tool for tracking progress and identifying areas for increased focus.
3. Many of the countries in the region are reforming their fisheries laws and regulations, including revising their arrangements for licensing foreign vessels, joint ventures and other structures. Increasing the quality of these regulations, in particular bilateral arrangements, could bring significant benefits in terms of reduced illegal fishing.
    - Developing design guidance, such as the use of surety bonds for foreign licensed vessels for instance could shift the burden of ensuring compliance from the fisheries agencies to the vessel operators, thus reducing agency costs and making compliance and other reporting part of established industry standard operating procedures.
    - APFIC could work with its members and outside organizations to establish a set of best practices for regulatory reform and structure, ranging from industry consultation to establishing compliance procedures. This could be particularly relevant for the APFIC

members with lower capacity and limited fisheries agency budgets, as it might allow them to increase the quality of their regulatory systems at low cost.

4. Throughout the analysis presented in this report, incursions, both domestically across different management zones and internationally across borders, were a common feature of illegal activity. Interviewees consistently mentioned corruption among enforcement officers as a central feature in enabling these incursions. In some cases, it was reported that enforcement agencies, including police and navy officers, were even involved in organizing the activities. Addressing this issue is an important component for reducing illegal fishing in the APFIC region. Based on the information gathered for this report, there are two recommendations with respect to incursions and their linkage to corruption.

    - First, it is critical that fisheries and enforcement officials understand that illegal-fishing activities as prescribed by the fishery legislation are criminal activities that carry appropriate penalties. If enforcement officials in particular view illegal-fishing violations as petty crime, they are less likely to take substantive action to deter or combat them and may also justify collusion with fishers engaged in the activity.

    - Second, it is critical that there is substantive oversight of enforcement officials and activities, particularly near border regions where lucrative but prohibited cross-border activities might occur. These activities could be embedded in a capacity development programme, targeting increased knowledge of fisheries and other relevant regulations, inspection and evidence-gathering skills, and awareness-raising to address issues related to corruption.

5. Many of the countries are engaged in similar activities, such as the development of VMS or the creation of interagency coordinating bodies for enforcement. However, sharing of information around these activities appears to be relatively limited.

    - For instance, many countries are in negotiation with VMS providers to implement or improve national systems. Some of the countries in the region have significant experience in negotiating with providers, designing tendering systems to increase competition and reduce costs, and issuing technological standards that ensure interoperability and reduce the cost of changing or combining providers where cost reductions are warranted. Creating venues for the sharing of such useful information could bring significant benefits to APFIC members and involve relatively modest costs.

6. Illegal-fishing activities around international borders, shared zones and disputed waters were a common pattern throughout the APFIC region. One key facility that is currently lacking in the region is the capacity to easily share information near borders to support monitoring and surveillance by neighbouring countries. The RPoA IUU currently has an informal system for sharing information via its meetings, direct contacts established through the organization and support from the Secretariat. However, even in that situation information is shared on an ad hoc basis and is dependent on direct contact among agencies.

    - APFIC could consider supporting an effort to investigate the potential for a platform for sharing this type of information. It would be important to consider barriers that might reduce participation or use in the process. However, members might be willing to share vessel-monitoring data in an anonymized form for a narrow section of their waters with neighbouring countries. If this was implemented as a platform where information could be securely shared in real time by partner countries sharing borders, it could increase the effectiveness of monitoring, surveillance and enforcement activities by both neighbours' fisheries agencies. While such a platform is likely to meet resistance from countries with disputed boundaries, even implementing it in areas where borders are well established could yield significant benefits at very low costs.

7. Fish purchasers were identified as key players involved in illegal fishing across all of the examined data sources. Increasing attention on monitoring, surveillance and enforcement action to address these businesses would likely pay disproportionately large returns across the region.
    - Depending on the structure of the industry across the region, it is likely that there are fewer buyers than vessels, and that they are relatively concentrated, meaning that increased compliance by these businesses will have upstream effects on the vessel operators they purchase from and downstream effects on other businesses in the supply chain.
8. Stock depletion is likely to be the key, ultimate driver underlying illegal fishing in the APFIC region. Concomitantly, overharvesting and excess capacity across the region are difficult problems to solve and have widespread links to livelihoods and other difficult issues.
    - Supporting improved stock status is an important component of addressing illegal fishing in the region.
    - Assisting countries in developing management plans, reducing fishing capacity, measuring stock status and implementing regulations that lead to rebuilding can all assist in reducing stock depletion, and ultimately increasing compliance.
    - While a challenging process, increased enforcement alone is unlikely to lead to significant reductions in illegal fishing at the regional level.

We end this section on a positive note. Fish bombing is common in the region surrounding Timor-Leste. However, one interviewee suggested that bombing was rare in Timor-Leste, largely due to cultural norms about the use of explosives for fishing. Thus, in the absence of formal regulatory action, Timor-Leste has managed to avoid a destructive fishing practice that plagues many countries in the region. Consideration of alternative approaches, social norms, information sharing and focused support for countries in the region has the potential to address many of the issues uncovered in this examination of illegal fishing in the 'APFIC area'.

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Appendices

A1. Summary of key findings of the APFIC regional review of illegal, unreported and unregulated (IUU) fishing by foreign vessels

Based on the information paper APFIC/16/INFO-07 presented at the 34th Session of the Asia-Pacific Fishery Commission, Colombo, 12–14 February 2016.

Background to this summary

Illegal, unregulated and unreported (IUU) fishing remains a pervasive global problem in the Asian region. Its clandestine and illegal nature makes IUU fishing difficult to detect and deter. It is also particularly hard to quantify its economic, environmental and social impacts. The unpublished report 'Regional review of illegal, unregulated and unreported (IUU) fishing by foreign vessels' was prepared by the Secretariat of the Asia-Pacific Fishery Commission (APFIC) in 2015 and presented as an information document at the 34th Session of APFIC (held in Colombo, Sri Lanka from 12 to 14 February 2016). Noting some of the limitations of the review (for example domestic IUU was not covered), the 34th Session welcomed the draft review as a first step towards understanding IUU fishing in the APFIC region and recommended a follow up.

The review quantified and characterized primarily illegal, but also unregulated or unreported fishing activity in the Asian region by foreign fishing vessels or vessels that had foreign beneficial ownership. The information sources used to derive the information for case examples of IUU-fishing hotspots were media reports and survey questionnaire and interview responses from key respondents in the region. In total, 33 IUU fishing hotspots were identified based on key criteria relating to the legality of the fishing vessels and their fishing activity. IUU related to domestic fleets within their own EEZs (e.g. small-scale and medium-scale fishing) and onshore processing were not covered in this review. The estimated values and volumes of IUU identified in the 2015 review were therefore lower than the estimates presented in the main report.

The 2015 review was completed at a time when many countries in the region were taking increasingly affirmative action to combat IUU fishing and the review recognized that progress was already being made in combating some of the activity presented. This appendix presents a summary of the findings of the 2015 review to provide a partial basis for comparison with the findings of the current 2021 report.

1. Main findings of the 2015 regional review (IUU)

1.1 IUU volume, value and fishing gear

The results of the review indicated that the total tonnage and value of the estimated IUU catch in all 33 identified IUU fishing hotspots was 2 034 257 tonnes to 2 467 284 tonnes, worth an estimated USD 3 055 million to USD 5 235 million (USD 3.06 billion to USD 5.24 billion). Excluding the East China Sea/Yellow Sea (for which data could not be disaggregated) this represented between 2.3 percent and 10.4 percent of the total reported catch for the fishing areas covered.

Most of the volume and value of IUU fish caught in the subregion can be clustered under a high-volume, low-value catch category. The low-volume, low-value catch is typified by traditional or small-scale IUU transboundary fishing and this represents a tiny fraction of the total IUU catch, even if the number of vessels involved may appear considerable. A disproportionate part of the advocacy around IUU fishing in the region

focuses on its impact on sensitive biodiversity and ETP species, even though the volume and aggregated value may be quite low.

Table A1.1: Characterization of IUU-fishing hotspots in the subregion

CHARACTERISTICS OF IUU CATCHES	**HIGH-VOLUME – LOW-UNIT VALUE**	**LOW-VOLUME – HIGH UNIT VALUE**
Volume	1 922 110 tonnes to 2 313 737 tonnes 93.8 % to 94.5 % of total IUU catches	70 687 tonnes to 100 347 tonnes 3.5 % to 4.1 % of total IUU catches
Value	USD 2 708 to USD 4 717 million 88.6 % to 90.1 % of total IUU catch value	USD 266 to USD 411 million 7.8 % to 8.7 % of total IUU catch value
Type of fishery, species targeted	Low(er) value fish destined for some form of processing. By far the largest volume and total value of the IUU catch in the region. Examples are trawl fisheries/purse seiners: • Surimi • Fish meal • Block frozen fish • Purse seine small pelagics	High-value products, typically destined for a niche or high-value markets. Mainly small vessels, longliners and collection vessels. These are typically targeting species that are ETP such as: CITES-listed species; shark fins, rays; sea turtles (shells and eggs); sea cucumber; sea snakes; corals; giant clams; aquarium trade. Also, longliners targeting sashimi-grade tuna
Indicative hotspots	2, 7, 11, 13, 15, 17, 18, 19, 20, 21, 25, 26, 33	ETP: 4, 10, 22, 23, 27, 28, 29, 32; Tuna: 12, 9
Characteristics of IUU catch	**High-volume – high-unit value**	**Low-volume – low-unit value**
Volume	25 960 tonnes to 37 200 tonnes 1.3 % to 1.5 % of total IUU catch	15 500 tonnes to 16 000 tonnes 0.6 % to 0.8 % of total IUU catch
Value	USD 67 million to USD 93 million 1.8 % to 2.2 % of total IUU catch value	USD 14 million to USD 15 million 0.3 % to 0.5 % of total IUU catch value
Type of fishery, species targeted	Higher value species that are destined for international markets, but which can be caught in large volumes using industrial gears (e.g. purse seine, large trawls, longlines) or where the IUU fishing is conducted by large numbers of smaller boats.	Mainly national IUU-fishing small boats (fisher communities) fishing across borders, into neighbouring countries under a notion of traditional fishing rights. Maybe driven by depleted resources in their own coastal state; the encroachment may be deliberate or non-deliberate 'drifting' because of limited navigational capacity. Some transboundary landings. Vessel types: squid jiggers; small gillnetters; small trawlers.
Indicative hotspots	Mainly tuna longline: 6, 8, 5, 14, 29, 31 High-value part of trawl catch (e.g. shrimp, snappers): 24, 25, 28 Purse seine: 14 Tuna handlining: 30	1, 13,16,17,3

Source: APFIC/16/INFO-07

1.2 Types of IUU

The types of IUU fishing found were generally systematic regular IUU fishing by foreign fishing vessels with foreign beneficial ownership as opposed to opportunistic activity. IUU fishing is typically concerned with fishing without authorization in EEZ waters, contravention of technical or management measures, unauthorized transhipments, fishing by vessels with dual flags or incorrect documentation and in some cases targeting of ETP species. These activities are typically a mixture of several interrelated issues and will therefore require a combination of actions, rather than single measures.

The review identified six categories of IUU-fishing activity which were used to identify and characterize IUU fishing by foreign vessels.

- Encroachment;
- Absence of authentic documentation;
- Non-compliance with technical measures;
- Illegal transhipment;
- Illegal species; and
- Degree of premeditation.

Table A1.2: Summary of the hotspot case examples demonstrating particular IUU-fishing characteristics

NUMBER OF CATEGORIES	NUMBER OF IUU-FISHING HOTSPOT CASE EXAMPLES	HOTSPOT CASE EXAMPLES
All 6 categories	7	2, 5, 6, 9, 11, 18, 22
Combination of 5 categories	10	1, 7, 10, 12, 13, 15, 16, 25, 27, 28
Combination of 4 categories	6	4, 20, 23, 26, 29, 32
Combination of 3 categories	9	3, 8, 14, 17, 21, 24, 30, 33, 31
Combination of 2 categories	1	31
1 single category	0	-
Total number of case examples	**33**	

1.3 Drivers of IUU

1.3.1 Weak monitoring, control and surveillance

In almost all cases the activity takes place in locations that are remote from surveillance by MCS units. IUU fishing may be undertaken by large-scale vessels needed to get to remote areas. In almost all of the 33 hotspots, weak or low levels of MCS were identified. The opportunity for IUU fishing is inversely proportional to a country's MCS capacity. Higher frequency of targeted, modern and well-equipped MCS units that make arrests and seizures will inevitably translate into lower levels of IUU fishing. Good MCS should be expanded to include mechanisms to stamp out corruption both on land and on sea. But MCS assets are expensive to acquire, maintain and operate. Many countries, both large and small, are financially challenged to meet the high costs of land, sea and air surveillance. This means that MCS assets and resources must be located and prioritized according to where they are likely to have the greatest effect.

In recent years, maritime security has become a priority for many countries in the region. This increase in priority is based on a wide range of factors relating to increased piracy, the trafficking of humans, drugs and arms, terrorism, and territorial claims and aspirations of countries in the region to better secure their sovereignty. Previously, maritime security administrations and fisheries administrations worked independently of each other. However, with limited financial resources to fund different branches of government with similar marine and air assets, it now makes more sense to combine maritime security with fisheries MCS.

Given the high costs of sea and air MCS, the review surmised that it is important for states to determine the level and impact of IUU by using risk assessment models and surveys to determine the level and impact of IUU. By using risk and impact models, governments will be able to better prioritize and identify hotspots. The review recommended risk assessments to identify hotspots and, in this way, MCS resources should be deployed to areas where relatively high volume and systematic IUU operations have been identified. Nonetheless there is a need to strengthen MCS on land, sea and air.

The difficulty with categorizing illegal fishing is that there are many combinations and aggregations within and between the types of IUU. Overall, 79 percent of the case examples showed clear signs of premeditated IUU fishing and 25 percent was typically transboundary fishing occurring around joint management areas using small crafts on an occasional basis.

The following matrix (Table A1.3) shows the risk assessment framework that can assist states in determining their risk and identifying hotspots.

Table A1.3: Simple risk assessment framework for identifying likely IUU hotspots

	LOW REWARD LOW LIKELIHOOD OF IUU FISHING	**HIGH REWARD HIGH LIKELIHOOD OF IUU FISHING**
Resource quality	Fishery resources are depleted.	Fishery resources in good condition/abundant.
Resource value	Target species are low value and in low abundance.	Target resource is high value.
Accessibility	High competition with other legal fishers.	Low competition with other fishers (e.g. closed or protected area; closed season) Inaccessibility of fishing grounds.
	HIGH RISK OF CAPTURE/SANCTION LOW LIKELIHOOD OF IUU FISHING	**LOW RISK OF CAPTURE/SANCTION HIGH LIKELIHOOD OF IUU FISHING**
Effective policies, control of corruption	Strong governance limits opportunities and provides high risk of capture and sanction. Strong, consistent government policy to combat IUU fishing.	Weak governance reduces risk of capture or sanction. Rent seeking and corruption facilitate operations. Weak inconsistent policy regarding IUU fishing, tendency to turn a blind eye or tolerate IUU fishing to avoid political conflict or support interests of fishing lobbies.
Strong judicial process	Effective prosecutions. Heavy fines/penalties (e.g. loss of licence, increased penalties for recidivism).	Ineffective judicial system. Low fines/penalties (no increased fines for recidivism; multiple offences do not result in loss of licence).
Monitoring, control and surveillance	Financing of MCS and related judicial processes. Hotspots targeted with regular MCS patrols. MCS units in close proximity. Effective VMS.	Limited budgets constrain MCS programmes and subsequent prosecutions. Limited MCS units. MCS units distant. Ineffective VMS or no VMS.
Borders and boundaries	Clear EEZ boundary demarcation. Fishing area close to land/shore. Distant from neighbouring EEZ.	Unclear EEZ boundaries. Disputed areas. Fishing area close to EEZ boundary. Close to high sea area.

1.3.2 Corruption

Corruption in fisheries has many forms. It may occur only once or be occasional and it can become regular or even institutionalized. In the case of illegal fishing, corruption may come from a number of different origins including turning a blind eye to an illegal act, using political power and social capital to coerce lower level officials into overlooking illegal acts, signing a declaration where it is known that the operator will not comply and operate within the spirit and authorization of the document and money or deeds are exchanged for such signature; colluding with officials to find loopholes in the law or bending the rules or to make false interpretation of laws in return for financial or other rewards; and use of threats or threatening language to create an atmosphere of fear and uncertainty and then receiving financial or other rewards to make the threat go away. The review identified the follow infractions that related to corrupt practices:

- The incidence of dual flagging in several countries in the subregion;
- In decentralized administrative situations, access licences were granted by local authorities to fishing vessels in contravention of national policy;
- Vessels that are at sea may bribe MCS officials to let them go; and
- Rent-seeking behaviour in ports and at sea.

In general, tackling corruption has never been explicitly a part of classical MCS. More recently, international organizations concerned with IUU fishing have elevated IUU into the global agenda to the extent that IUU

fishing is now recognized as (transboundary) environmental crime, often with strong linkages to organized crime.

1.3.3 Fraudulent companies and loopholes

Over the years the closure of EEZ waters to foreign-flagged fishing vessels by the APFIC member states has resulted in a number of other arrangements coming into play. Probably the most common examples are joint ventures (JVs), chartering or similar arrangements, which require that the foreign-flagged vessel be reflagged to the country where the JV will take place. Difficulties in verifying whether or not a JV vessel has been legally and correctly deregistered in the vessel's original country are not uncommon. Vessels in this situation of dual flagging are stateless. The reflagging of vessels to fish under JV arrangements or as local registered companies with beneficial ownership outside the country therefore challenge the effectiveness of Port State Measures' implementation. These dual-flagged vessels may easily avoid detection and undermine a coastal state's efforts to implement port inspection schemes, in particular if the target of inspections is only foreign-flagged vessels, because they will enter the ports of their new flag state and return to their home ports under the respective national flag.

Trawl fisheries and purse seiners in several areas of the region illegally access neighbouring waters or illegally tranship fish on to carrier vessels and return these catches to the country of beneficial ownership of the fleet. This is a typical example of the use of dual flagging to circumvent the requirements to land and report to the coastal state.

Other IUU-fishing activities include vessels operating under access agreements carrying the same markings and illegal landings of fish in ports of neighbouring countries in contravention of national laws. Juxtaposing illegal operations are commercial servicing operations that may support the illegal activities of fishing vessels. At-sea services such as bunkering, victualling, provision of spare parts, crew changes and repatriation are becoming increasingly available and enable vessels to remain at sea for longer periods and fish more distant waters. This is an important feature of reducing the operational cost of fishing.

In almost every case the review found that there was a need for strengthening of vessel registries and vessel tracking, together with the establishment of effective port controls on domestic and foreign vessels. A major recommendation was that these actions are undertaken within a National Plan of Action planning framework, as laid out in the 2002 FAO International Plan of Action to Deter, Prevent and Eliminate Illegal, Unreported and Unregulated fishing (IPOA-IUU).

1.3.4 Outdated legal and management frameworks

The fishery legal frameworks in many countries have not kept up to date with the rapid evolution of fisheries. In particular, the rapid advances in technologies as well as the emergence of long distance and transboundary fishing in the region are weak areas in current legislation. This is not confined to the fishery legislation, but also relates to associated legislation in, for example, maritime transport, customs, labour standards, labour migration and immigration. This greatly limits the ability of competent officials to inspect and detain vessels and gear.

Collection and recording of forensic evidence of the illegal-fishing act are also a challenge for many fisheries administrations because of lack of training or inadequate facilities and processes to collect, secure and present forensic evidence at the levels required to ensure prosecution and eventual sanction. However, many of the countries in the subregion are updating their legal frameworks to enable more effective action to be taken against IUU-fishing vessels.

1.3.5 Ineffective vessel registries and related controls

The rapid increase in fishing vessels capable of operating over increasingly long distances has meant that many flag states are incapable of exerting adequate controls over their fleets. Vessel registrations systems may be weak, with many registries remaining incomplete or not updated. Although many states have registry systems, albeit non-functional or only partially functional ones, these registries are not integrated with the system of fishing licences because the responsibilities for registration and licensing are often within different

ministries. This is particularly a problem with dual-flagged vessels as it allows both flag countries to avoid responsibility for the vessel.

1.3.6 Extensive sea areas

The increased marine area which needs to be covered by countries post-UNCLOS means that many countries have considerable challenges in deploying effective MCS coverage. Fishers among neighbouring countries may also consider that they have transboundary fishing rights. In some cases, this has led to the setting up of joint use or joint management areas as a way of reducing disagreements and avoiding criminalization. The review identified 12 bilateral and 5 trilateral boundaries.

1.3.7 Official tolerance of IUU fishing

Historically, there has been a high level of tolerance of IUU fishing by national vessels and by small-scale foreign vessels within the region. Partly because of the desire to avoid escalation of fisheries encroachment into a political dispute, and sometimes in the interest of maintaining cordial relations with neighbouring countries, there is a general policy of returning IUU-fishing vessels to their flag states or to their owners rather than to detain them or confiscate them and prosecute the owners. This approach is most commonly seen in the case of transboundary encroachment of small-scale fishing vessels. For the larger-scale fishing vessels, there is less tolerance of unauthorized fishing by foreign vessels. However, it is not uncommon for neighbouring countries to have access arrangements of reciprocal agreements. Such arrangements may be at the national level or among adjoining provincial administrations. In many cases these arrangements may not be fully legal and exploit other governance weaknesses described below.

1.3.8 Weak vessel tracking and monitoring

The use of VMS in the region is almost exclusively applied to very large vessels. An effective legal framework is essential for VMS to be an effective tool. In some countries with VMS, the data are still not admissible as evidence in a court of law as vessels must be physically observed to be in violation of fishery regulations. In the Asia-Pacific region, there are recurring issues with mandatory VMS units being tampered with after installation. This includes switching the units off, tampering with the electronics and/or data, and intentionally disabling or disrupting the data transmissions.

1.3.9 Economics

Estimating the true economic costs of IUU fishing in the region is almost impossible because of the clandestine nature of illegal fishing, the lack of published information and the reluctance of officials and perpetrators to talk about IUU-fishing activity. However, a few important points can be mentioned. The economics of fishing are an important driver of IUU and are influenced by:

- Many fisheries in the region have been classified as either overfished or fished to their limits;
- Subsidies in the fishing sector sustain uneconomic fishing and may incentivize IUU fishing;
- Illegal fishers tend to use older vessels;
- Abusive crew employment conditions, forced labour and even slavery can and do occur under these conditions;
- ETP species catch may be a bonus for a crew on an otherwise legal fishing boat;
- Profitability of fishing may be achieved or increased by underreporting, avoiding landing fees and taxes; and
- Countries should evaluate the economic losses caused by IUU fishing.

This economic evaluation could help fisheries managers to justify funding to deter, combat and eliminate IUU fishing. It should be linked to a risk assessment to evaluate where the greatest risks exist and where action will have the most impact.

1.3.10 Institutionalized tolerance of IUU fishing to maintain raw material supply

All countries in the subregion have fisheries policies to increase the supply of fish in a sustainable manner to supply local markets for increased food security and to increase foreign exchange revenue from the fisheries and aquaculture sectors. This has led to incentives to encourage expansion of the processing sector. The effect may encourage turning a blind eye to the landing of IUU catch obtained from other countries, especially if these catches supply processing or other export markets and improve employment and other social benefits.

The slow implementation of structural reforms in the fishery delays the eventual impact of unemployment, reduced raw product supply, financial loss and discontent that arise when fisheries are brought under a sustainable management regime. Thus, the concern of short-term economic losses outweighs long-term and often uncertain, economic impacts that result from IUU fishing, and in many cases, fishing has grown beyond the sustainable biological carrying capacity of the EEZs, especially that of the relatively small EEZs.

1.3.11 Inadequate port and service infrastructure in countries providing fishery access

Countries wishing to develop certain fisheries in their EEZs where there is limited investment or knowledge of the particular fishing operation often have policies to grant fishing licences to foreign fishing vessels. These licences are usually conditional on reflagging, landing some or all products, following fisheries management practices, paying dues and taxes, employing nationals, setting up and managing onshore facilities, and creating formal companies with local and foreign shares. The fishing grounds may be at the extremities of the EEZ and with little infrastructure. During the review, key respondents reported dissatisfaction among foreign fishing vessel owners because of the high cost of operating in remote areas that inevitably involve transhipment and making payments to corrupt officials. However, it should be noted that the vessel owners enter these access agreements knowing the difficulties involved and presumably they exercise due diligence before signing the agreements. In order to reduce these losses, some fishing ventures have resorted to at-sea transhipments back to other more developed port areas, which invariably lie outside of the country that has granted fishing access. These situations lead to breaking of the accords, rendering the operation illegal.

1.3.12 High-value endangered, threatened and protected species (ETP)

ETP species, including deep water corals, fall within either the fisheries or environmental laws to some degree. In addition, some countries have signed, ratified or are party to the international conventions and norms related to the conservation and protection of ETP species. The rarity of ETP species is a driver along with elevated demand, paying high prices in lucrative market chains and illegal trade flows. ETP species were identified in 58 percent of the cases. ETP species in IUU fisheries are caught as bycatch or purposely targeted. The volumes of ETP species found on board were too high for catching alone and transhipment was certainly suspected. Port inspections (on national vessels returning from fishing /trading overseas) are going to be most effective in deterring this trade because at present the risk of capture at sea seems rather low. The review identified that there is a lack of regional data on the extent of the ETP species trade and more rigorous analysis and assessment would enable a clearer picture of the threats to be established. A list of references for prices in ETPs can be found at the end of this document.[1]

[1] List of prices for ETPs.

2. Options for taking action

Identify, quantify and prioritize IUU-fishing hotspots
This is a primary step for taking action as it informs the development of long-term policy and provides the justification for financial support to combat IUU fishing.
Use a characterization and scoring system to identify and prioritize IUU-fishing hotspots (or IUU-fishing activities within a specific fishery). This assessment of likelihood and susceptibility to IUU-fishing activity can be used to rapidly screen many fisheries.
The scoring system could also be used to track progress in improving management or as a simple risk assessment for prioritizing MCS and other actions to combat IUU fishing.
Quantify the cost and impact of IUU fishing, including the impact of subsidies.
This can be applied equally to both domestic and foreign IUU-fishing activity.
Undertake fishery legal reform
Strengthen the sanctioning system for IUU-fishing offences including fines, loss of licence and seizure of fishing assets and catch.
Incorporate port inspections and relevant powers to act into fishery legal frameworks.
Include IUU fishing in legal controls on import/export.
Harmonize central and decentralized government fishery law and implementation of policy.
Strengthen national legal frameworks to enable greater flag state control over vessels operating both inside and outside of EEZs.
Improve coordination and transparency related to vessel registration and reflagging
Strengthen vessel registry systems and their linkage to fishing licensing.
Strengthen national systems and subregional sharing of information for vessel re-registration, de-registration and chartering arrangements to control dual flagging.
Strengthen MCS capacity using risk-based-systems
Use risk-based assessments to inform actions. This enables more flexible judgement in actions to be taken on the water (e.g. detain and return to port or escort out of EEZs and report to flag states).
Link fisheries MCS and intelligence to other maritime security measures, especially control of smuggling. Sensitize/train navy and coastguards on IUU-fishing issues and establish protocols for taking action.
Improve vessel marking systems.
Develop greater trust with small-scale fishers and domestic fleets to report IUU-fishing activity (typically by larger vessels or foreign vessels).
Ensure VMS data are admissible as evidence in judicial cases.
Improve communication and awareness on IUU-fishing issues with fishers
Develop more comprehensive awareness-raising programmes on relevant laws and management measures, maritime boundaries, consequences of IUU fishing.
Effective application of VMS
Mandatory VMS on larger vessels, effective monitoring and the necessary policy and legal power to take action against non-compliant vessels.
Apply to all forms of fishing and fishing-related service vessels.

Develop subregional agreement(s) for coordination of communication and reporting of VMS-related data, especially the reporting of non-compliance.
Establish or strengthen port inspections and monitoring
This relates to the above and in particular to control over foreign vessels entering port. It especially requires powers of denial of entry to port, risk-based sampling of vessels for port inspections, and strengthened sanctions for IUU-fishing offences.
Train agency staff on in-port and at-sea inspections, collection and the recording of forensic evidence of illegal fishing.
Improve inspection and controls over nationally flagged vessels that have foreign beneficial ownership or that are operated under JVs.
Improve catch and landing monitoring from national- and foreign-flagged vessels.
Effective port inspections (on national vessels returning from fishing/trading overseas) are going to be most effective in deterring species trade.
Improve port infrastructure and operations
Improve cold storage infrastructure to encourage local landings.
Monitor the activity of port officials to improve transparency of catch reporting and the collection of landing fees.
Ensure that processing capacity is not overdeveloped as this can drive overfishing and IUU fishing.
Improve catch documentation systems
Addressing the reporting of catches is fundamental to understanding fishing efforts and changes in the fishery. Paper logbooks are cumbersome and rarely linked to dynamic fishery management decision-making. Improving the use of logbooks or development of an e-reporting system are significant steps for harnessing the power of information technology in support of fishery management.
Strengthen regulations for transhipment of catches.
Improve bilateral (trilateral) cooperation
Develop joint management area authorities. Such bodies would be more effective than national fishery agencies in addressing IUU fishing in joint managed areas.
Provide the opportunity for coordinated monitoring of vessels, harmonized standards and management measures, improved catch documentation and joint assessments.
Develop or formalize bilateral agreements regarding actions taken against transboundary fishing by small-scale fishing vessels.
Strengthen subregional cooperation
As with bilateral and trilateral management authorities, subregional cooperation offers the opportunity to develop common norms for combating IUU fishing.
Typically, these will relate to minimum standards, large-scale spatial or temporal management measures and, in particular, agreements on the sharing of data and information (relating to vessels, registries and movements, beneficial ownership and JVs, as well as stock assessments).
The basis of effective subregional cooperation is strong national commitment and development of the necessary structures. Using subregional cooperation as a starting point may provide some momentum to initiate the national actions. Ultimately the emergence of subregional mechanisms is contingent on sufficient national capacity and a commitment to act.

3. Summary of hotspots pre-2015

HOTSPOT 1	SOMALIA AND YEMEN EEZ[2]
Type of IUU-fishing activity	Unauthorized fishing in the EEZs of Pakistan, Islamic Republic of Iran, Yemen and Somalia and also in contiguous areas beyond national jurisdiction (ABNJ). Use of illegal gears. Dual flagging. Unregulated fishing.
Vessel nos., size & gear	Estimated 25 vessels 30 GRT to 50 GRT of 450 horsepower to 700 horsepower (HP) mostly with onboard freezing facilities. Fishing with tuna drift nets.
Species	Tuna and tuna-like species including yellowfin, longtail, skipjack tunas and billfish. Sharks and shark fins by-catch. **ETP:** Whale sharks, cetaceans and turtles, thresher, oceanic white tip and silky sharks in contravention of Indian Ocean Tuna Commission (IOTC) resolutions. No data collected or published on their protection.
Approximate illegal catch	About 250 tonnes to 300 tonnes on a monthly basis. This activity continues for about 10 months/year. Price of landed fish is very low.
Estimated value	Estimated catch = 2 500 tonnes/year to 3 000 tonnes/year. Estimated value of catch = USD 0.8 million to USD 1.2 million (USD 320 to USD 400/tonne).

HOTSPOT 2	EEZ BOUNDARIES BETWEEN PAKISTAN AND ISLAMIC REPUBLIC OF IRAN[2]
Type of IUU-fishing activity	Dual flagging and registration. Unregistered vessels fishing without authorization. Non-reporting, or underreporting. EEZs of Pakistan, Islamic Republic of Iran, Yemen and Somalia and contiguous ABNJ affected.
Vessel nos., size & gear	700 smaller fishing boats (+/-5 tonnes) with outboard engines and gillnets; 230 larger boats (30 GRT to 50 GRT) 450 HP to 700 HP using tuna drift nets Most of these have onboard freezing facilities. Large gillnetters substantially affect fishing from May to September. Stop fishing in June and July.
Species	Smaller boats: (Indian mackerel and sardinellas) and demersal fish. Larger boats: tunas and tuna-like species. **ETP:** Sharks, whale sharks, cetaceans.
Approximate illegal catch	It is difficult to estimate the quantity of fish being caught in the operations by small boats as no separate area statistics are maintained.
Estimated value	Estimated volume = 60 000 tonnes. Estimated value (USD 2 500/tonne to USD 5 000/tonne) = USD 150 million to USD 300 million.

[2] This case study was made possible by information from Muhammad Moazzam Khan, Former Director General, Marine Fisheries Department, Government of Pakistan and the Technical Advisor (Marine Fisheries), WWF-Pakistan, Karachi, Pakistan.

HOTSPOT 3	EEZ BOUNDARY BETWEEN PAKISTAN AND INDIA
Type of IUU-fishing activity	Unauthorized fishing in EEZs of India and Pakistan. Mostly encroachment along coast of Gujarat State and the Pakistani province of Sindh;[3] 200 to 300 fishers apprehended every year.[6] In June 2014 and May 2015 Pakistani authorities apprehended a total of 73 Indian vessels[6]; in 2014 the Pakistan Maritime Security Agency (PMSA) held Indian fishers and 11 boats found fishing illegally.[4,5]
Vessel nos., size & gear	Twenty to 30 vessels:[6] 8 m length overall (LOA) – small gillnetters (daily fishing), 15 m LOA to 20 m LOA – medium-size shrimp trawlers (multiday fishing), 20 m LOA to 30 m LOA – large gillnetters (multiday fishing). Forty to 70 vessels: 15 m LOA to 25 m LOA – medium-size fish and shrimp trawlers (multiday fishing). Pakistani fishers use small gillnets/shrimp trawls/drift gillnets for tuna.
Species	Drift gillnets: tunas, sharks and other pelagic species. Trawlers: Ribbonfish, threadfin bream, cuttlefish, squid, shrimp and demersal species. **ETP:** Gillnetters release turtles and whale sharks (Moazzam, 2014;[6] Moazzam, 2013).[6] Cetaceans reportedly released.
Approximate illegal catch	3 000 tonnes/year by Pakistani boats in Indian waters and about 10 000 tonnes/year by Indian boats.[6]
Estimated value	Total IUU fish in volume = 13 000 tonnes. Total IUU fish in value (USD 1 000/tonne) = USD 13.2 million.

HOTSPOT 4	LAKSHADWEEP ISLANDS (INDIA'S EEZ)
Type of IUU-fishing activity	Fishing without authorization around the Lakshadweep Islands, dual flagged vessels.[7] In 2007 Sri Lankan fishing vessels apprehended.[8] In 2014 the Indian coastguard seized a boat for possession of 2 tonnes of sea cucumbers valued at USD 120 000; 16 fishers held.[9] IUU fishing from neighbouring Indian states.
Vessel nos., size & gear	Small multiday longline vessels. Tuna longlines, diving for sea cucumbers. Relatively healthy fishery resources. The present annual production is about 12 000 tonnes, less than 5 percent of the total potential (50 000 tonnes tuna-like fish[10] and 100 000 tonnes of sharks).[11]
Species	**ETP:** Fishing for protected species in contravention of the Indian Wildlife Protection Act. Sea cucumber. Tunas and tuna-like species, large pelagic fish, sharks.
Approximate illegal catch	Unknown.
Estimated value	Unknown.

[3] Wikipedia. 2015. *India-Pakistan maritime trespassing*. Available at https://en.wikipedia.org/wiki/India%E2%80%93Pakistan_maritime_trespassing

[4] The Indian Express. 2015. 48 Indian Fishermen Captured by Pakistan; 8 Boats Seized. Available at http://indianexpress.com/article/india/india-others/48-indian-fishermen-captured-by-pakistan-8-boats-seized/

[5] NDTV.Com. 2015. *Pakistan captures 2 boats with 12 Indian fishermen off Gujarat coast: report.* Available at http://www.ndtv.com/india-news/pakistan-captures-2-boats-with-12-indian-fishermen-off-gujarat-coast-report-722601.

[6] Muhammad Moazzam Khan, Ex-Director General, Marine Fisheries Department, Government of Pakistan, and Technical Advisor (Marine Fisheries), WWF-Pakistan, Karachi, Pakistan.

[7] New Indian Express. 2013. HC Moved to Release Illegally Detained Fishermen. Available at http://www.newindianexpress.com/states/kerala/article1481667.ece

[8] Oneindia.com. 2007. Lankan *fishermen apprehended for illegal fishing.* Available at http://www.oneindia.com/2007/01/30/lankan-fishermen-apprehended-for-illegal-fishing-1170232998.html

[9] The Hindu. 2014. Lankan Boat Seized for Fishing Sea Cucumber, 16 Men Held. Available at http://www.thehindu.com/todays-paper/lankan-boat-seized-for-fishing-sea-cucumber-16-men-held/article5894435.ece

[10] Aneesh Kumar, K.V., Meenakumari, B. & Remesan, M. P. 2013. *Investigations on longline fishing in Lakshaweep Sea with special reference to bycatch issues, bait and hook selectivity.* Ph.D thesis. Cochin, India, Cochin University of Science and Technology. Available at http://dyuthi.cusat.ac.in/xmlui/handle/purl/3996).

[11] Union Territory of Lakshadweep. 2012. *Annual plan 2011-2012.* Available at http://lakshadweep.nic.in/AnnualPlan_2011_2012_7.htm

HOTSPOT 5	MALDIVES EEZ
Type of IUU-fishing activity	Foreign fishing vessels without any form of authorization to fish in the Indian Ocean almost a daily occurrence[12]. Fishing for ETP (mainly sharks), using illegal-fishing gear such as large-scale drift nets; contravention of conservation and management measures (CMMs) of the IOTC.[12] IUU fishing in Maldivian waters seems to be systematic and regular.
Vessel nos., size & gear	Longliners – ranging from 12 m LOA to 40 m LOA capable of staying at sea for weeks. The smaller vessels generally carry ice for preservation of fish and the larger vessels have onboard freezing/chilling capabilities.[12] The main gears comprise longlining, purse seining, drift netting; 100 to 200 incidents of IUU-fishing activities may occur annually. Most of the IUU-fishing activities are reported by fishers.[12] In 2012 a vessel was seen at 26 NM from the Addu Atoll coastguard ship 'Ghaazee'.[12]
Species	Vessels apprehended in Maldivian waters fish for tuna species. However, they also target sharks and billfish species depending on the fishing season and availability of tuna.[13] Rays including manta rays have been found on these vessels. Turtles are not as common but have been reported to an extent.[12]
Approximate illegal catch *Estimated value*	Rough estimates about 6 000 tonnes to 16 000 tonnes annually. There is a lot of uncertainty in these figures as apprehensions are rare.[12] Most IUU fish caught in Maldivian waters are tunas. Based on the current market prices the value of IUU fish caught in Maldivian waters could range from USD 9 million to USD 22 million.[13] Estimated financial value = 6 000 tonnes to 16 000 tonnes of tuna (USD 1 400/tonne to USD 1 500/tonne).

HOTSPOT 6	CHAGOS ARCHIPELAGO
Type of IUU-fishing activity	The Chagos Archipelago (Marine Protected Area). Transhipment in international waters. Non-compliance with IOTC CMMs. illegal gear – large-scale driftnets. Non-reporting/underreporting of catches in 2009[14]. In 2011 vessels arrested and reported to the IOTC. In 2012 4 Sri Lankan vessels arrested and reported to the IOTC. In 2013, 2 vessels arrested and reported to the IOTC[15]. Illegal fishing, fishing without licence or expired licence)[16]. In 2014, 9 vessels arrested and reported to the IOTC.[17]
Vessel nos., size & gear	Commercial tuna vessels >24 m in length using longlines, gillnets.
Species	Yellowfin, albacore, skipjack tuna species. **ETP:** Thresher sharks.[18]
Approximate illegal catch *Estimated value*	Unknown. Unknown.

[12] Ministry of Fisheries and Agriculture, Republic of Maldives. 2015. Interview on IUU fishing in the Maldives. Conducted May 2015.

[13] Ministry of Fisheries and Agriculture, Republic of Maldives, 2015. Interview on IUU fishing in the Maldives. Conducted May 2015.

[14] Atuna. 2009. Sri Lankan Tuna Vessel Caught IUU Fishing in Indian Ocean. *Tuna Fishing News*. Available at www.atuna.com

[15] IOTC. 2013. *IUU fishing in BIOT waters by fishing vessels flagged in Sri Lanka.* 10th IOTC Compliance Committee Meeting, 2013. Available at http://www.iotc.org/sites/default/files/documents/2013/04/IOTC-2013-CoC10-08b%5BE%5D.pdf

[16] Indian Ocean Tuna Commission (IOTC). 2014. *Report on illegal fishing in BIOT waters by the Taiwan Province of China flagged vessel Maan Yih Feng.* Available at http://iotc.org/sites/default/files/documents/2014/04/IOTC-2014-CoC11-08dE_-_FV_Maan_Yih_Feng_0.pdf

[17] MRAG. 2015. Resolution 11/03. *On establishing a list of vessels presumed to have carried out illegal, unregulated and unreported fishing in the IOTC area.* Available at http://iotc.org/sites/default/files/documents/2015/04/AllEF_20150413.pdf

HOTSPOT 7	PALK BAY (WITHIN SRI LANKA'S EEZ)
Type of IUU-fishing activity	Fishing without authorization using illegal gear (trawl and pair trawls[19] and monofilaments[20]), banned gears.[21]
Vessel nos. size & gear	Mainly 13 m vessels LOA up to 16 m LOA. (2010) The estimated numbers of vessels were 2 625 trawlers, 278 gillnetters and 650 outboard boats.[22] (2014) Estimated 1 900 trawlers. (2014) up to March 2015). Total of 185 boats impounded with action taken against 937 crew members. The Sri Lankan Navy has reported 36 865 instances of poaching in the Sri Lankan EEZ[23].
Species	Shrimps, small demersal species and low-value bycatch used as fish for human consumption, and in animal feeds. Trawlers, gillnets and small-scale fishing gears. Bottom trawls and pair trawls are the predominant methods.[19] **ETP:** Turtles, sea snakes, dugongs, dolphins, seahorses and sea cucumbers (to a lesser extent).
Approximate illegal catch *Estimated value*	From 2011 to 2014 the Central Marine Fisheries Research Institute (CMFRI) reported annual landings along the Indian side of Palk Bay amounting to 156 000 tonnes. It was estimated that about 100 000 tonnes were from trawlers and the rest came from other gears.[22] An estimated 50 percent of the trawl catch (50 000 tonnes) and 20 percent of the catch from other gears (11 200 tonnes) was obtained from the Sri Lankan side of Palk Bay. Estimated IUU catch from in Sri Lankan waters = 61 200 tonnes.[22] Estimated financial loss = USD 153 million[24] (USD 2 500/tonne) to USD 750 million.[25]

HOTSPOT 8	ANDHRA PRADESH AND ORISSA STATES (WITHIN INDIA'S EEZ)
Type of IUU-fishing activity	Unauthorized fishing in the Indian EEZ 60 km and 120 km off Andhra Pradesh and Orissa and north of Tamil Nadu.
Vessel nos. size & gear	Mainly multiday boats 15 m LOA to 17 m LOA. Longliners and drift gillnets. An estimated 100 vessels operating regularly. In 2009 the Indian coastguard (ICG) arrested 116 vessels of which >100 were Sri Lankan longliners. In 2011 the ICG caught 31 boats in one year with 153 fishers and 30 tonnes of catch confiscated. In 2012 5 fishers apprehended for fishing without a licence with a catch of over 2 000 kg.[26] Also in 2012 6 fishers were arrested by marine police in Kakinada for illegally fishing.[27] In 2014 160 fishers were being held by India, especially in Andhra Pradesh, Tamil Nadu and Odisha.[28]
Species	Tuna species.

[19] Sathyapalan, J., Srenivasan, J. & Sholtens, J. 2008. *Fishing fleet reduction and its livelihood implications: a case study of Palk-Bay resource users in the East Coast of Tamil Nadu, India.* Chennai, India, UNTRS and FAO project.

[20] Scholtens, J., Bavinck, M. & Soosai, A.S. 2012. *Fishing in dire straits: transboundary incursions in the Palk Bay*. Available at http://www.academia.edu/8757497/Fishing_in_Dire_Straits_trans-boundary_incursions_in_the_Palk_Bay._Economic_and_Political_Weekly_47_25_87-96

[21] NDTV. Com. 2014. *75 fishermen from Tamil Nadu arrested by Sri Lanka Navy.* Available at

http://www.ndtv.com/south/75-fishermen-from-tamil-nadu-arrested-by-sri-lanka-navy-554452

[22] Vivekanandan. E. 2015. Interview – Palk Bay Case Study, April 2015.

[23] Scholtens, J., Bavinck, M. & Soosai, A.S. 2012. *Fishing in dire straits: transboundary incursions in the Palk Bay*. Available at http://www.academia.edu/8757497/Fishing_in_Dire_Straits_trans-boundary_incursions_in_the_Palk_Bay._Economic_and_Political_Weekly_47_25_87-96

[24] Based on catch of 61 200 tonnes and average value of USD 2.40 /kg.

[25] Daily News. 2013. Poaching Loss Whopping 97,500M/Year. Available at: http://www.dailynews.lk/?q=local/poaching-loss-whopping-97500-myear).

[26] NDTV. Com. 2012. *Coast guard apprehends five Sri Lankan fishermen.* Available at http://www.ndtv.com/south/coast-guard-apprehends-five-sri-lankan-fishermen-483298

[27] NDTV.Com. 2012. *Six Sri Lankan fishermen arrested for entering Indian waters*. Available at http://www.ndtv.com/south/six-sri-lankan-fishermen-arrested-for-entering-indian-waters-481190

[28] NDTV.Com. 2014. *Centre asks Andhra Pradesh to release 25 Sri Lankan fishermen.* Available at http://www.ndtv.com/south/centre-asks-andhra-pradesh-to-release-25-sri-lankan-fishermen-548660

HOTSPOT 8	ANDHRA PRADESH AND ORISSA STATES (WITHIN INDIA'S EEZ)
	ETP: Sharks and turtles.
Approximate illegal catch	Difficult to quantify because vessels are released back to their flag states. Estimated IUU catch is based on ~100 vessels fishing 500 kg/day for 120 days/year due to seasonality.
Estimated value	Estimated catch = 6 000 tonnes. Estimated value (USD 3 000/tonne) = USD 18 million.

HOTSPOT 9	TUNA LOP VESSELS IN BAY OF BENGAL (WITHIN INDIA'S EEZ)
Type of IUU-fishing activity	Dual registration/dual flagging.[29] Underreporting of catches. Illegal transhipment of catches. Leaving India's EEZ to fish in international waters without prior clearance. In violation of the Maritime Zones of India Act, related to ownership of the vessels. Fishing in IOTC area of competence without registration with the IOTC.
Vessel nos. size & gear	In April 2015, 35 of the 44 vessels were from 16 m LOA to 58.7 LOA; 77 percent of the vessels were less than 24 m LOA. In 1995 some 800 vessels were operating[30]. On 15 April 2015 44 vessels belonged to 13 companies; 41 of the 44 vessels were longliners and there were 3 hook and line vessels.
Species	Tuna and tuna-like species, large pelagic fish and sharks. **ETP:** Some species of sharks and turtles
Approximate illegal catch *Estimated value*	Annual catches range from 235 tonnes to 576 tonnes from small-size to medium-size fish. Bycatch represents 50 percent of longline catches (corroborated by Greenpeace).[31] A single vessel can feasibly produce between 470 tonnes and 1 100 tonnes of tuna and bycatch annually. Yellowfin and big eye tuna prices in Japan for fish from Australia, South Africa and Japan for chilled, gutted, gilled and air-flown fish fetch between USD 8 300/tonne and USD 23 000/tonne.[32] The bycatch is sold in India at a price of USD 1.50/kg. However, catch offloaded in other ports is ~USD 8.00/kg. Total catch/vessel of between 470 tonnes and 1 100 tonnes/year = 19 270 tonnes to 45 100 tonnes/year for 41 vessels (50 percent tuna and 50 percent bycatch). The assumption is that most is IUU fishing because of non-compliance with requirements. Total catch of IUU fish = 19 270 tonnes to 45 100 tonnes. Total value of IUU fish = USD 91.5 million to USD 214.2 million.

HOTSPOT 10	ANDAMAN AND NICOBAR ISLANDS (WITHIN INDIA'S EEZ)
Type of IUU-fishing activity	Poaching in Hut Bay and Little Andaman (South Andaman), Kamorta and Tillangchong.[33] In addition, fishing without authorization, licence or permits; use of illegal mesh sizes; fishing in closed areas; non-reporting, misreporting or non-declaration of catches; non-payment of fees and dues; vessel names obscured; use of false or expired registration documents or no documents. In 2011 900 nationals who had returned to their home port from the Andaman Islands in late November remained in prison in the Andaman capital, Port Blair. Mostly fishers, they were given terms for as long as 6.5 years for illegally entering Indian waters.[34] In 2012 4

[29] Ganapathiraju, P. 2012. *Illegal and unreported fishing: global analysis of incentives and a case study estimating illegal and unreported catches from India.* Ph.D thesis. Available at http://www.researchgate.net/publication/274066489_Illegal_and_unreported_fishing__global_analysis_of_incentives_and_a_case_study_estimating_illegal_and_unreported_catches_from_India

[30] Kurien, J. (2005). Evolving towards unsustainability. *International Journal of Rural Management*, 1(1), 73-96.

[31] Greenpeace. 2013. *Out of line: the failure of the global tuna longline fisheries.* Available at http://www.greenpeace.org/international/Global/international/publications/oceans/2013/459-OutOfLineReport-DEF-LR.pdf

[32] INFOFISH. 2012. *Fact sheet ISSN 0127-9114.* Available at www.infofish.org/pdf/itn/ITN%207-2012.pdf

[33] Das, P. 2011. Securing the Andaman and Nicobar Islands. *Strategic Analysis*, 35(3). Available at http://dx.doi.org/10.1080/09700161.2011.559988

[34] Aung Kyi. 2011. Hundreds more Detained in Port Blair: Fishermen. *Myanmar Times*, 5 December 2011. Available at http://www.mmtimes.com/index.php/component/content/article/87-national-news/1611-hundreds-more-detained-in-port-blair-fishermen.html

HOTSPOT 10	ANDAMAN AND NICOBAR ISLANDS (WITHIN INDIA'S EEZ)
	vessels were fishing illegally in the Indian EEZ.[35] In 2015 9 fishers were arrested for operating illegally near the Sentinel Islands. Commercial fishing is banned in the Andaman Islands.
Vessel nos., size & gear	Various sizes of vessels with sophisticated electronic equipment and smaller vessels. Estimated 10 vessels/year to 24 vessels/year.[36] Gears are large trawls and small-scale gears. Hunting for sea cucumbers, which are then shipped to countries in Asia and sold as a delicacy called bêche-de-mer.[37]
Species	Sea cucumbers, trochus, finfishes, corals, fish, shells. **ETP:** Sharks (for fins), saltwater crocodiles, dugongs.
Approximate illegal catch *Estimated value*	Estimated catches (upper limits) by foreign fishing vessels:[36] Trochus, 294 tonnes x USD 4 700/100 kg = USD 13.8 million. Sea cucumbers, 495 tonnes x USD 100/kg = USD 49.4 million. Finfish (by trawlers), 44 200 tonnes x USD 1 200/tonne = USD 53 million. Total estimated catch = 44 989 tonnes. Total estimated value = USD 116.2 million.

HOTSPOT 11	MYANMAR EEZ (SOUTHERN WATERS BORDERING THAILAND)
Type of IUU-fishing activity	Offshore fishing fleet[38] fishing without valid licences; fishing in shallow water zones less than 10 NM from shore; transhipment at sea; illegal landings and trade in a foreign country; sea cucumber fishing in EEZ of India; blast fishing; using illegal gear (small mesh size); dual flags; fishing without authorization.[39] Not authorized to fish in the IOTC area, landing and not reporting. Longline vessels without licences are targeting sharks; also collecting ETP and reef-associated species from local fishers. Underdeclaration of catch**.**
Vessel nos., size & gear	Trawlers and tuna longliners; 400 to 500 trawlers between 200 GRT and 300 GRT; 400 to 500 vessels in the Myeik area tranship about 90 percent of all their catch to carriers; 60 tuna longliners <25 m LOA.
Species	Trawlers – demersal and finfish species; longliners – sharks, tunas and **ETP** sharks and certain reef fish. Vessels also collect reef fish, sea cucumbers. Some vessels have targeted dolphins using gillnets.[40] Lampi Island National Marine Park within the Myeik Archipelago is in this hotspot. This area is known to be high in biodiversity and includes some "previously unrecorded specimens that may even be new to science," and more than 700 different species of corals, some of which are living in turbid waters.[41]
Approximate illegal catch	400 to 500 Myanmar vessels transhipping fish to 5 carriers every day (there are ~10 carriers in all), or the equivalent of 2 000 drums of 100 kg each (= 200 tonnes/carrier). Estimated

[35] Greenpeace. 2012. *Greenpeace exposes pirate fishing practices off Andaman coast: governance gaps in marine fisheries allow illegal, unreported and unregulated fishing to go unabated in the EEZ.* Available at http://www.greenpeace.org/india/en/Press/Greenpeace-exposes-pirate-fishing-practices-off-Andaman-coast/

[36] Pramod, G. 2014. 2010. *Illegal, unreported and unregulated marine fish catches in the Indian exclusive economic zone.* Field report. Vancouver, Canada, Policy and Ecosystem Restoration in Fisheries, Fisheries Centre, University of British Columbia, BC. 30 pp.

[37] Indigenous Peoples Human Rights Defenders Network. 2015. *This remote tribe could be wiped out for the most trivial of reasons.* Available at http://www.iphrdefenders.net/country-updates/india/860-this-remote-tribe-could-be-wiped-out-for-the-most-trivial-of-reasons

[37] Reuters. 2011. *Myanmar poachers looting Andaman ecology – India.* Available at http://www.reuters.com/article/2007/06/07/idUSDEL46065

[37] Nijhawan, S. 2015. 13 Facts You Didn't Know about the Andaman and Nicobar Islands. *India Times*, 19 April 2015. Available at http://www.indiatimes.com/culture/travel/13-facts-you-didnt-know-about-the-andaman-and-nicobar-islands-231903.html

[38] Information from key respondent in 2015 who wishes to remain anonymous.

[39] Democracy for Burma. 2009. *Thai fishing boats seized daily by authorities in southern Burma.* Available at

https://democracyforburma.wordpress.com/2009/01/07/thai-fishing-boats-seized-daily-by-authorities-in-southern-burma/

[40] Information from key respondent in 2015 who wishes to remain anonymous.

[41] Stop Illegal Fishing. 2014. *Illegal fishing threatens rich marine diversity of Myeik Archipelago.* Available at http://www.stopillegalfishing.com/news_article.php?ID=1129#sthash.zJlf4wLM.dpuf

HOTSPOT 11	MYANMAR EEZ (SOUTHERN WATERS BORDERING THAILAND)
Estimated value	transhipment amounts to 260 000 tonnes/year [39,40](260 000 tonnes/year at USD 1 200/tonne = USD 312 million). Catch from 300 to 400 Thai vessels = 300 000 tonnes (5 tonnes/vessel/day x 200 days/year at USD 1 200/tonne = USD 360 million). Tuna is estimated at USD 36 million/year for 60 vessels at 12 000 tonnes (60 tuna x 1 000 kg/day x 200 days/year = 12 000 tonnes at USD 8/kg = USD 36 million). Total weight of IUU catch is estimated at 572 000 tonnes. Total value of IUU catch is estimated at USD 708 million.

HOTSPOT 12	TUNA LONGLINING AND TRANSSHIPMENT IN THE BAY OF BENGAL
Type of IUU-fishing activity	Unauthorized fishing on the high seas in contravention of IOTC CMMs. Underreporting and/or non-reporting to the coastal state and the IOTC. Transhipment at sea in contravention of IOTC CMMs (IOTC Resolution 14/06); several vessels operating under flags of convenience (e.g. Bolivia, Plurinational State of); stateless vessels using falsified registry documentation (e.g. claiming to be flagged to Taiwan Province of China and Belize, but these vessels are stated as illegally flying these flags by Belize and Taiwan Province of China (IOTC circulars 2014-035[42] & 2015–042[43] & 2015-047[44]); vessels obscuring markings or having no vessel markings, failing to have vessel documentation, International Telecommunication Union Radio Call Signs, etc.; also using non-licensed vessels from the IOTC contracting party country (CPC), e.g. Indonesia. Contravention of IOTC CMMs: IOTC Resolution 07/02[45], 14/06[46] and 10/11.[47]
Vessel nos., size & gear	80 longliners 20 m LOA to 27 m LOA, 40 GRT to 150 GRT. Approximately 36 tuna longliners are IUU representing 45 percent of the vessels entering port. About 20 of them are stateless. Vessels routinely entering with catches that exceed probable catch for number of days at sea.
Species	Primarily yellowfin tuna and some billfish (e.g. black marlin, swordfish), chilled for high-value sashimi markets. **ETP:** May include sharks.
Approximate illegal catch *Estimated value*	Total landings exceed 6 000 tonnes of which 4 513 tonnes are exported.[48] About 2 700 tonnes landed from stateless vessels or unauthorized transhipment. This represents ~30 percent of total landings but could be higher. The value of the IUU fish at the dockside is estimated at upwards of USD 27 million (chilled sashimi-grade tuna, value before re-export ~USD8.00/kg to USD 10/kg).

[42] IOTC circular 2014–035. Communication from Sri Lanka concerning a request for Belize to provide clarifications on the activities of the fishing vessel Shuen Siang.

[43] IOTC Circular 2015–042. Response of Taiwan POC following the invitation to investigate the activities of 12 fishing vessels that have landed their catch in Phuket, Thailand in 2013.

[44] IOTC Circular 2015-047. IOTC IUU vessels list.

[45] IOTC Resolution 07/02 concerning the establishment of an IOTC record of vessels authorized to operate in the IOTC area.

[46] IOTC Resolution 14/06 on establishing a programme for transshipment by large-scale fishing vessels.

[47] IOTC Resolution 10/11 on port state measures to prevent, deter and eliminate illegal, unreported and unregulated fishing.

[48] FAO Fishstat J. 2011. *Export commodities for Thailand.*

HOTSPOT 13	MALACCA STRAIT (THAILAND, MALAYSIA AND INDONESIAN EEZs)
Type of IUU-fishing activity	Fishing without valid permits or licences. Using trawls in no trawl areas.[49] Dual-flagged vessels.[50] Illegal/unauthorized landings across national boundaries into neighbouring coastal states.[51]
Vessel nos., size & gear	15 m LOA to 25 m LOA. From 2006 to 2014 a total of 235 fishing vessels of various sizes was arrested by Malaysian enforcement agencies for fishing violations (average 30/year). In 2011, 2 fishing boats with 5 crew on board apprehended in the Indonesian EEZ in the Malacca Strait.[49] In 2014 Indonesian marine police arrested dozens of fishers in waters off East Aceh for alleged illegal fishing; boats' names were also in Indonesian.[52] In 2015 a fishing boat exploded after it was caught fishing illegally off the coast of North Sumatra.[53]
Species	Demersal species caught in trawls. The Malacca Strait is home to various ETP species such as turtles and dugongs. However, environmental degradation, intense shipping traffic and other anthropogenic impacts are probably taking their toll on these species. Few references to the status of fisheries.
Approximate illegal catch	Unauthorized fishing in neighbouring EEZ. Regular occurrences of IUU fishing were reported but the number of vessels was relatively low. [49]
Estimated value	Assumption: 5 vessels encroaching daily = 1 825 incidents/year. Average catch 500 kg/day to 1 000 kg/day = 912 tonnes/year to 1 825 tonnes/year. Estimated value USD 1.1 million to USD 2.2 million. Unauthorized/dual-flagged vessel landings: 30 to 40 vessels, 30 tonnes weekly, 10 months per year = 9 000 tonnes/year to 12 000 tonnes/year. Estimated value (USD 1 500/tonne) = USD 13.5 million to USD 18 million.

HOTSPOT 14	WEST COAST SUMATRA (INDONESIAN EEZ)
Type of IUU-fishing activity	Foreign vessels without permits or licences. Vessels may be compliant with the IOTC but are suspected of IUU fishing. Tuna purse seine, FAD and tuna longline satellite locators from vessels licensed for high seas have been found within Indonesian waters (within EEZ). [54]
Vessel nos., size & gear	Unknown numbers of small vessels: <100 GRT. Large vessels: 2 000 GRT to 4 000 GRT, 70 m LOA to 110 m LOA. However, 26 industrial-type purse seine floating FAD locators retrieved between 2004 and 2007.[54] Purse seine, handlining, possibly longliners, trawlers.
Species	Tuna species (longliners, purse seiners); demersal species (trawlers).
Approximate illegal catch	Unknown.
Estimated value	Unknown.

[49] Antara News. 2011. Malaysian Fishing Boats also Violated Border. Available at http://www.antaranews.com/en/news/70199/malaysian-fishing-boats-also-violated-border

[50] Key respondent.

[51] Permal. S, Centre for Maritime Security and Diplomacy. *Malaysia's and Indonesia's security concerns and priorities in the Strait of Malacca, similarities and differences.* Available at http://www.mima.gov.my/v2/data/pdf/presentation/112.Indonesian-Malaysian%20Security%20Priorities%20in%20the%20Strait%20of%20Malacca.pdf

[52] Jakarta Globe. 2014. Dozens Arrested in Malacca Strait over Illegal Fishing. Available at http://thejakartaglobe.beritasatu.com/news/dozens-foreign-fishermen-arrested-malacca-strait-illegal-fishing/

[53] Malaymail Online. 2015. *Indonesia blows up Malaysian ship for illegal fishing, report says.* Available at http://www.themalaymailonline.com/malaysia/article/indonesia-blows-up-malaysian-ship-for-illegal-fishing-report-says

[54] Anonymous. 2015. Interview on IUU fishing activities off West Coast Sumatra. Conducted 28 May 2015.

HOTSPOT 15	MALAYSIAN EEZ (NORTHEAST COAST PENINSULAR MALAYSIA)
Type of IUU-fishing activity	Fishing without permission or licence, fishing in prohibited areas, unauthorized transhipment, dual-flagged vessels. Contravention of licences (not landing in designated port, not reporting, not paying taxes etc.). Use of illegal gears.
Vessel nos., size & gear	Trawlers >70 GRT and smaller local vessels using pair- and benthic trawls and purse seines. The estimated number of IUU vessels operating is 100. Based on estimated catch rates in this area for pair trawl vessels are 75 kg/hr to 100 kg/hr. Using low-cost (subsidized/smuggled) fuel and trawling for 12 hours/day to 14 hours/day for 120 days/year depending on monsoon arrival and 100 boats trawling for 1 400 kg/day for 120 days at a catch per unit effort of 100 kg/hr for 14 hours/day, the estimated catch is 21 000 tonnes/year.
Species	Demersal species from trawl fisheries and lower value fish and small pelagic fish. **ETP:** Not identified as very serious for the east coast of Peninsular Malaysia.
Approximate illegal catch *Estimated value*	Estimated catch = 22 100 tonnes. We can assume an additional 10 percent to 25 percent of IUU fishing form other vessels. This represents and additional 2 210 tonnes to 5 500 tonnes. Therefore, the total IUU catch estimate for fish from the east coast of Peninsular Malaysia is estimated at between 24 310 tonnes and 27 600 tonnes. This trawl catch is relatively low value, so the per kilogram price assigned to the bulk of the IUU fish catch is USD 1 000/tonne, giving an estimated total value of USD 24.3 million to USD 27.6 million.

HOTSPOT 16	GULF OF THAILAND (THAI EEZ)
Type of IUU-fishing activity	Unauthorized fishing by foreign vessels along the EEZ border of Thailand and Viet Nam in the Gulf of Thailand (GoT). Encroachment well into the EEZ as far as Rayong, Chonburi provinces. Also, provinces in the Upper Gulf and across to Nakorn Sri Thammarat, Songkhla and Chumphon provinces in the lower GoT. Unregistered/unlicensed vessels/dual-flagged vessels.
Vessel nos., size & gear	Various, mainly small size <15 m LOA. In 2015. Squid jigging, longlining, drift netting, purse seine[55]. 67 foreign vessels caught fishing in the Thai EEZ by patrol vessels.[56] Estimation is a minimum of 200 to 300 vessels/year.
Species	Vietnamese vessels target sea snakes and sea cucumbers.
Approximate illegal catch	Unknown. Estimated catch: cannot be determined as mainly ETP and dried products
Estimated value	Based on the current market value of sea snakes, sea cucumbers, dried squid, yellow pike, conger eel (gas bladder) on the Chinese market, IUU fish losses are estimated at between USD 200 000 and USD 300 000**Error! Bookmark not defined.**.

HOTSPOT 17	CAMBODIAN EEZ
Type of IUU-fishing activity	Fishing without a licence by foreign vessels in the Cambodian EEZ and surrounding disputed waters during the closed season and use of illegal/banned gears and fishing methods (electric shock, illegal fine nets).
Vessel nos., size & gear	Various, from <90 HP to 400 HP. In 2002, 167 to 226 Thai vessels were licensed to operate in Cambodian waters, but many other IUU vessels were also operating.[57] Mainly trawling, purse seining. In 2011, 40 illegal vessels found; 2 000 m of fishing nets, 1 000 m of electrical wire and

[55] Key respondent. 2015. Interview on the subject of IUU fishing in Thailand EEZ.

[56] Bangkok Post. 2015. Three Vietnamese Boats Seized for Illegal Fishing. Available at http://www.bangkokpost.com/news/security/556659/three-vietnamese-boats-seized-for-illegal-fishing

[57] Gillett, R. 2004. *The marine fisheries of Cambodia.* FAO/FishCode Review. No. 4. Rome, FAO. Available at http://www.fao.org/docrep/007/j1617e/j1617e00.htm

HOTSPOT 17	CAMBODIAN EEZ
	1 700 crab traps confiscated.[58] Bycatch of trawlers most likely affecting ETP species (actual species and numbers unknown).
Species	Demersal species, crustaceans (shrimps), low-value fish (bycatch).
Approximate illegal catch *Estimated value*	Catches from the licensed 167 to 226 vessels operating in Cambodian waters in 2002 were estimated to be from 26 500 tonnes to 37 500 tonnes. Most of the catch of foreign vessels subsequently is assumed to be IUU in some form and the vessel numbers approximately the same as the numbers previously licensed.. Estimated total = 26 500 tonnes to 37 500 tonnes. Estimated value (USD 1 000/tonne to USD 1 500/tonne) = USD 26.5 million to USD 56.3 million.

HOTSPOT 18	NATUNA SEA (WITHIN THE INDONESIAN EEZ)[59]
Type of IUU-fishing activity	Opportunistic entry into Indonesian Natuna Sea waters from neighbours fishing without authorization, underreporting and/or non-reporting and non-payment or avoidance of export taxes, transhipment with only partial landing of fish in Indonesia. Vessels not deleted from original registries. Dual flagging. Brokers involved in providing documentation for a commission. The broker applies for a fishery business license (SIUP) to bring in vessels, then looks for vessels and applies for a fishing permit (SIPI) for each vessel brought in. The vessels coming in present fake deletion documents (one vessel with three registrations – sometimes one of these vessels is deleted but two remain registered). Falsification of documentation, transmitters turned off, use of illegal gears and methods in contravention of Indonesian laws.
Vessel nos., size & gear	Trawlers are 60 GRT to 150 GRT and purse seiners 120 GRT to 280 GRT; 320 trawlers and 60 to 80 purse seiners; 15 chilled carriers of about 280 tonnes to 380 tonnes cargo capacity. Another 140 vessels made up of 70 pair trawlers, unknown number of other tuna purse seiners. Fish chilled with ice for transhipment as well as landing in port. Smaller trawlers tranship to collector boats. In 2011 the navy arrested 3 illegal fishing boats[60],[61] The three apprehended fishing vessels were 60 GRT, 40 GRT and 30 GRT.[62] In 2012 the DG PSDKP of MMAF RI examined 1 150 boats and arrested 39 boats – 11 Indonesian-flagged boats and 28 foreign-flagged vessels.[63] Also in 2012, 9 boats were re-arrested for conducting illegal-fishing activities in Indonesia's Natuna waters.[64] In 2013 4 fishing vessels were arrested for fishing without a business licence.[65] In 2014 16 boats allegedly conducted illegal fishing.
Species	Tunas and neritic tuna. Trawlers are targeting surimi species and low-value fish for fishmeal (multiple species) Pair trawlers – mixed demersal species. **ETP:** Dry season – seahorses in the catch. The ship's master receives personal income from sale (owner does not see this income). Traded in nearby ports.
Approximate illegal catch	+/-40 000 tonnes of neritic tuna (tonggol, blackfin tuna, bonito) and skipjack tuna/year; +/-190 000 tonnes/year (Songkhla trawlers); +/-105 000 tonnes/year from Vietnamese pair trawlers – (~6 tonnes/day per pair trawl x 70 pairs x 250 fishing days/year.

[58] The Phnom Penh Post. 2011. Kep Officials Crack Down on Vietnamese Boats. Available at http://www.phnompenhpost.com/national/kep-officials-crack-down-vietnamese-boats

[59] Key informant wishes to remain anonymous.

[60] Antara News. 2011. Navy Arrests Illegal Vietnamese Fishing Boats. Available at http://www.antaranews.com/en/news/67994/navy-arrests-illegal-vietnamese-fishing-boats

[61] KOMPAS. 2011. *Indonesia naval patrol catches Malaysian vessel.* Available at http://english.kompas.com/read/2011/03/31/05134315/Indonesia%20Naval%20Patrol%20Catches%20Malaysian%20Vessel

[62] Atara News. 2011. Three Malaysian Fishing Boats Nabbed in Riau Province Waters. Available at http://www.antaranews.com/en/news/70625/three-malaysian-fishing-boats-nabbed-in-riau-province-waters

[63] Antara News. 2012. Again, Hiu Macan Arrested 9 Fishing Boats from Viet Nam. Available at http://www.antaranews.com/en/news/81739/again-hiu-macan-arrested-9-fishing-boats-from-vietnam

[64] Available at http://www.antaranews.com/en/news/81739/again-hiu-macan-arrested-9-fishing-boats-from-vietnam

[65] Antara News. 2013. Four Malaysian Fishing Vessels Arrested by the MMFA's Patrol Boats on Illegal Fishing Accusation. Available at http://www.antaranews.com/en/news/88054/four-malaysian-fishing-vessels-arrested-by-the-mmfas-patrol-boats-on-illegal-fishing-accusation

HOTSPOT 18	NATUNA SEA (WITHIN THE INDONESIAN EEZ)[59]
Estimated value	Total estimated catch is between 290 000 tonnes and 335 000 tonnes. Total estimated value (USD 1 000/tonne to USD 1 500/tonne) = USD 290 million to USD 502 million.

HOTSPOT 19	SARAWAK (WITHIN MALAYSIA EEZ)
Type of IUU-fishing activity	Foreign vessels in Sarawak, Malaysia lacking EEZ licence.[66] Not reporting or underreporting, cloning of vessel licences.[67] Fishing in prohibited areas less than 30 NM from shore.[68]
Vessel nos., size & gear	Small-size and medium-size trawlers and larger pair trawlers.[69] 17 m to 23 m wooden vessels. (2010). 300 medium- and large-fishing boats operated by a company in Sarawak and operating in Sarawak waters.[70] It is assumed these were reflagged to Malaysia as chartering is not allowed under Malaysian law. (2014) Ten reflagged vessels, (2014) 50 to 100 medium-scale trawlers (possibly up to 250, but unclear how many are operating legally).[71] Four illegal vessels caught per month = 48/year. Thirty foreign vessels sighted in port.[72]
Species	Assumed general demersal species from trawl fishery.
Approximate illegal catch *Estimated value*	Each vessel catches between 80 tonnes and 100 tonnes of fish/month at MYR 10/kg (USD 3.30/kg). At catch rates of 100 kg/hour to 277 kg/hour operating 12 hours per day for approximately 200 days per year it can be assumed that: Estimated IUU catch = 12 000 tonnes to 66 700 tonnes. Estimated value of catch (USD 1 500/tonne to USD 3 000/tonne) = USD 18 million to USD 220 million. **ETP:** Sarawak is home to all five sea turtle species They nest mainly in Similajau National Park. The articles on IUU fishing show that IUU fishing is also taking place in proximity to these parks and it is therefore feasible that turtles are being caught intentionally and as bycatch.[73]

HOTSPOT 20	BRUNEI DARUSSALAAM EEZ
Type of IUU-fishing activity	Encroachment into Brunei EEZ by unlicensed foreign fishing vessels particularly in Zones 1 and 2.[74] Illegal/destructive fishing methods (explosives, poison [including cyanide], mainly by small artisanal fishers).
Vessel nos., size & gear	Unknown numbers of vessels fishing at 3 NM to 20 NM offshore (<60 GRT), 61 GRT to 150 GRT at 20+ NM offshore. Longlining, purse seining, trawling.
Species	Demersal and pelagic. Some shark fishing reported (unclear if ETP species).

[66] New Sawarak Tribune. 2015. Two Boats Detained by MMEA for Illegal Fishing. Available at http://www.newsarawaktribune.com/news/44415/Two-boats-detained-by-MMEA-for-illegal-fishing/

[67] Borneo Post. 2015. Illegal Fishermen Making a Fortune in Sarawak Waters. Available at http://www.theborneopost.com/2015/06/23/illegal-fishermen-making-a-fortune-in-sarawak-waters/#ixzz3e8a7DETd

[68] APEC. 2008. *Case study on illegal, unreported and unregulated (IUU) fishing off the east coast of Peninsular Malaysia.* Available at http://publications.apec.org/publication-detail.php?pub_id=104

[69] New Sawarak Tribune. 2015. Two Boats Detained by MMEA for Illegal Fishing. Available at http://www.newsarawaktribune.com/news/44415/Two-boats-detained-by-MMEA-for-illegal-fishing/

[70] Thai Ministry of Labour. 2010. Office of Labour Affairs in Malaysia Investigates Thai Fishermen. Available at http://www.mol.go.th/en/anonymouse/foreignlabour/11472

[71] Key respondent. Interview on IUU fishing in Sawarak, Malaysia.

[72] APEC. 2008. *Case study on illegal, unreported and unregulated (IUU) fishing off the east coast of Peninsular Malaysia.* Available at http://publications.apec.org/publication-detail.php?pub_id=104

[73] Visit Sawarak. 2015. *Sea turtle conservation programmes.* Available at http://sarawaktourism.com/attraction/sea-turtle-conservation-programmes/

[74] Brunei Department of Fisheries, Ministry of Industry and Primary Resources. 2011. *Brunei Darussalam national plan of action to prevent, deter and eliminate illegal, unreported and unregulated fishing.* ISBN 99917-31-51-2.

HOTSPOT 20	BRUNEI DARUSSALAAM EEZ
Approximate illegal catch *Estimated value*	Estimated USD 19 million lost each year to IUU fishing[75] (assuming a catch value of USD 1 000/tonne to USD 1 500/tonne). Estimated IUU catch = 12 700 tonnes to 19 000 tonnes.

HOTSPOT 21	GULF OF TONKIN/BEIBU GULF
Type of IUU-fishing activity	Infractions that undermine the fisheries management measures established under the Agreement on Fishery Co-operation in the Tonkin Gulf between the Government of the People's Republic of China and the Government of the Socialist Republic of Vietnam. These are primarily encroachment but also fishing in the closed season.
Vessel nos., size & gear	Viet Nam: Vietnamese multiday fishing boats typically of about 15 m LOA. China: High-capacity trawlers in the range of 20 m LOA to 40 m LOA. Sixty-one illegal IUU-fishing vessels were counted during a Chinese trawl survey over a 6-day period in July 2013. Chinese fishery patrols from 2004 to 2009 intercepted 488 foreign IUU-fishing vessels in the Chinese area (~100/year). Smaller vessels using gillnets and light falling nets, trawls and purse seines and light attracting lift nets contribute to 43 percent of catches.[76] Over a ten-year period, the Vietnamese coastguard drove away 7 781 vessels and the border guard intercepted 1 800 encroaching ships, a total of 9 581 illegal incidents. However, this is only what was intercepted. There is an unknown quantity that was not chased or intercepted.[77] Gears include large trawls and purse seines.
Species	Multispecies fishery targeting squids and small pelagic finfish.
Approximate illegal catch *Estimated value*	Based on ~778 to 958 annual IUU-fishing vessel incidents, large scale (*pro rata* over 10 years of recorded incidents), ~5 tonnes/day to 10 tonnes/day, smaller scale 2 tonnes/day to 3 tonnes/day = 3 650 tonnes/year to 10 950 tonnes/year. Based on smaller size vessels, but possibly as high as 3 650 vessels/year (~10/day) 80 percent small scale, 15 kg/day to 40 kg/day = 44 tonnes/year to 117 tonnes/year. 20 percent larger scale, 2 tonnes/day to 3 tonnes/day = 1 460 tonnes/year to 2 190 tonnes/year. Total estimated IUU catch = 5 000 tonnes/year to 13 000 tonnes/year. Total estimated IUU value (USD 1 500 to USD 2 000/tonne) = USD 7.5 million to USD 26 million.

HOTSPOT 22	PALAWAN (WITHIN PHILIPPINES EEZ)
Type of IUU-fishing activity	Regular, consistent entry into Philippines waters by foreign vessels to fish or collect fish/ETP species. Fishing without authorization, buying and collection of protected species from local communities. In Palawan, Benavente-Villena and Pido (2004) revealed that 38 percent of foreign illegal fishing is concentrated in Balabac and 11 percent in Tubbataha, a declared UNESCO World Heritage Site and the country's only national marine park[78].
Vessel nos., size & gear	Numbers not easily obtained. Multiday vessels, tuna vessels, in most cases 30 m LOA to 50 m LOA.[79] Smaller vessels less than 21 m LOA but average between 14 m LOA and 18 m LOA.

[75] The Brunei Times. 2014. $19 million Lost Due to Illegal Fishing. Available at http://m.bt.com.bn/news-national/2014/11/09/19-million-lost-due-illegal-fishing

[76] Long Et Ba Thong. 2008. *IFFET 2008 Viet Nam proceedings.* Available at http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/37507/461.pdf?sequence=1

[77] Tuoi Tre News. 2014. Over 9,500 Ships Illegally Fish in Tonkin Gulf in Last Decade: Report. Available at http://tuoitrenews.vn/society/22600/over-9500-chinese-ships-illegally-fish-in-tonkin-gulf-over-10-years-report

[78] see http://www.rappler.com/move-ph/30579-poaching-fun-philippines

[79] The Straits Times Asia. 2014. 12 Chinese Jailed for Illegal Fishing in the Philippines. Available at http://www.straitstimes.com/news/asia/south-east-asia/story/12-chinese-jailed-illegal-fishing-philippines-20140805

HOTSPOT 22	PALAWAN (WITHIN PHILIPPINES EEZ)
	Longliners and pole and line gear, driftnets for turtles, also likely that the vessels are collecting from local fishers.
Species	Marine turtles are deliberately hunted and collected, giant clams, corals and live baby sharks. Large tunas, sharks,[80] sailfish and marlin, dorado and large cavallas**.** **ETP:** Coral trout/grouper (*Plectropomus* spp.) and humphead wrasse (*Cheilinus undulatus*); [81,82] the latter species is protected under CITES.
Approximate illegal catch *Estimated value*	About 20 tonnes per successful operation lasting about one week in various fishing grounds in the Sulu Sea and Southern Palawan, targeting hawksbill turtles. Turtle shell price >USD 225/kg. Assuming regular incursions are >1 vessel/month, based on trip duration of 20 days and vessels of 20 m LOA to 30 m LOA, the total operating costs of 12 trips/year are estimated at USD 288 000. Catch/collection of 5 tonnes/trip to 20 tonnes/trip, at an average price of USD 25/kg to USD 50/kg, is equivalent to USD 125 000 to USD 1 million/trip or USD 1.5 million/year to USD 12 million/year.

HOTSPOT 23	SCARBOROUGH SHOAL
Type of IUU-fishing activity	Targeting of ETPs[83]. China and Philippines claim sovereignty over the area thus there is uncertain to what extent fishing being carried out by either country is an infraction or not.
Vessel nos., size & gear	Unknown amount using trawling, driftnetting, live fish.
Species	500 sea turtles on one vessel. Groupers, lobsters (crustaceans), sea cucumbers and live shark.[84] Giant clams, corals.[85]
Approximate illegal catch	Unknown.
Estimated value	Unknown.

HOTSPOT 24	TIMOR-LESTE EEZ
Type of IUU-fishing activity	Trawlers and gillnetters fishing illegally in the Timor-Leste EEZ. Transhipment without authorization or illegal shipment (may not be illegal). In 2012 an illegal-fishing vessel entered the waters of Timor-Leste and cleaned out an entire population of trochus from a no-take zone located within the Nino Konis Santana National Park. The total value of the catch was a USD 20 000. [86] Flags from Indonesia and other countries.
Vessel nos., size & gear	Small vessels – 5 GRT to 10 GRT up to >40 GRT, >100 m length. Trawling, longlining, purse seining, gillnetting.

[80] The Straits Times Asia. 2014. 12 Vietnamese Jailed in Philippines for Illegal Fishing. Available at http://www.straitstimes.com/news/asia/south-east-asia/story/12-vietnamese-jailed-philippines-illegal-fishing-20140618?page=9

[81] Philstar. 2014. Chinese Poachers Face Wildlife Raps. Available at http://www.philstar.com/headlines/2014/05/09/1321038/chinese-poachers-face-wildlife-raps

[82] Philstar. 2015. Palawan RTC Orders 9 Jailed Chinese Fishermen Freed. Available at http://www.philstar.com/nation/2015/06/09/1464053/palawan-rtc-orders-9-jailed-chinese-fishermen-freed

[83] The Diplomat. 2015. Philippines Accuses China of Ramming Boats in South China Sea. Available at http://thediplomat.com/2015/02/philippines-accuses-china-of-ramming-boats-in-south-china-sea/

[84] Financial Times 2012. Philippines and China in naval stand-off. Available at https://www.ft.com/content/2bcc70f2-837f-11e1-ab78-00144feab49a

[85] E-International Relations. 2012. *Beyond the Scarborough scare: joint resource management in the South China Sea.* Available at http://www.e-ir.info/2012/05/01/beyond-the-scarborough-scare-prospects-for-joint-resource-management-in-the-south-china-sea/

[86] Lynn, T. 2012. Is Timor-Leste striving to protect resources for local communities? *Humanature Conservation International Blog.* Available at http://blog.conservation.org/2012/12/in-timor-leste-striving-to-protect-resources-for-local-communities/#sthash.K0ELWAkC.dpuf

HOTSPOT 24	TIMOR-LESTE EEZ
Species	Tunas and tuna-like species and other small pelagic species. Demersal species in some trawlable areas. Sea turtles used for local consumption. Dugong.
Approximate illegal catch *Estimated value*	Annual tonnage caught is estimated at less than 10 000 tonnes. Reportedly approximately 1 000 tonnes are lost to IUU fishing.[87] Catches mainly on the outer fringes of the southern boundaries with Australia and the western boundaries with Indonesia. Annual losses to IUU fishing are estimated at USD 20 million.[88] This contradicts the reported figure of 1 000 tonnes above, being closer to a more realistic figure of ~10 tonnes to 20 000 tonnes of high-value tunas, high-value demersals and small pelagic fish.

HOTSPOT 25	ARAFURA SEA (INDONESIAN EEZ)
Type of IUU-fishing activity	Dual flagging. No valid permission or licence,[89] forged documents (many cases indicated that hidden licence fees exist). Non-compliance with contractual access arrangements. Non-compliance with transhipment regulations.[90] (Reported that when the carrier vessel is in port, fish are not offloaded to the cold storage and then reloaded onto the carrier but transhipped directly from the fishing vessels to the carrier). Non-compliance with catch certification regulations[91] (not reporting or underreporting). Fishing <4 NM from shore in contravention of Reg. No. 42/2014 particularly in FMA 718.[92].
Vessel nos., size & gear	Based on information from the Directorate General of Marine Fisheries Surveillance (DGMFS) in January 2015 and interviews, the larger foreign fishing vessels are between 300 GRT and 400 GRT. but other data indicate broader ranges of vessels size. Mainly trawls.
Species	Mainly low-value demersal fish species (red bream, croakers, big eyes) used in the manufacture of surimi; frozen whole in blocks. Small sharks taken as bycatch and very low-value fish are normally discarded as it is too far to bring them back to port for fish meal. **ETP:** Possibly sea turtles and sea snakes in the trawls. Not reported in large quantities and do not appear to be a significant issue in the Arafura Sea.
Approximate illegal catch *Estimated value*	Under these arrangements vessels are allowed to fish within the EEZ but not in the waters close to the islands or within the territorial sea. Working conditions on vessels have led to what is tantamount to slavery.[93] This has been facilitated by bribery.[94] Sixty-six vessels catching 6 tonnes/day for 250 days/year. Estimated catch = 99 000 tonnes. Estimated value (USD 1 200/tonne to USD 2 000/tonne) = USD 118.8 million. Additional 64 to 104 vessels from other countries catching 3 tonnes/day for 250 days/year. Estimated catch = 48 000 tonnes to 78 000 tonnes. Estimated value (USD 1 200/tonne to USD 2 000/tonne) = USD 57.6 million to USD 156 million.

[87] Amaral, J.X. 2010. *Current fisheries and aquaculture policies relevant to the regional fisheries livelihood project (RFLP) in Timor-Leste.* Available at http://www.fao.org/3/a-ar477e.pdf

[88] FAO. 2015. The Democratic Republic of Timor Leste. In *FAO fisheries and aquaculture county profiles.* Available at http://www.fao.org/fishery/facp/TLS/en

[89] Tempo.Co bisnis. 2015. Pemilik kapal hai fa minta jokowi copot menteri susi. 19 May. Available at http://www.tempo.co/read/news/2015/04/23/090660217/Pemilik-Kapal-Hai-Fa-Minta-Jokowi-Copot-Menteri-Susi

[90] Detik Finance. 2015. *Ministry regulation of transshipment KP No. 57/2014 and modifications better monitor transshipment in line with RFMO best practices – VMS on carriers, observers, reporting of coordinates and species and quantities transferred.* Available at http://finance.detik.com/read/2015/01/22/162300/2811094/4/menteri-susi-bakal-izinkan-bongkar-muat-ikan-di-laut-tapi-diawasi-ketat

[91] Peraturan Direktur Jenderal. 2014. *Technical verification of fish landings.* Nomor 10/PER-DJPSDKP/2014. Available at http://djpsdkp.kkp.go.id/index.php/arsip/file/154/perdirjen-psdkp-nomor-10-djpsdkp-2014-tentang-juknis-verifikasi-pendaratan-ikan.pdf/

[92] Interview with two key respondents.

[93] McDowell, R. & Mason, M. 2015 [online]. *More than 300 slave fishermen now safe on Indonesian island.* Yahoo News. Available at http://news.yahoo.com/ap-investigation-prompts-emergency-rescue-300-plus-slaves-052136674.html

[94] Mongabay. 2015. *Indonesia recognizes bribery might have enabled slavery in eastern waters.* Available at http://news.mongabay.com/2015/0409-jacobson-fishing-slavery-bribery.html

HOTSPOT 25	ARAFURA SEA (INDONESIAN EEZ)
	Arafura Sea minimum low volume = 340 500 tonnes to 370 500 tonnes. Arafura Sea minimum low value = USD 408.6 million to USD 741 million.

HOTSPOT 26	PAPUA NEW GUINEA EEZ ('DOG LEG')
Type of IUU-fishing activity	Vessels fish along the edge of the EEZ and it is highly likely that the EEZ line between Indonesia and Papua New Guinea is crossed occasionally or regularly.[95] It is also possible the vessels fish in other parts of the Papua New Guinea EEZ. The landings may be recorded, but it is not known if they are reported back to the government. For fisheries management and conservation, the catch should be recorded as Papua New Guinea catch. Fishing without VMS.
Vessel nos., size & gear	~300 GRT. Fifty-two trawlers fishing in Papua New Guinea under licences.[96] In 2014, 5 boats illegally fishing without VMS.[97] In 2015, fishing vessels confiscated by the Indonesian Navy for fishing outside of the authorized Papua New Guinea zone. Mainly trawls.
Species	Mixed demersal fish species.
Approximate illegal catch *Estimated value*	Unknown. Unknown.

HOTSPOT 27	ASHMORE REEF, SCOTT REEF, CARTIER ISLAND (WITHIN THE AUSTRALIAN EEZ)
Type of IUU-fishing activity	Unauthorized fishing in the Australian EEZ. Fishing without a valid licence. Illegal possession of protected species.[98] Fishing using banned methods (explosives).[99]
Vessel nos., size & gear	15 m LOA to 20 m LOA. Two Type 3 Bohdis (shark-fishing vessels) apprehended in 2014.[100] Large clam-fishing vessels (367) apprehended in 2006.[101] In 2014 four vessels (giant clams and sea cucumbers) apprehended.[99] Longlining, illegal methods (explosives).
Species	**ETP:** Giant clams, sea cucumbers (trepang), shark species.
Approximate illegal catch *Estimated value*	Giant clams valued at approximately USD 4 700 each. [100] Sea cucumbers seized valued at USD 51 400. The benefits are high compared to the risk considering that Ashmore Reef is 18 NM from the nearest point of land and 40 NM from the EEZ boundary. Assuming the 2006 apprehensions of 100 vessels with an average of (low estimate) 50 giant clams at USD 4 700 each. Estimated value: 360 vessels x 50 clams x USD 4 700 (each) = USD 23 million.

[95] Bangkok Post. 2015. Company Finds Itself Caught in Indonesia's Net. Available at http://www.bangkokpost.com/lite/topstories/503921/company-finds-itself-caught-in-indonesia-net

[96] Key respondent. 2015. Interview on Dog Leg, Papua New Guinea.

[97] LOOP. 2014. *5 Illegal boats nabbed in PNG waters.* Available at http://www.pngloop.com/2014/10/28/5-illegal-boats-nabbed-png-waters-2/

[98] Fisheries Information System (FIS). 2014. *Poachers targeting valuable marine resources caught, prosecuted.* Available at http://www.fis.com/fis/worldnEws/search_brief.asp?l=e&id=67914&ndb=1&monthyear=4-2014&day=1&country=11&df=1

[99] Agricultural and Food Marketing Association (AFMA). 2012. *Illegal blast fishers convicted and boats destroyed.* Available at http://www.afma.gov.au/illegal-blast-fishers-convicted-and-boats-destroyed/

[100] AFMA. 2014. *Recent apprehension of Bodhis.* Available at http://australianfisheriesmanagementauthority.createsend1.com/t/ViewEmail/r/C344A705A7CBE77D2540EF23F30FEDED

[101] FIS. 2011. *Border control measures successfully cut down on illegal fishing.* Available at http://fis.com/fis/worldnews/worldnews.asp?l=e&ndb=1&id=42404

HOTSPOT 28	TAGANAK ISLANDS (WITHIN THE PHILIPPINES EEZ)
Type of IUU-fishing activity	Trawlers fishing without authorization in Philippine territory near and around the turtle islands heritage site. *Taukes* (*towkays*) bribe with catch-and-cash payment. [102] Vessels target collecting turtle eggs and catching of turtles.
Vessel nos., size & gear	Size of vessels ranges between 20 GRT and 70 GRT, operating on a multiday basis carrying ice, fuel and supplies for at least a week; 20 to 30 boats operating daily in the area.[102] From 2000 to 2008, over 1 000 foreigners arrested for illegal fishing in the waters of Palawan.[103]From 2005 to 2009, the Philippine Navy recorded 571 cases of illegal fishing both by local and foreign fishers.[104] Vessels use gillnets and dive equipment for turtles and stern otter trawls.[102]
Species	Shrimps and ground fishes. Sea turtles. The Turtle Islands, one of the world's major nesting sites of marine turtles, are located at the country's southernmost frontier.[105] The Turtle Islands Heritage Protected Area is the biggest rookery for green and hawksbill turtles.[106] The boats smuggle turtle eggs. The number of turtles that die or drown during the operations of these trawlers may be significant. Collection/stealing of turtle eggs is common. In Tawi Tawi municipality, most, if not all, wildlife crimes are unsolved or simply settled out of court. [104] In 2009 sea turtles laid about 1 million eggs on the shores of Baguan alone.**Error! Bookmark not defined.**
Approximate illegal catch *Estimated value*	**Trawlers:** Catch 10 tonnes/day to 20 tonnes/day.[102] Typical catch comprises 20 percent shrimp and 80 percent low-value fish. Ex-vessel prices of USD 3 000/tonne for shrimp and USD 1 200/tonne for demersal species. Estimated IUU catch = 3 650 tonnes/year to 7 300 tonnes/year. Estimated value = USD 5.6 million to USD 11.3 million. One sea turtle can sell for USD 3 000.[107] The buying price for one turtle egg is PhP 3.50 (PhP 1.00 = USD 0.021, 25 February 2021) compared to PhP 23.40/egg in Kota Kinabalu. The Philippine Navy estimates that the average annual revenue loss due to illegal fishing by both local and foreign fishers in the Sulu–Sulawesi Sea alone is about USD 1.6 million.[108]

HOTSPOT 29	CELEBES SEA AND NORTH SULAWESI (INDONESIA, MALAYSIA, PHILIPPINES EEZ)
Type of IUU-fishing activity	The most common illegal activities[109] are fishing without a licence or with a fake licence, fake vessel registration, dual flagging, using explosives and poisons, landing in unauthorized fishing ports, non-reporting, underreporting or misreporting.
Vessel nos., size & gear	Vessels <10 GRT fishing one to two days, using small-scale gears.[110] Small-scale commercial boats 15 GRT and 60 GRT and large-scale commercial fishing vessels with modern technology >60 GRT. In 2011, vessels operating in the Indonesian side of the border; 22

[102] Key respondent.

[103] GMA News. 2010. *Stronger law enforcement pushed for Palawan, Tawi Tawi Seas.* Available at http://www.gmanetwork.com/news/story/192957/news/regions/stronger-law-enforcement-pushed-for-palawan-tawi-tawi-seas

[104] Global Nation Inquirer. 2010. *Turtle Islands: Hundreds of nautical miles away from justice*. Available at http://globalnation.inquirer.net/news/breakingnews/view/20100730-284016/Turtle-Islands-Hundreds-of-nautical-miles-away-from-justice).

[105] GMA News. 2014. *Ecotourism projects eyed for Tawi-Tawi's Turtle Islands.* Available at http://www.gmanetwork.com/news/story/364006/cbb/ecotourism-projects-eyed-for-tawi-tawi-s-turtle-islands

[106] Biodiversity Information Sharing Service (Asean Clearing House Mechanism). 2010. *Turtle Islands Heritage Protected Area*. Available at http://chm.aseanbiodiversity.org/index.php?option=com_content&view=article&id=137&Itemid=223

[107] Principles for Responsible Investment (PRI). 2012. *Sea turtle poaching and high demand in China.* Available at http://www.pri.org/stories/2012-02-08/sea-turtle-poaching-and-high-demand-china

[108] Palma, M. & Tsamenyi, M. 2008. *Case study on the impacts of illegal, unreported and unregulated (IUU) fishing in the Sulawesi Sea.* Available at http://publications.apec.org/publication-detail.php?pub_id=105

[109] Palma, M.A. & Tsamenyi, M. 2008. APEC- Case study on the impacts of illegal, unreported and unregulated (IUU) fishing in the Sulawesi Sea (available at http://www.apfic.org/attachments/article/67/apec%20sulu%20sulawesi.pdf).

[110] World Fishing and Aquaculture. 2012. *Indonesia to boost sustainable fisheries production.* Available at http://www.worldfishing.net/news101/regional-focus/indonesia-to-boost-sustainable-fisheries-production

HOTSPOT 29	CELEBES SEA AND NORTH SULAWESI (INDONESIA, MALAYSIA, PHILIPPINES EEZ)
	boats and crews apprehended for "smuggling and terrorists".[111] In 2014 two trawlers scuttled.[112] Also in 2014 three boats apprehended fishing without permits.[113] In 2015 the Indonesian Navy arrested more illegal boats in the Celebes Sea[114] and sunk two vessels captured in North Sulawesi.[115]
Species	Tunas, billfishes, sharks, Napoleon wrasse, corals, marine mammals. **ETP:** Dugongs, leopard sharks, thresher sharks, whale sharks, hawksbill and green turtles, dolphins and whales.
Approximate illegal catch *Estimated value*	According to the Ministry of Marine Affairs and Fisheries, the total cost of IUU-fishing in the Indonesian EEZ part of the Sulawesi Sea, conducted only by purse seine and longline vessels catching large pelagics was ~ USD 153 604. This included financial loss due to non-payment of fishing fees, value of the fuel subsidy provided to such vessels and the actual value of the IUU catch[116].

HOTSPOT 30	NORTH MALUKU (WITHIN INDONESIA EEZ)
Type of IUU-fishing activity	Fishing without authorization. Mother boats accompanied by smaller handline vessels fishing without authorization, no registration of permits).[117] Non-declaration of catches to Indonesia.
Vessel nos., size & gear	Larger outrigger mother boats typically on average 20 m LOA to 30 m LOA. Can reach 50 GRT and can operate autonomously for 22 to 30 days. Crews of between 15 and 30 fishers.
Species	Mainly yellowfin tuna bound for domestic and international markets.[118] In addition to bigeye and albacore tunas, marlins and a very small percentage of other large pelagic species such as oil fish and dolphin fish.
Approximate illegal catch *Estimated value*	Assuming IUU fishing continued at 2008 levels, when 242 foreign vessels were arrested, approximate values for high-value fresh tuna in ice caught by handline are as follows: 242 vessels x 75 kg/day x 200 days = 3 630 tonnes. Price USD 5 000/tonne to USD 8 000/tonne = USD 18 million to USD 29 million. Estimated volume approximately 3 600 tonnes/year to 4 500 tonnes/year. Estimated value approximately USD 18 million to USD 29 million.

[111] Antara News. 2011. Indonesian Naval ships arrest 22 Philippine Fishing Boats. Available at http://www.antaranews.com/en/news/73074/indonesian-naval-ships-arrest-22-philippine-fishing-boats

[112] Jakarta Globe. 2015. Police Sink Malaysian Boats Fishing Illegally in Indonesian Waters. Available at http://thejakartaglobe.beritasatu.com/news/police-sink-malaysian-boats-fishing-illegaly-indonesian-waters/

[113] The Jakarta Post. 2014. War on Illegal Fishing Begins. Available at http://www.thejakartapost.com/news/2014/12/06/war-illegal-fishing-begins.html

[114] The Jakarta Post. 2015. Navy Arrests More Illegal Boats in Celebes Sea. Available at http://www.thejakartapost.com/news/2015/02/27/navy-arrests-more-illegal-boats-celebes-sea.html

[115] Antara News. 2015. Indonesian Navy Sinks Filipino Fishing Boats. Available at http://www.antaranews.com/en/news/97332/indonesian-navy-sinks-filipino-fishing-boat

[116] Palma, M. & Tsamenyi, M. 2008. *Case study on the impacts of illegal, unreported and unregulated (IUU) fishing in the Sulawesi Sea.* Available at http://publications.apec.org/publication-detail.php?pub_id=105

[117] Antara News. 2012. Again, Two Philippines' Fishing Boats Arrested by MMAF Supervisor Boat. Available at http://www.antaranews.com/en/news/81388/again-two-philippines-fishing-boats-arrested-by-mmaf-supervisor-boat

[118] ACIAR. 2011. *Preliminary assessment of the handline (*banca*) fisheries in the Philippines.* Available at http://aciar.gov.au/publication/fr2011-26

HOTSPOT 31	BALINTANG CHANNEL, BATANES ISLAND (WITHIN THE PHILIPPINES EEZ)
Type of IUU-fishing activity	Fishing in the Philippines EEZ without permit/licence. No flag displayed.[119,120]
Vessel nos., size & gear	Various (small catch vessels <15 m LOA, larger vessels >30 m LOA). Diving, tuna longline, driftnetting.
Species	Lobsters, tunas.
Approximate illegal catch	In 2013-15 foreign poaching was widespread in northern Philippine waters and amounted to some USD 1.8 million to USD 3.5 million every year.[121,122]
Estimated value	Estimated value = USD 1.8 million to USD 3.5 million. Estimated catch (based on USD 5 000/tonne to USD 10 000/tonne for tunas and lobsters) equivalent to 360 tonnes to 700 tonnes.

HOTSPOT 32	SENKAKU/DIAOYU ISLANDS
Type of IUU-fishing activity	Encroachment in unresolved areas. Fishing without authorization. Breach of management measures of the Provisional Management Zone by using illegal methods.[123] Targeting of protected coral species. Vessels fishing for red corals; snappers and groupers also caught. Vessels fishing for mackerel around the Senkaku Islands.[123]
Vessel nos, size & gear	Reuters[124] estimated 17 m LOA to 24 m LOA (based on photos of vessels in online news articles). In 2013 Japanese border guards detained fishers in southern Okinawa.[125] In 2014 100 ships were suspected.[122] Taiwan Province of China commit to punish infractions by fishing boats.[126] In 2014 6 persons hunting illegally for red corals.[127] In 2015 skipper jailed for coral poaching.[128] Diving and illegal dredges.
Species	Red corals and finfishes.
Approximate illegal catch *Estimated value*	In one crackdown, 38 kg of red corals were confiscated by Chinese authorities, valued at USD 2.5 million.[129] Assuming average cost per vessel, each fishing trip amounts to USD 8 000 to USD 12 000, the breakeven cost of 100 to 200 vessels, two to three trips per year, is USD 1.6 million to USD 7.2 million.

[119] Official Gazette. 2013. Balintang Channel Incident Report. Available at http://www.gov.ph/2013/08/07/balintang-channel-incident-report/

[120] PhilStar. 2014. Gov't Troops in Cagayan Act as Village Watchmen, Referees. Available at http://www.philstar.com/headlines/2014/06/01/1329623/govt-troops-cagayan-act-village-watchmen-referees

[121] East Asia Forum. 2013. *Taiwan: fishing for a fishery agreement with the Philippines.* Available at http://www.eastasiaforum.org/2013/06/14/taiwan-fishing-for-a-fishery-agreement-with-the-philippines/

[122] Global Nation Inquirer. 2015. Illegal Taiwanese Ship Seized off Batanes; 6 Foreigners Nabbed. Available at http://globalnation.inquirer.net/122684/illegal-taiwanese-ship-seized-off-batanes-6-foreigners-nabbed#ixzz3e8obpuvE

[123] The Asahi Shimbun. 2013. Taiwan fishermen Report Japan Patrol Boats "Backing Off''. Available at http://ajw.asahi.com/article/behind_news/politics/AJ201301090067

[124] Reuters. 2014. Japan Cracks Down on Chinese Illegal Fishing. Available at http://www.reuters.com/video/2014/11/14/japan-cracks-down-on-chinese-illegal-fis?videoId=347493889

[125] Russian Radio. 2013. Japan detains a Chinese ship for illegal fishing off the coast of Okinawa. Available at http://in.sputniknews.com/indian.ruvr.ru/2013_02_02/Japan-detains-a-Chinese-ship-for-illegal-fishing/

[126] The Japan Times. 2014. Taiwan to Punish Unlicensed Fishermen Caught Beyond Senkaku Zone. Available at http://www.japantimes.co.jp/news/2014/05/02/world/taiwan-to-punish-unlicensed-fishermen-caught-beyond-senkaku-zone/

[127] Nikkei Asian Review. 2014. Behind Soaring Prices of Precious Coral: China. Available at https://asia.nikkei.com/Business/Markets/Commodities/Behind-soaring-prices-of-precious-coral-China

[128] The Straits Times Asia. 2015. Japan Jails Chinese Skipper over Coral Poaching. Available at http://www.straitstimes.com/news/asia/east-asia/story/japan-jails-chinese-skipper-over-coral-poaching-20150527

[129] Hiraga, T. 2015. *The red coral poaching problem in Ogasawara Islands in Japan.* Available at https://jeffersonfellowships.files.wordpress.com/2014/02/2014jeffs-hiragapaper-final.pdf

HOTSPOT 33	REPUBLIC OF KOREA EEZ (YELLOW SEA)
Type of IUU-fishing activity	Unauthorized fishing in the northwestern EEZ of the Republic of Korea. Possible transhipment of catch.
Vessel nos., size & gear	Originally smaller scale vessels, but now predominantly large steel trawlers. Trawling, bottom trawling, longlining, driftnetting, purse seining; 1 000 to 1 500 illegal vessels/day estimated at 50 percent of 2 000 to 3 000 vessels based on air surveillance data;[130] 150 illegal fishing days/year (April to May, October to December).
Species	Demersals, small pelagics, crustaceans.
Approximate illegal catch *Estimated value*	1 000 to 1 500 vessels averaging catches of 3.06 tonnes/day operating for 150 days/year: Estimated IUU catch = 458 848 tonnes to 688 272 tonnes. Estimated value (USD 1 800/tonne) = USD 816 million to USD 1 225 million.

[130] Kwang-Nam Lee & Jin-Ho Jung. 2014. Estimating the fisheries losses due to Chinese's illegal fishing in the Korean EEZ. *J. Fish. Bus. Adm*., 45(2): 073–083. Available at http://koreascience.or.kr/article/JAKO201431454589067.page

A2. Stocktaking IUU in Asia survey questions

Welcome to the research study.

We are interested in understanding the magnitude of illegal, unregulated and unreported (IUU) fishing in Southeast Asia. You will be presented with information relevant to IUU fishing and asked to answer some questions. Your responses will be kept completely confidential.

CSIRO is conducting this survey on behalf of the Food and Agriculture Organization of the United Nations (FAO). Together with CSIRO, FAO is assessing the quantity and magnitude of illegal fishing in Southeast Asia. Given your experience as a representative of the national administration of a country in the region, your input is very valuable. This survey aims to synthesize your knowledge and perceptions about the problems of illegal fishing at the regional level.

The term 'IUU fishing' refers to illegal, unregulated and unreported fishing. This survey is interested in the incidence of illegal-fishing activities. We are not asking questions about unregulated or unreported fishing in this survey. A fishing vessel is presumed to be engaged in illegal-fishing activities if it is shown to carry out activities in contravention of the conservation and management measures applicable in the area concerned. This includes, but is not limited to, fishing without a valid licence, in a closed area, beyond a closed depth or during a closed season, or by using prohibited gear, falsifying a boat's identity or obstructing the work of inspectors.

All respondents will remain anonymous and your answers will be kept completely confidential. Only collective responses will be used by FAO to help steer the implementation of a roadmap for the assessment of illegal fishing. Our results will be disseminated back to all riparian countries.

The study should take you around 15 minutes to complete. You have the right to withdraw at any point during the study, for any reason, and without any prejudice. If you would like to contact the Principal Investigator in the study to discuss this research, please e-mail chris.wilcox@csiro.au.

By clicking the button below, you acknowledge that your participation in the study is voluntary, you are 18 years of age and that you are aware that you may choose to terminate your participation in the study at any time and for any reason. If you decide to withdraw from the survey, any responses you have provided up to that point will be deleted. You may also skip any questions you do not wish to answer.

A1. This survey has been approved by CSIRO's Social Science Human Research Ethics Committee in accordance with the National Statement on Ethical Conduct in Human Research (2007). Any concerns or complaints about the conduct of this study can be raised with the Manager of Social Responsibility and Ethics on +61 7 3833 5693 or by e-mail at csshrec@csiro.au.
Please note that this survey will be best displayed on a laptop or desktop computer.

Yes I consent. Begin the survey.

No I do not consent. I do not wish to participate.

A2. The following is a list of 25 seafood types and marine animals which are known to be impacted by illegal-fishing activities. Please indicate your level of experience with each of them (None, < 1 year, 1–5 years, 5–10 years, > 10 years).

- Yellowfin tuna – *Thunnus albacares*
- Longtail tuna – *Thunnus tonggol*
- Skipjack tuna – *Katsuwonus pelamis*
- Albacore tuna – *Thunnus alalunga*
- Bigeye tuna – *Thunnus obesus*
- Black marlin – *Istiompax indica*
- Swordfish – *Xiphias gladius*
- Sailfish – *Istiophorus platypterus*
- Mackerel
- Dorado, or dolphinfish – *Coryphaena hippurus*
- Red bream/sea bream – *Pagrus major* and *Pagellus bogaraveo*
- Napoleon wrasse/humphead wrasse – *Cheilinus undulates*
- Groupers
- Croakers/drums
- Small demersal species
- Shark species
- Shrimp species
- Lobsters
- Squid and cuttlefish
- Sea snails
- Sea cucumbers
- Seahorses – *Hippocampus* spp.
- Giant clams
- Corals
- Marine mammals – whales, dolphins, dugongs

A3. The same list of seafood types and marine animals is shown below. In your opinion, how much of the landings of these species do you believe involved illegal-fishing practices in the past 12 months (None/Little/Less than half/More than half/Almost all/All)

- Yellowfin tuna
- Longtail tuna
- Skipjack tuna
- Albacore tuna
- Bigeye tuna
- Black marlin
- Swordfish
- Sailfish
- Dorado/dolphinfish
- Red seabream
- Napoleon wrasse
- Groupers
- Croakers
- Small demersals/low-value bycatch
- Mackerel

- Shrimp species
- Shark species
- Squid and cuttlefish
- Lobsters
- Sea snails
- Sea cucumbers
- Seahorses
- Giant clams
- Corals
- Marine mammals – dolphins, whales
- Dugongs

A4. From this section onwards, the questionnaire will focus only on questions relevant to the area in which you work. Please choose the appropriate subregion.

A. Gulf of Oman, Pakistan, West India, Arabian Sea and the Maldives
B. Bay of Bengal, Andaman Sea, Malacca Strait
C. Gulf of Thailand, South China Sea
D. Arafura–Timor Sea, Banda Sea, Savu Sea
E. Sulu–Celebes Sea, Sulawesi Sea, Makassar Strait, Halmahera Strait
F. East China Sea, Yellow Sea

A5. Below is a map of the area you selected in the previous question. Using your mouse, please click on the areas on this map where you believe illegal fishing likely occurs. You can mark up to 20 locations.

We are now showing you, on the same map, areas which have been previously identified as hotspots for illegal-fishing activity. Please indicate whether you believe these hotspots are still active areas of high illegal-fishing activity (Yes, still a hotspot/No longer a hotspot/Not sure).

B1. From this section onwards, the questionnaire will focus only on priority species for the subregion you selected.

Regarding the subregions of Gulf of Oman, Pakistan, West India, Arabian Sea, and the Maldives:
Indian mackerel, skipjack tuna and croakers/drums are considered relevant to illegal fishing by the Asia-Pacific Fishery Commission.

In addition to these, which of the species below do you believe is the most affected by illegal fishing? Choose only one.

- Yellowfin tuna
- Longtail tuna
- Albacore tuna
- Bigeye tuna
- Black marlin
- Swordfish
- Sailfish
- Dorado/dolphinfish
- Red seabream
- Napoleon wrasse/humphead wrasse
- Groupers
- Small demersal species and low-value bycatch

- Shark species
- Shrimps
- Lobsters
- Squid and cuttlefish
- Sea snails
- Sea cucumbers
- Seahorses
- Giant clams
- Corals
- Marine mammals – dolphins, whales, dugongs

The following questions will ask you about the three priority species for your region, as well as your selection from the previous question.

B1. Which of the options below best describes your experience with the selected species in terms of both fishing and related illegal activity?

- Have seen something
- Have read or heard about something
- No experience

B2. In your opinion, please rank these four species/seafood types as to how they are most impacted by illegal-fishing activity? With 1 being the most impacted, 4 being the least.

B3. In your opinion, illegal catches of the species below make up what percentage of annual landings in your country? Please slide the bar to indicate your best estimate.

B4. We are interested to know whether small-scale or large-scale fishing operations are more likely to be involved in illegal-fishing practices. Use the slider to indicate, in your opinion, who is more involved in illegal landings of the selected species? For the purposes of this survey, we define *small-scale fishing* as being boats no greater than 12 m in length.

B5. Thinking *only* about the illegal activities associated with **your selected species,** what do you believe is the frequency of the activities given below for both small-scale and commercial fishing? (Never/Sometimes/Mostly/Always)

- Encroachment
- Breach of licence conditions
- Non-compliant gear
- Illegal transhipment
- Premeditated activity

B6. Which regulations do you believe are being breached?

- National regulations
- Bilateral agreements
- FAO Compliance Agreement, CITES Agreement, or UN Straddling Stocks Agreement
- Not sure

B7. In your opinion, please identify the actor(s) in the supply chain who are behaving illegally with regards to illegal-fishing activities*. Examples of such activities might include intentionally mislabelling products, using illegal transport routes, dealing with unauthorized processors or direct illegal-fishing activities.* You may choose more than one answer.

- Fishers
- Purchasers
- Processors
- Wholesalers
- Exporters
- Restaurateurs

B8. Where are the most likely destination markets?

a. Local markets
b. National markets
c. Neighbouring markets
d. International markets further afield

B9. What types of infrastructure are involved in illegal activities?

e. Markets
f. Refrigerated trucks
g. Exporters
h. Transhipping boats
i. Processing plants
j. Fishing boats
k. Restaurants

C. We are very grateful for your time spent in answering this online survey.

If you would like to add any additional information that was not considered in this survey about illegal fishing, any species of interest or general comments, please do so here.

All respondents will remain anonymous and all responses will remain confidential. However, if you are willing to be contacted for potential clarification of your responses or to discuss this topic in more detail, please provide us with your e-mail address here.

A3. Survey outreach to prospective participants

Table A3.1: A list of APFIC country contacts who were approached requesting their assistance in circulating the link to our online survey

	COUNTRY	REPRESENTATIVES	E-MAIL	DATES CONTACTED BY CSIRO
1	Bangladesh	Mr Abu Sayed Md. Rashedul Haque, Director General, Department of Fisheries	dg@fisheries.gov.bd	16/07/2019 06/08/2019 03/09/2019 25/03/2020
2	Brunei Darussalam	Ms Mariani Sabtu, Head of International Trade & Business Promotion, Ministry of Industry and Primary Resources	mariani.sabtu@mprt.gov.bn	16/07/2019 06/08/2019 03/09/2019 13/03/2020 25/03/2020
3	Cambodia	Mr. Eng Cheasan, Director General, Fisheries Administration Mr. Buoy Roitana. Deputy Director General. Fisheries Administration	engrcheasan@yahoo.com roitana@gmail.com	16/07/2019 06/08/2019 03/09/2019 25/03/2020
4	People's Republic of China	Deputy Director, Bureau of Fisheries and Fisheries Law Enforcement, Ministry of Agriculture and Rural Affairs Prof. Jianye Tang, Professor, Shanghai Ocean University, China	fishcngov@126.com jytang@shou.edu.cn	16/07/2019 06/08/2019 03/09/2019 24/03/2020
5	India	Joint Secretary, Marine Fisheries & CVO Dr. Yugraj Yadava, Director (BOBP-IGO)	jsfy@nic.in yugraj.yadava@bobpigo.org	16/07/2019 06/08/2019 03/09/2019
6	Indonesia	Secretary General, MMAF Desri Yanti, Assistant Deputy Director for the UN and International Cooperation, MMAF	sekjen@kkp.go.id desri.yanti1@kkp.go.id	16/07/2019 05/08/2019 03/09/2019 25/03/2020
7	Malaysia	Ms. Rohani binti Mohd Rose (Ms.) Fmr. Director of Planning and Development. Division, Department of Fisheries (retd.)	rohanimr@dof.gov.my	16/07/2019 05/08/2019 03/09/2019 13/03/2020 25/03/2020
8	Maldives	Mr Rasheed, Minister for Fisheries Mr Adam Ziyad, Director of Fisheries Compliance, MOFMRA Dr. Shafia Aminath, Permanent Secretary (MOFMRA) M. Shiham Adam (MRC, MOFMRA)	Hassan.rasheed@fishagri.gov.mv adam.ziyad@fishagri.gov.mv shafia.aminath@fishagri.gov.mv shiham.adam@fishagri.gov.mv	16/07/2019 06/08/2019 03/09/2019 19/02/2020

	COUNTRY	REPRESENTATIVES	E-MAIL	DATES CONTACTED BY CSIRO
9	Myanmar	Mr. Khin Maung Maw, Director-General, Department of Fisheries Ms Nilar Kywe, Deputy-Director, Department of Fisheries	dof@mptmail.net.mm myintzinhtoo@gmail.com	19/02/2020 24/03/2020
10	Pakistan	Mr Asad Chandna, Director General, Fisheries, Ministry of Ports and Shipping Dr Safia Mushtaq, Fisheries Development Commissioner, Ministry of Maritime Affairs M. Farhan Khan, Assistant Fisheries Development Commissioner.	asadchandna@gmail.com fdcofpakistan@gmail.com farhankhan704@gmail.com	16/07/2019 06/08/2019 03/09/2019 02/03/2020 24/03/2020
11	Philippines	Commodore Eduardo Gongona (Ret.), Director, Bureau of Fisheries and Aquatic Resources (BFAR)	dobfarco@yahoo.com	16/07/2019 06/08/2019 03/09/2019 20/02/2020 24/03/2020
12	Sri Lanka	Secretary of Fisheries Mr M.M.Ariyarathne, Assistant Director (High Seas), DFAR AD Cross	secfisherieslk@gmail.com fisarvms@gmail.com bco.dfar@yahoo.com	16/07/2019 03/03/2020 24/03/2020
13	Thailand	Dr. Adisorn Promthep, Director General, DOF Ms Supranee Chatthong, DOF Mr. Theerawat Samphawamana, Chief, International Organization and Multilateral Cooperation Group, DOF	adisornp@fisheries.go.th asurat9212@yahoo.com	16/07/2019 06/08/2019 03/09/2019 20/02/2020 24/03/2020
14	Timor-Leste	Mr Acacio Guterres, Director General of Fisheries, MAF Pedro Rodrigues, Chief of Monitoring and Controlling and Surveillance, MAF	pedro.rodrigues@maf.gov.tl	06/08/2019 14/02/2020
15	Viet Nam	Tran Dinh Luan, Deputy Director General, , Directorate of Fisheries, MARD Ms Nguyen Mai Huong, Department of Science Technology and International Cooperation, DOF	luantd.tcts@mard.gov.vn	16/07/2019 06/08/2019 03/09/2019 13/03/2020 23/03/2020

A4. Semistructured interview questions

Stocktaking IUU in Asia – interviews

Interviewees are reminded that they are free to decline to answer any question and we can cease the interview at any time. Information gathered will be aggregated and the interviewee will not be identified in our report. Anonymity is assured.

SECTION A

1. Respondent's name
2. What is your role with respect to the fishing industry? Choose one:
    a. Fisher
    b. Fisheries official/port official
    c. Scientist
    d. Consultant
    e. Industry representative
    f. Processor/wholesale/export
    g. Vessel services
    h. NGO
3. How many years of experience do you have in the fisheries industry?
4. What countries do you have experience with, in terms of fishing?
5. Please use the map to identify hotspot areas where illegal fishing is prominent.
6. The respondent was sent a link to an online, clickable map of known hotspots that was generated in 2015. The respondent was asked to indicate which are still hotspots and which are no longer hotspots.

SECTION B

7. At this point we transition to focusing on illegal-fishing practices at one location/hotspot. Pick a site you know well. Can you describe the area you would like to focus on and tell us what you now about it, and your level of experience (first hand, second hand, etc)?
8. What is the nature of illegal activity taking place at this site? For example:
    - Encroachment
    - Breach of licence conditions
    - Non-compliant gear
    - Illegal transhipment
    - Premeditated activity
    - Blast fishing
    - Protected area
    - Protected species
    - Corruption
    - Fake documentation
    - Unlicensed activity

9. What are the origins of the vessels undertaking illegal activities in this zone? In this question we are looking for the flag of the vessels, and any information about the nationality of the crew.

10. In which port(s)/province(s) are the IUU fish from these vessels offloaded?

11. In your rough estimation, how many vessels are engaged in this activity?

12. What is the gear/vessel type and the typical size of the vessels undertaking the IUU fishing? Are they multiday vessels? Typically in cases of country to country, these are

    - Trawlers
    - Pair trawlers
    - Purse seiners
    - Longliners
    - Reefers/carriers
    - Drift netters
    - Smaller recreational or independent fishers

13. In your rough estimation, how much fish is being caught illegally? We know this is difficult to estimate so a range or 'ballpark' figure is quite acceptable. We are interested in any of the following:

    - How much fish
    - The value of the catch
    - How much is paid in fees (unofficial)
    - How often this happens

14. What are the main species that are being targeted by these vessels?

15. Are any endangered, threatened and protected species an important aspect of this IUU? If so, which? Can you tell us anything about their value?

16. What is driving this IUU-fishing activity?

17. Can you name the port closest to the hotspot and offer any an analysis of the MCS situation (fishery patrol, coastguard, marine police, navy) at this location?

18. What are the gaps in control that you see?

19. What solutions have been proposed for this IUU-fishing problem?

20. Are any solutions currently in place or working?

21. What is your confidence level in answering these questions specific to this hotspot?
    Answer 1, 2 or 3.

    1. *Confident: I am sure these activities take place and the numbers/descriptions provided are close to accurate.*
    2. *Fairly sure: I am aware of these activities and have a rough idea of what is going on, but I am not sure about the numbers.*
    3. *Some idea: I know something, but I'm not confident: I have heard of these issues from colleagues/acquaintances but do not know much detail.*

SECTION C

22. We will now move away from questions about your specific hotspot and would like to discuss governance in more general terms. Is fishing by foreign-flagged vessels allowed in your country according to the present law? If yes, can you provide the regulation numbers/references?
23. What is your government's current policy related to foreign fishing vessels fishing in your EEZ?
24. Do you have any other insights that you want to share?
25. Is there another person that you know who would have some insights and information on IUU fishing in your country?
26. Interviewees were asked to e-mail us any supporting references, documents or publications that are pertinent to the discussion we have had.

--END--

A5. Price data used in economic analyses

Table A5.1: Price data used in economic analyses

SPECIES	YEAR					SOURCE
	2015	2016	2017	2018	2019	
Albacore	2.70	1.71	2.83	2.35	2.22	1
Anchovy	0.99	0.97	0.92	0.93	0.89	1
Bigeye tuna	2.57	2.53	3.17	3.65	3.99	1
Black marlin	2.10	1.90	2.21	1.51	1.29	1
Coral	2.62	2.46	2.01	1.75	1.46	2
Croaker	7.18	6.77	5.74	5.74	5.42	2
Fish (unspecified)	3.37	3.32	3.29	3.29	3.25	2
Giant clam	0.32	0.32	0.32	0.32	0.32	4
Grouper	2.73	2.87	3.03	3.46	3.72	2
Napoleon wrasse	31.39	31.39	31.39	31.39	31.39	5
Lobster	32.41	30.51	31.35	35.16	36.66	2
Longtail tuna	1.53	1.63	1.68	1.88	1.95	1
Mackerel	1.76	1.81	1.17	1.33	1.21	1
Mammals	2.79	2.79	2.79	2.79	2.79	6
Sailfish	2.10	1.90	2.21	1.51	1.29	1
Sea cucumber	60.96	50.92	26.87	48.09	48.19	2
Seabream	2.87	4.03	5.75	5.72	6.34	2
Seahorse	184.00	184.00	184.00	184.00	184.00	3
Shark	3.84	3.22	4.65	5.23	5.78	2
Shark fins	18.03	20.24	20.54	17.63	16.98	2
Shrimp	8.89	9.09	8.96	9.30	9.29	2
Skipjack tuna	1.30	1.30	1.35	1.37	1.38	1
Squid	2.21	3.71	3.86	3.51	3.59	2
Swordfish	4.59	5.10	5.07	4.73	4.70	1
Tuna (unspecified)	2.10	1.85	2.26	2.31	2.37	2
Turtle	5.49	5.49	5.49	5.49	5.49	7
Yellowfin tuna	2.40	2.06	2.29	2.32	2.33	1
Frigate tuna	2.87	3.06	3.73	4.64	5.27	1

Sources: 1. SEAFDEC (2020) and earlier issues; 2. FAO FishStat Trade statistics; 3. Average of several online market wholesale sites: available at https://www.eworldtrade.com/pd/ew1514455410168345/dried-seahorse-for-sale/267733/; https://buydryseahorse.com/; https://gawler-sa-au.global-free-classified-ads.com/listings/dried-seahorse-for-sale-per-kg-it5820919.html; https://www.ec21.com/ec-market/dried-seahorse.html. 4. Online wholesale site: available at https://www.tridge.com/intelligences/giant-clam; 5. Online wholesale site: available at https://www.supplybunny.com/en/products/frozen-humphead-wrasse-fish-500g-2kg-sold-per-kg; 6. Chen and Phipps (2002); 7. Mancini and Koch (2009).

Note: All prices have been indexed up to 2019 real values. All prices are USD/kg.

A6. Media data – incidents reported per location

Table A6.1: Media data – incidents reported per location

JURISDICTION	INCIDENTS REPORTED	ORGANIZATIONS	PERSONS INVOLVED	VESSELS INVOLVED
Australia	14	0	158	16
Bangladesh	1	0	519	32
Chagos Archipelago	2	0	32	3
Cambodia	3	0	19	1
China	9	1	8	1
China, Hong Kong SAR	2	0	8	1
India	22	2	315	29
Indonesia	48	2	747	337
Japan	5	0	8	6
Korea, Republic of	4	0	32	4
Malaysia	20	0	343	43
Maldives	3	0	28	9
Mauritius	1	0	0	1
Myanmar	1	0	3	8
Pakistan	19	0	763	64
Papua New Guinea	4	0	77	4
Philippines	32	0	318	59
Solomon Islands	2	0	11	4
Sri Lanka	77	0	777	149
Taiwan Province of China	2	0	3	2
Thailand	30	8	334	89
Timor-Leste	1	0	0	15
Viet Nam	2	0	0	5
High Seas	25	1	0	31
Total	**329**	**14**	**4 503**	**913**

A7. Media data – vessel flags in reported incidents

Table A7.1: Media data – vessel flags in reported incidents

VESSEL FLAG	NUMBER OF INCIDENTS INVOLVING VESSELS WITH THIS FLAG	NUMBER OF VESSELS WITH THIS FLAG REPORTED IN IUU INCIDENTS	TOTAL PEOPLE REPORTEDLY INVOLVED ON VESSELS WITH THIS FLAG
Angola	1	1	0
Bangladesh	1	1	3
Bolivia, Plurinational State of,	2	10	0
Cambodia	2	1	0
China	46	49	419
Djibouti	1	6	0
India	50	53	1 209
Indonesia	9	8	61
Korea, Democratic People's Republic of	1	1	8
Korea (unspecified)	1	1	0
Malaysia	8	11	47
New Zealand	1	2	0
Pakistan	1	1	18
Philippines	18	33	220
Singapore	3	3	4
Somalia	2	1	3
Sri Lanka	28	24	248
Stateless	4	7	26
Taiwan Province of China	4	5	12
Thailand	8	16	6
Viet Nam	48	73	777
Not specified	62	40	344
Total	**301**	**347**	**3 405**

A8. Media data – nationalities involved in reported incidents

Table A8.1: Media data – nationalities involved in reported incidents

NATIONALITY	NUMBER OF INCIDENTS INVOLVING PERSONS OF THIS NATIONALITY	SUM OF PERSONS	NUMBER OF JURISDICTIONS REPORTING THIS NATIONALITY	JURISDICTION MOST COMMONLY REPORTED OFFENDING IN
Australia	1	1	1	Australia
Bangladesh	2	3	1	Myanmar
Cambodia	2	11	2	Cambodia
Chile	1	1	1	Indonesia
China	19	244	8	China
India	54	1 655	5	Sri Lanka
Indonesia	12	80	5	Australia
Korea, Republic of	1	11	1	Papua New Guinea
Korea, Democratic People's Republic of	1	8	1	Japan
Malaysia	3	16	1	Malaysia
Myanmar	1	10	1	Indonesia
Pakistan	2	23	2	Pakistan
Palau	1	3	1	Malaysia
Papua New Guinea	1	14	1	Australia
Philippines	19	260	5	Philippines
Russian Federation	1	6	1	Indonesia
Singapore	1	1	1	Indonesia
Sri Lanka	30	290	3	Sri Lanka
Taiwan Province of China	3	3	2	Indonesia
Thailand	2	7	1	Thailand
Viet Nam	38	936	9	Indonesia
Not specified	56	877	14	
Total	**251**	**4 460**		

A9. Media data – species targeted in reported incidents

Table A9.1: Media data – species targeted in reported incidents

TARGET SPECIES	INCIDENTS
Anchovy	2
Arowana	1
Conch	1
Coral	1
Crab	1
Crayfish	1
Crocodiles	1
Dolphin – including Irrawaddy river dolphin	2
Fish – generic/small fry/trash fish	82
Fusilier	1
Giant clam	6
Grouper	3
Mackerel	2
Rays	5
Salmon	1
Sea cucumber	39
Seahorse	5
Shark	22
Shrimp	7
Squid	6
Toothfish	7
Totoaba	2
Trevally	1
Trochus	2
Tuna spp.	19
Turtle	5
Whale	1
Whale shark	6
Other or unspecified	11
Total	**243**

A10. Media data – infraction types per location

Table A10.1: Media data – infraction types per location

LOCATION OF INFRACTION	ENCROACHMENT	BREACH OF LICENCE CONDITIONS	NON-COMPLIANT GEAR	BLAST FISHING	PROTECTED AREA	PROTECTED SPECIES	ILLEGAL TRANSSHIPMEN
Australia	13		1		1	8	
Bangladesh	1		1				
Chagos Archipelago	2					1	
Cambodia			2				
China		2	5		1	2	
China, Hong Kong SAR	1		1				
India	8	2	3		3	9	
Indonesia	46	3	14			4	3
Japan	5						
Korea, Republic of	4						
Malaysia	13		7	5		3	
Maldives	3		6			1	1
Mauritius	1						
Myanmar	1					1	
Pakistan	18		2				
Papua New Guinea	4					3	
Philippines	9	2	18	7	2	8	
Solomon Islands	2					2	
Sri Lanka	37		53	7	1	8	
Taiwan Province of China	2						
Thailand	23	5	3		2	8	
Timor-Leste						1	
Viet Nam	1					1	
High Seas	10	3	3			1	
Total	**204**	**17**	**119**	**19**	**10**	**61**	**4**

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