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Tharamony Ngoun/FFI

Sea Turtle Bycatch Assessment at Landing Hotspots, Cambodia:

A comparison with bycatch assessment report in 2018 and understanding the community's perception

Tak Chandara, Matt Glue, Laure Joany, Stefanie Rog

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List of Acronyms

CFi	Community Fisheries
CMCP	Coastal and Marine Conservation Programme of FFI
FAO	Food and Agriculture Organization
FFI	Fauna & Flora International
FiA	Fisheries Administration
FiAC	Fisheries Administration Cantonment
IWT	Illegal Wildlife Trade
KAP	Kampot
KEP	Kep
KK	Koh Kong
SHV	Preah Sihanouk
MAFF	Ministry of Agriculture, Forestry and Fisheries
MoU	Memorandum of Understanding
USFWS	United States Fish and Wildlife Service

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មូលដ្ឋានសង្ខេប

ការសិក្សានេះមានគោលបំណង វាយតម្លៃ ចំនួនការនេសាទបានអណ្តើកសមុទ្រដោយចៃដន្យ និងការយល់ដឹងរបស់សហគមន៍នៅតំបន់កំពង់ទូកសំខាន់ៗ លើការអភិរក្សអណ្តើកសមុទ្រក្នុងប្រទេសកម្ពុជា ស្របទៅនឹងគោលដៅអន្តរាគមន៍ការអភិរក្ស និងផែនការណ៍គ្រប់គ្រងជលផលដើម្បីកាត់បន្ថយប្រេកង់ និងអាត្រាងាប់នៃអណ្តើកសមុទ្រដែលនេសាទបានដោយចៃដន្យ។

ការប្រមូលទិន្នន័យការនេសាទបានអណ្តើកសមុទ្រដោយចៃដន្យ ធ្វើឡើងតាមរយៈការចុះសម្ភាសន៍អ្នកនេសាទ និងសហគមន៍មូលដ្ឋាននៅកំពង់ទូក និងភូមិនេសាទតាមបណ្តោយឆ្នេរសមុទ្រទាំងបួនខេត្តក្រុងនៃប្រទេសកម្ពុជា។ វិធីសាស្ត្រសួររកព័ត៌មានបន្តរពីម្នាក់ទៅម្នាក់ នឹងបច្ចេកទេសស៊ើបអង្កេតត្រូវបានប្រើប្រាស់ក្នុងការប្រមូលទិន្នន័យនេះ។ អ្នកសម្ភាសន៍សរុបចំនួន ៣២៩ នាក់ ស្ថិតនៅ ២៣ ទីតាំងកំពង់ទូក ឬភូមិនេសាទ ក្នុងនោះ ខេត្តកែប ៧៦ (KEP) កំពត ៨១ (KAP) ព្រះសីហនុ ៨០ (SHV) និង កោះកុង ៨៨ (KK)។

ការប្រមូលទិន្នន័យនេះបានប៉ាន់ប្រមាណថា អត្រាការនេសាទបានអណ្តើកសមុទ្រដោយចៃដន្យមានចំនួន ៨៧៨ក្បាលក្នុងមួយឆ្នាំ ហើយដោះលែងទៅវិញមានចំនួន ៥៩១ក្បាល បើប្រៀបធៀបនឹងរបាយការណ៍ស្រាវាយតម្លៃឆ្នាំ២០១៨ មានចំនួន២៥៥ក្បាល ដែលនេសាទបានដោយចៃដន្យ។ លទ្ធផលសំខាន់ៗរួមមាន៖ ១) គោលដៅនេសាទយកអណ្តើកសមុទ្រនៅតាមសហគមន៍ឆ្នេរកើតមានជាពិតប្រាកមែន គឺចេញពីទូកអួនអូសរបស់អ្នកនេសាទជនជាតិខ្មែរ និងបរទេសចេញទៅនេសាទស្ថិតនៅខេត្តកែប កំពត ហើយខេត្តព្រះសីហនុ កំពុងកើនឡើងការចេញទៅនេសាទផងដែរ ដោយព្រោះជលចាប់បានធ្លាក់ចុះ បូករួមនឹងតម្រូវការទីផ្សារ និងភាពក្រីក្រ ២) ស្ទើរពាក់កណ្តាលនៃអ្នកនេសាទបានផ្តល់បទសម្ភាសន៍ថា ការសម្លាប់អណ្តើកសមុទ្រ "មិនមែន" ជាអំពើខុសច្បាប់ទេ ហើយ ៣៥ភាគរយឆ្លើយថា "បាទ/ចាស" ជាអំពើខុសច្បាប់ ដែលបញ្ជាក់យ៉ាងច្បាស់ថា ត្រូវចាំបាច់មានវគ្គបណ្តុះបណ្តាលអប់រំផ្សព្វផ្សាយនាពេលអនាគត និងចេញសេចក្តីប្រកាសបទប្បញ្ញត្តិពីរាជរដ្ឋាភិបាលកម្ពុជា ដល់សហគមន៍នេសាទ ៣) ចំនួនអណ្តើកសមុទ្រនៃការនេសាទបានដោយចៃដន្យក្នុងឆ្នាំ ២០២២ និងឆ្នាំ២០១៨ គឺមានចំនួនខុសគ្នាគួរឲ្យកត់សម្គាល់ ដែលមានការកើនឡើងពី ៨៣ក្បាល ដល់ ៥១៥ក្បាល ទូទាំងតំបន់ឆ្នេរសមុទ្រកម្ពុជា។ ការនេសាទអណ្តើកសមុទ្រដោយចៃដន្យ នៅខេត្តកែប និងកំពត កំពុងស្ថិតក្នុងភាពគ្រោះថ្នាក់ ដោយសារអ្នកនេសាទមួយចំនួនបានប្រើប្រាស់ឧបករណ៍នេសាទខុសច្បាប់ ដូចជា អួនអូសឆក់ជាដើម រីឯនៅខេត្តកោះកុង និងព្រះសីហនុ ក៏កំពុងស្ថិតក្នុងស្ថានភាពគួរឲ្យព្រួយបារម្ភផងដែរ ដោយសារទូកអួនអូស និងការប្រើប្រាស់លប់កន្ទុយកណ្តារ ដាក់នៅតំបន់ស្មៅសមុទ្រ ដែលជាកន្លែងផ្តល់ចំណីដល់អណ្តើកសមុទ្រ។ ៤) ល្មិច *(Chelonia mydas)* និង ក្រាស *(Eretmochelys imbricate)* ត្រូវបានជាប់ដោយចៃដន្យញឹកញាប់ជាងគេ។ ៥) មានការចូលរួមជាវិជ្ជមានពីសំណាក់អ្នកនេសាទ បន្ទាប់ពីពួកគេនេសាទបានអណ្តើកសមុទ្រដោយចៃដន្យ គឺពួកបានប្រគល់វាទៅកាន់សហគមន៍នេសាទ ឬមន្ត្រីជលផលមូលដ្ឋាន (៥៦% នៃផ្តល់បទសម្ភាសន៍) និងជាអវិជ្ជមាន បរិភោគ(១០%) ជួញដូរ(២៣%) ឬលក់បន្តឲ្យឈ្មួញ

កណ្តាលក្នុងមូលដ្ឋាន ដែលជាជនជាតិខ្មែរ និងជនជាតិវៀតណាម ស្ថិតនៅក្នុងខេត្តកែប ឬលក់ឲ្យ អ្នកមានឥទ្ធិពលដែលប្រាក់កាស (ឧ.ហ អ្នកឧកញ្ញា ទៀ វិចត្រ) ងាប់ហើយបោះចោលទៅសមុទ្រ វិញ (១១%)។ ៦) ក្នុងរយៈពេល ៥ឆ្នាំចុងក្រោយ ការនេសាទបានអណ្តើកសមុទ្រដោយចៃដន្យមាន ការថយចុះ។ ផ្អែកតាមលទ្ធផលរកឃើញខាងលើកាបានផ្តល់ជាអនុសាសន៍ ដើម្បីកាត់បន្ថយការ នេសាទបានអណ្តើកសមុទ្រដោយចៃដន្យមានដូចខាងក្រោម៖

- ទូកអួនអូសខុសច្បាប់នៃអ្នកនេសាទជនជាតិខ្មែរ និងជនជាតិវៀតណាម នៅតែបន្តកើត មានឡើង ដោយសារការអនុវត្តន៍ច្បាប់នៅមានភាពខ្វះខាត ដែលជាមូលហេតុនាំឲ្យមាន ការកើនឡើង បទល្មើសនៅក្នុងតំបន់។ ដូច្នេះ ចាំបាច់ត្រូវបង្កើនការល្បាត និងពង្រឹងការអនុ វត្តន៍ច្បាប់ ដើម្បីឈានទៅរកការការលុបបំបាត់ការប្រើប្រាស់ឧបករណ៍នេសាទខុសច្បាប់។
- គួរមានការលើកទឹកចិត្តដល់អ្នកនេសាទទាំងឡាយតាមខេត្តក្រុងក្នុងតំបន់ឆ្នេរសមុទ្រ ចូល រួម សង្គ្រោះ និងដោះលែងអណ្តើកសមុទ្រ។ ឧទាហរណ៍៖ ការចែករំលែក រូបថត និងវីដេអូ សកម្មភាពអប់រំផ្សព្វផ្សាយ ទាំងឡាយលើបណ្តាញសង្គម និងការបោះពុម្ពលើសម្ភារៈ ផ្សព្វផ្សាយជាដើម។
- ប្រើប្រាស់ឧបករណ៍ SMART ដើម្បីដាក់ចេញការត្រួតពិនិត្យតាមដានសកម្មភាពនេសាទ នៅក្បែរទីតាំង រកចំណីរបស់អណ្តើកសមុទ្រ ទីតាំងដែលឧស្សាហ៍នេសាទបានអណ្តើកស មុទ្រដោយចៃដន្យ ក៏ដូចជាទីតាំងជម្រកសំខាន់ៗផងដែរ។
- ដើម្បីត្រួតពិនិត្យរយៈពេលវែងលើការគម្រាមកំហែងអណ្តើកសមុទ្រ យើងគួរសិក្សាការ នេសាទបានអណ្តើកសមុទ្រដោយចៃដន្យ និងការជួញដូរខុសច្បាប់ រៀងរាល់៥ឆ្នាំម្តង។ និងភាពតានតឹងផ្សេងៗទៀត គួរត្រូវបានដាក់បញ្ចូលផងដែរ ដូចជា ការសាងសង់កំពង់ផែ ការអភិវឌ្ឍន៍តំបន់ឆ្នេរ កាកសំណល់ និងផ្លាស្ទីកសមុទ្រ ព្រមទាំងការប្រើប្រាស់សារធាតុ គីមីជាដើម។
- បន្ថែមសកម្មភាពអប់រំផ្សព្វផ្សាយដល់សហគមន៍នីមួយៗ និងសាលារៀន ព្រមទាំងស្វែងរក អ្នកធ្វើការស្ម័គ្រចិត្តបន្ថែមទៀត ដើម្បីហ្វឹកហ្វឺនសមត្ថភាពដល់សហគមន៍ ដែលជាផ្នែកមួយ នៃក្រុមជនបង្គោលអភិរក្សអណ្តើក។

Executive Summary

The study aims to assess the scale of sea turtle bycatch and understand community perception toward conserving sea turtle species at key landing sites in Cambodia, with the goal of informing conservation interventions and fisheries management plans to reduce the frequency and mortality of sea turtle bycatch.

The sea turtle bycatch surveys were conducted through interviews with local fishers and communities at landing sites and fishing villages across the four coastal provinces of Cambodia. A snowball sampling method combined with undercover techniques was utilized. In total, 329 samples, 76 Kep (KEP), 81 Kampot (KAP), 80 Preah Sihanouk (SHV), and 88 Koh Kong (KK) were taken from 23 landing sites.

The survey estimated a bycatch rate of 878 sea turtles bycatch per year, with 491 released, compared to the bycatch of 244 sea turtles from the 2018 assessment. The key findings are 1) Targeted sea turtle fishing in coastal communities is confirmed, and the frequency of both Cambodian and foreign-operated trawling vessels operating in KEP, KAP, and SHV were increasing due to a decrease of fishery products with high market demand and poverty 2) Almost half the fishers interviewed stated that the killing of turtles was "Not" illegal, while 35 percent said "Yes" that it was illegal, highlighting the requirement for further awareness raising and information dissemination on Cambodian government regulations. 3) There is a significant difference in incidents of bycatch between the current study, completed in 2022, and the 2018 assessment. With an increase from 83 to 515 incidences of bycatch across the entire coastline of Cambodia. KEP and KAP are high-risk points as poachers were using illegal fishing gear such as electric trawling, with results from KK and SHV showing cause for concern as trawlers and rat traps operate in seagrass habitats within the foraging ground of sea turtles. 4) Green *(Chelonia mydas)* and hawksbill turtles *(Eretmochelys imbricate)* were most regularly encountered as bycatch. 5) Response actions to sea turtle bycatch were shown to be a mixture of positive, released by themselves or donated to CFis or local FiAC (56% of respondents), and negative, consumed (10.5%), trade (23%) or sold to local brokers, Vietnamese, in KEP or influencers (i.e. Tea Vichet), discarded (11%). 6) There is a perceived reduction of sea turtle bycatch in the last 5 years. Based on the finding above, the following recommendations are proposed to reduce sea turtle bycatch:

- Khmer and Vietnamese-operated trawling vessels continue to violate Fisheries law as a lack of enforcement increasing leads to illegal behavior within the area. Therefore, improving patrolling and strengthening law enforcement towards destructive fishing practices and gears are needed.
- Sea turtle rescue and release should be promoted with all fishers along the coastal provinces. For example, through sharing photos and videos from activities on Facebook and disseminating awareness materials.

- Regulating and monitoring fishing activity near turtle foraging grounds, bycatch hotspots, and key habitat areas by utilizing Spatial Monitoring and Reporting Tool (SMART).
- Long-term monitoring of threats to sea turtles should be conducted every five years for bycatch and evidence of Illegal Wildlife Trade (IWT). Other stressors should also be assessed including the construction of ports, coastal urbanization, marine debris, and plastic and chemical discharge.
- More awareness-raising activities with each community, and school, and outreach to find more volunteers for community capacity building as part of the Sea Turtle Focus Group.

I. Introduction

The Cambodian coastline extends 435 kilometers long across four provinces, Koh Kong (KK), Preah Sihanouk (SHV), Kampot (KAP), and Kep (KEP) (Johnsen & Munford, 2012). The marine fishery along supplements the national demand for vital protein resources (Fisheries Administration, 2011) and provides crucial income for Cambodians living in the coastal provinces (MAFF, 2016). Cambodia's coastal and marine waters also support a rich abundance of marine life including globally threatened species such as sea turtles.

Before 1979, fives species of sea turtles were recorded in Cambodia (Try, 1999), the Critically Endangered hawksbill turtle *(Eretmochelys imbricate)* (Mortimer, J.A & Donnelly, 2008), Endangered green turtle *(Chelonia mydas)* (Seminoff et al., 2004), Critically Endangered (Pacific population) leatherback turtle *(Dermochelys coriacea)*, Endangered loggerhead turtle *(Caretta cartta)*, and Vulnerable olive ridley turtle *(Lepidochelys olivacea)* (Try, 1999).

Over a decade, 2001-2011, Fauna & Flora International (FFI) surveys reported the sightings of five different species by 66 fishers; 72% green, 74% hawksbill, 3% olive ridleys, 1% loggerhead, and 1% leatherbacks (FFI, 2011). All species are listed on the IUCN Red List of Endangered Species, on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), protected under the Law on Fisheries (Article 23 and 92), 2006, and as endangered species under Sub-Decree No. 123, August 23rd, 2009. In the 10-year "Action Plan for the Protection of Sea Turtles in Cambodia 2016-2026," it has been recorded that turtles are under threat from; destructive fishing practices, associated by-catch, habitat degradation, coastal development and pollution, harvesting of meat and reductionism of the turtle's by-catch of the fishers (Vong et al., 2018), and global warming, which adds further challenges to sea turtle survival (Ouk Vibol, 2017).

Sea turtles that have been accidentally caught by fishing gear are defined as bycatch. The number of turtles sighted and the level of turtle bycatch has been continually studied in Cambodia (Aylin McNamara, Me'ira Mizrahi, 2015; Diamond et al., 2012; Dijk, 2002). A study produced in 2015 across the four coastal provinces reported 233 sea turtle sighting events (Aylin McNamara, Me'ira Mizrahi, 2015), with indications that both green and hawksbill populations may have declined over the past 10 years. For the last 10 years, FFI's online sea turtle sighting database has recorded 163 sightings, with only 135 tagged and released, showing a continued trend of decline (Figure 1). FFI was concerned that the areas where few sea turtles sightings have been reported would also be hotspots for bycatch and turtle mortality. Follow-up sea turtle by-catch assessments at sighting hotspots and landing sites were highly recommended by FFI's 2018 report. To address this reporting gap, the Coastal and Marine Conservation Programme (CMCP) of FFI, with support from ARCADIA and USFWS, has conducted a sea turtle by-catch assessment in hotspots along the coastal provinces of Cambodia.

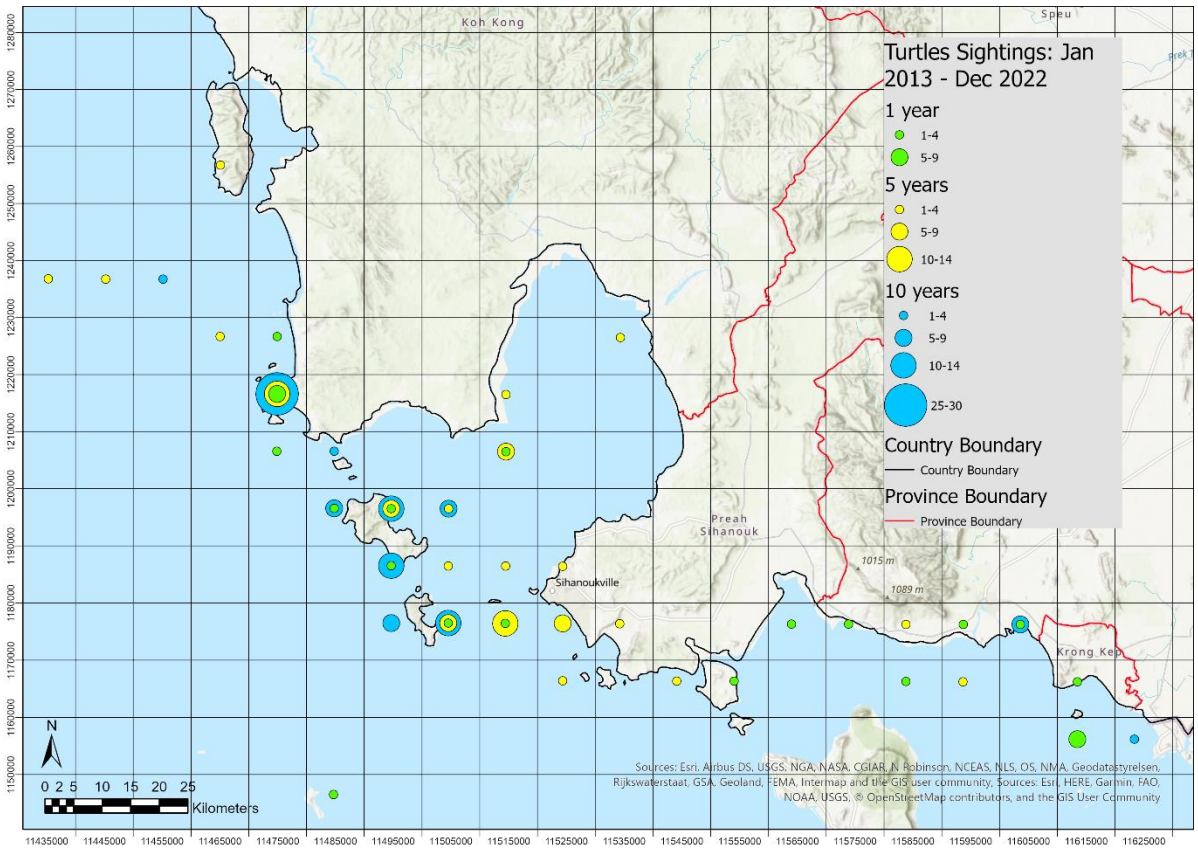

Figure 1. Sea turtle sightings over the one year, five years, and ten years from community consultation, by location (FFI, 2022)

II. Research Objectives

This research aims to assess the sea turtle bycatch and understand community perception toward conserving species at the predefined hotspot areas in Cambodia, with the ultimate goal of informing conservation interventions and fisheries management to reduce the frequency of sea turtle bycatch and related mortality. To understand the sea turtle bycatch, the following objectives need to be achieved:

1. Identify the species of sea turtles' bycatch and sightings in hotspots areas
2. Estimate the frequency of sea turtle bycatch and assess perceived trends in bycatch rates over time
3. Compare of sea turtle bycatch rate with the assessment report in 2018, made in current and previous hotspots, combined to produce an estimated rate for future conservation action
4. Understand the attitude of fishers towards sea turtle bycatch
5. Identify the key communities' engagement to reduce sea turtle bycatch

III: Methodology

3.1 Site and Sample Selection

This bycatch assessment consists of a survey conducted at the landing sites and fishing villages in hotspot areas across the four coastal provinces in Cambodia – Koh Kong (KK), Preah Sihanouk (SHV), Kep (KEP), and Kampot (KAP) from November-December 2022 (Figure 2). A snowball sampling method was used to ask the interviewees to suggest additional people who have also encountered sea turtles as bycatch the study's purpose (Bryman, 2016). The identification of hotspot areas and the selected sample sites, was made through both recommendations from the assessment report in 2018 and asking government officials of FiA in each coastal province to recommend the places that are known for significant sea turtle bycatch. To determine the required sample size for the study to be representative and statistically significant, Fishing Vessel Census Data from 2018 (Fisheries Administration, 2019) was used to obtain information on the total number of fishing boats that used fishing gear with the potential to accidentally capture sea turtles in the hotspot areas. The study defined the fishing gears which are a threat to sea turtles as the following: bottom longline, cast net, dragged basket, gillnet, hook, sine net, towed longline, trap, trawl, and gleaning. The sample size was then calculated using a margin of error, e=0.1 or 10%, percentage value p=0.75, and confidence interval, z-score 1.645 (at 90%), by academic best practice. 329 samples, 76 (KEP), 85 (KAP), 80 (SHV), 88 (KK) and were taken from 23 sites (landing sites) in the four coastal provinces. The names and locations of the survey sites (n = 23) and the number of samples from each site are shown in Appendix 1.

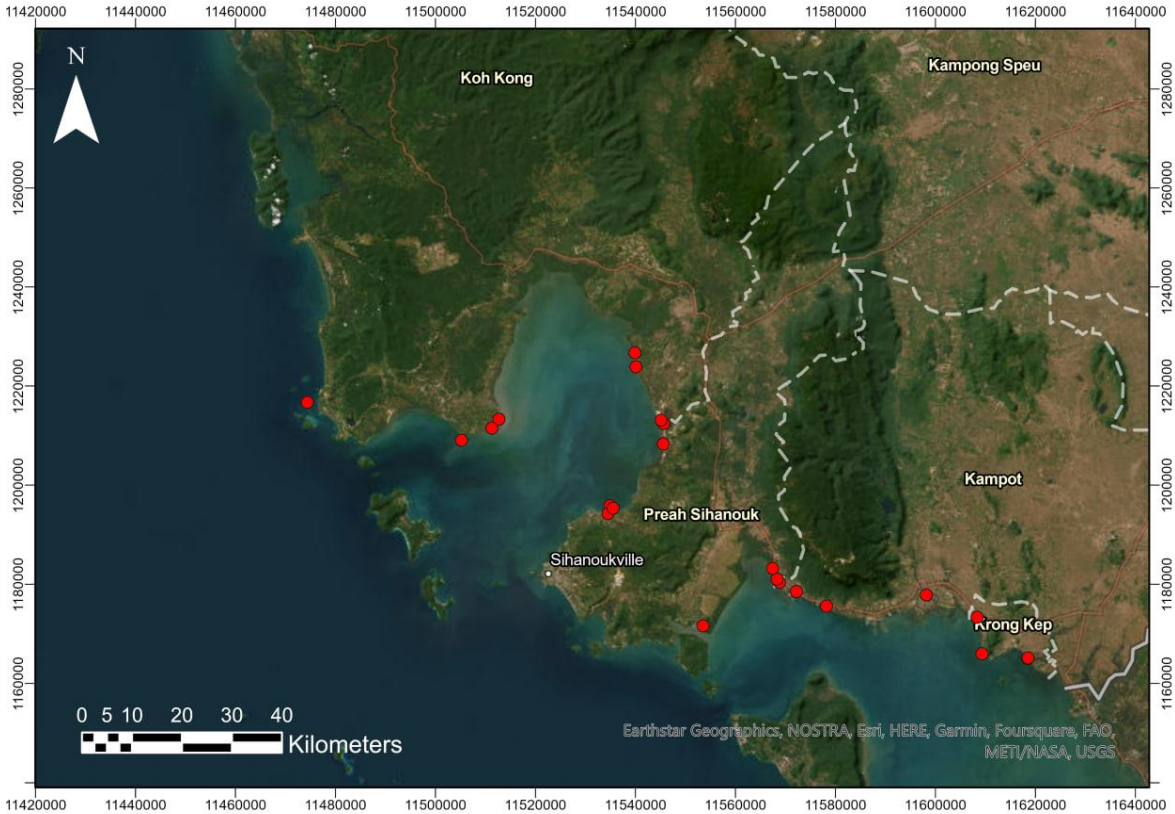

Figure 2. Locations where interviews were conducted

Sample size:
The **sample size** can be calculated, based on the total number of vessels, the margin of error, and the confidence:

$$\text{Sample size} = \frac{\frac{z^2 \times p\,(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p\,(1-p)}{e^2 N}\right)}$$

N = population size,
e = Margin of error (percentage in decimal form) = 0.10 (or 10%),
p = Percentage Value (as a decimal[1]), p=0.75, and
z = 1.645, confident interval, z-score (at 90%)

Recommended sample size with different values for margin of error and confidence levels for each vessel using fishing gear of threat to sea turtles, for the entire coastal area combined for all provinces.

Margin of error	**90% confidence**	**95% confidence**
5%	182	245
10%	49	69

Since under normal circumstances, most of the vessels will be using fishing gear of threat to sea turtles, a 10% margin of error is acceptable, with 90% confidence, then we need to take about 49 samples per province.

3.2 Data Collection and Analytical Tools

The Dugong Memorandum of Understanding (MoU) Standardized Catch and Bycatch Questionnaire was adapted and used to collect the sea turtle bycatch information (CSM, 2017). There are three main parts to the structured interview questionnaire: 1) fishers' demographics 2) fishers' experience 3) sea turtle bycatch experience. In this study, bycatch was defined as sea turtles caught in fishing gears while a sighting was defined as observing a sea turtle while swimming, accidentally caught in a ghost net, or stranded on the beach. An undercover interview method was used, with the surveyors posing as students. A technique to make the fishers feel confident to speak to surveyors by providing correct information such as routes of trade and locations where turtles are often caught. To ensure the validity of data, a set of criteria were used to evaluate the information from fishers after each interview. These criteria included how open and honest the fishers seemed, the interest shown to answer the questions, and their certainty when answering numerical

[1] the percentage of your sample that picks a particular answer, set to 0.5 for calculate the optimal sample size without any assumptions, it is possible to set it at 0.75.

questions. See all questions used to collect the data in Appendix 2. Due to the nature of the research objectives, frequency counts were used to obtain numerical estimates of turtle bycatch. Descriptive statistics in Microsoft Excel 2019 and Survey 123 were used to collect and analyze the data.

IV: Results and Discussion

4.1 Fishing Gear and Species of Sea Turtle Sighting

4.1.1 Fishing Gear, Location, and Effort

There are 9 types of fishing gear used by fishers in this survey. These fishing gear includes bottom longline, trawl, gleaning, cast net, dragged basket, gillnet, hook, towed longline, and trap. Most of the fishers have targeted catches according to the types of fishing gear with different habitat types for fishing areas. Reef and seagrass are the main habitat types in which fishing gear most frequently accidentally captures sea turtles.

The fishers normally went fishing 7 days (78% of respondents) a week in high season (Figure 3) and 4 days (21% of respondents) a week in low season (Figure 4). Of the fishers interviewed, 95.44% said that fishing was their primary livelihood, and 88.45% said it was their only source of earning. 98.48% were men, 0.91% were women, and 0.61 were other as fishing in Cambodia is seen as a male profession, therefore the majority of fishers are male and men were the primary subjects for the survey.

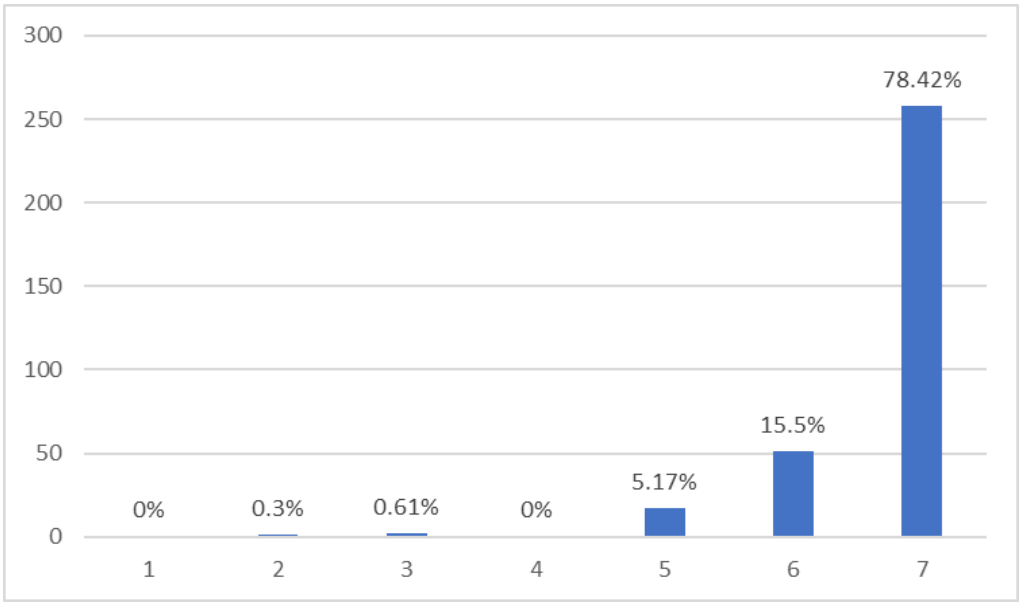

Figure 3. Number of days fishing per week in high season

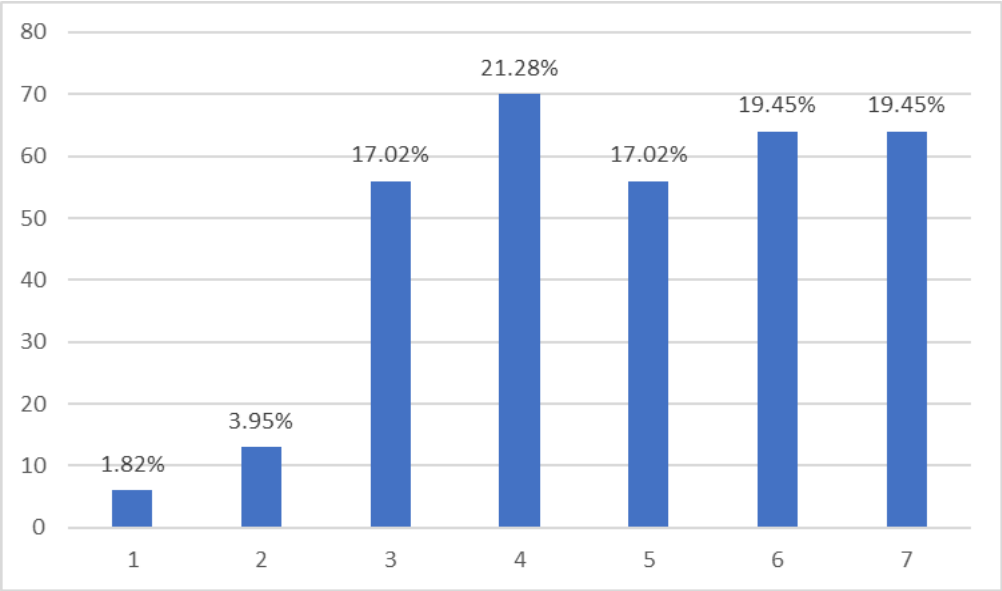

Figure 4. Number of days fishing per week in low season

4.1.2 Sea Turtle Species Bycatch

Calculations estimate that 878 (295 (KEP), 220 (KAP), 192 (SHV), 171 (KK)) sea turtle bycatch incidents occurred per year per year among fishers based at landing sites, 2022 (Figure 5), and only 491 (99 (KEP), 155 (KAP), 115 (SHV), 122 (KK)) were released by fishers or other stakeholders (Figure 6). The majority of bycatch consisted of green turtles (84.8%, n=279), hawksbills (17.93%, n=59), olive ridley (1.22%, n=4), loggerhead (3.65%, n=12), leatherback (0.3%, n=1), and don't know the species (0.3%, n=1) (Figure 7). Of the fishers interviewed, 78% of fishers within the age range of 30-60 years old said that compared to when they started fishing, there was less sea turtle bycatch. The high number of bycatches for green and hawksbill turtles poses a significant threat to the species, potentially also implying these are the more common turtle species found in Cambodian waters. The low incidence of olive ridley, loggerhead, and leatherhead are mostly unconfirmed reports as the species are only known from a handful of sightings (Aylin McNamara, Me'ira Mizrahi, 2015), with only one sighting of a leatherback in Cambodia in 2001 (Dijk, 2002).

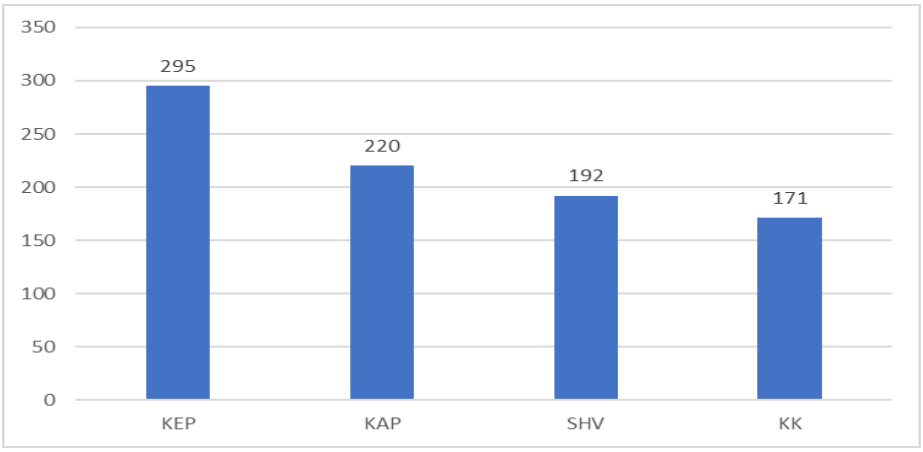

Figure 5. Sea turtle by-catch incidents per year

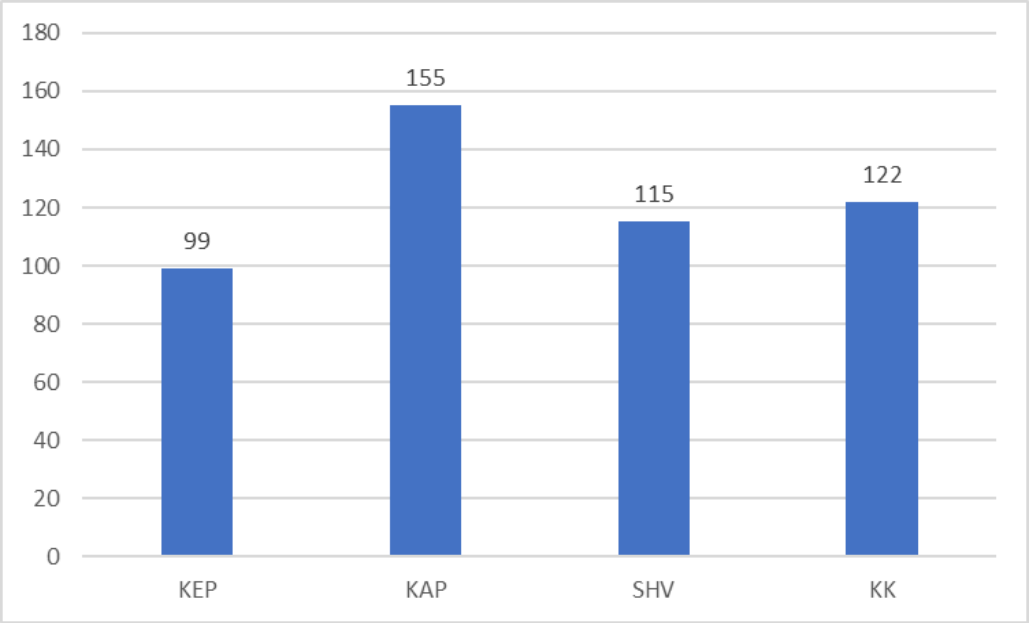

Figure 6. Sea turtles released per year

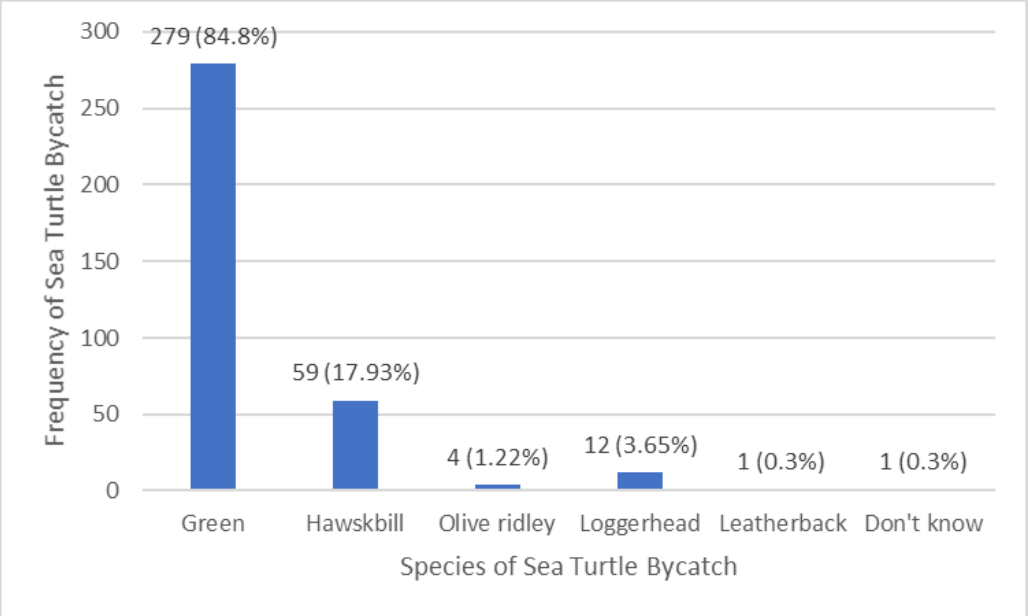

Figure 7. Frequency of each species of sea turtle reported as bycatch

4.1.3 Sea Turtle Sighting

The total number of sea turtle sightings reported in this survey was 356. The majority of sightings were of green turtles (259), followed by hawksbills (69), loggerheads (22), olive ridleys (4), leatherbacks (1), and in one instance the participant could not identify the species (Figure 8). The fishers primarily observed sea turtles while fishing, travelling, accidentally caught in nets, and when stranded on beaches.

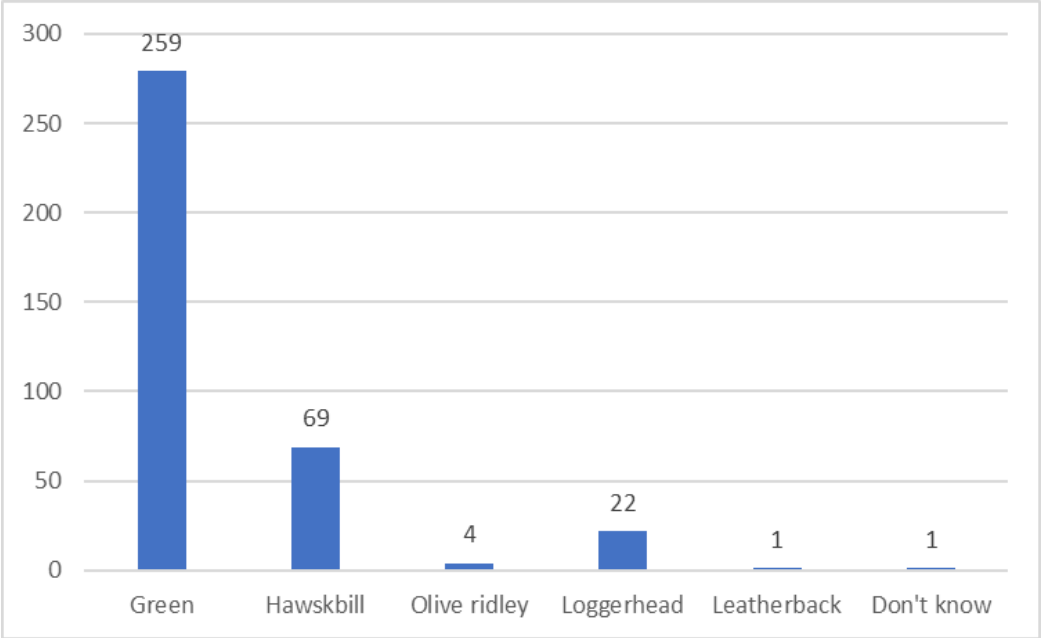

Figure 8. Number of sea turtle sightings

4.2 Location of Sea Turtle Sighting and Bycatch

From coastal provinces, 87.23% of 73 (KEP), 70 (KAP), 73 (SHV), and 71 (KK) interviewees knew of a place where turtles occurred, with 12.46% with 3 (KEP), 15 (KAP), 7 (SHV), 17 (KK) saying they did not know where turtles occurred (Figure 9). Most of the respondents, 52 (KEP), 54 (KAP), 52 (SHV), 52 (KK) stated that the location of sightings changed over time, 19 (KEP), 14 (KAP) 15 (SHV), 14 (KK) did not change, and 4 (KEP), 17 (KAP), 13 (SHV), 22 (KK) did not know (Figure 10). Some sighted within the provinces were identified by interviewees as places turtles are regularly seen (Table 1).

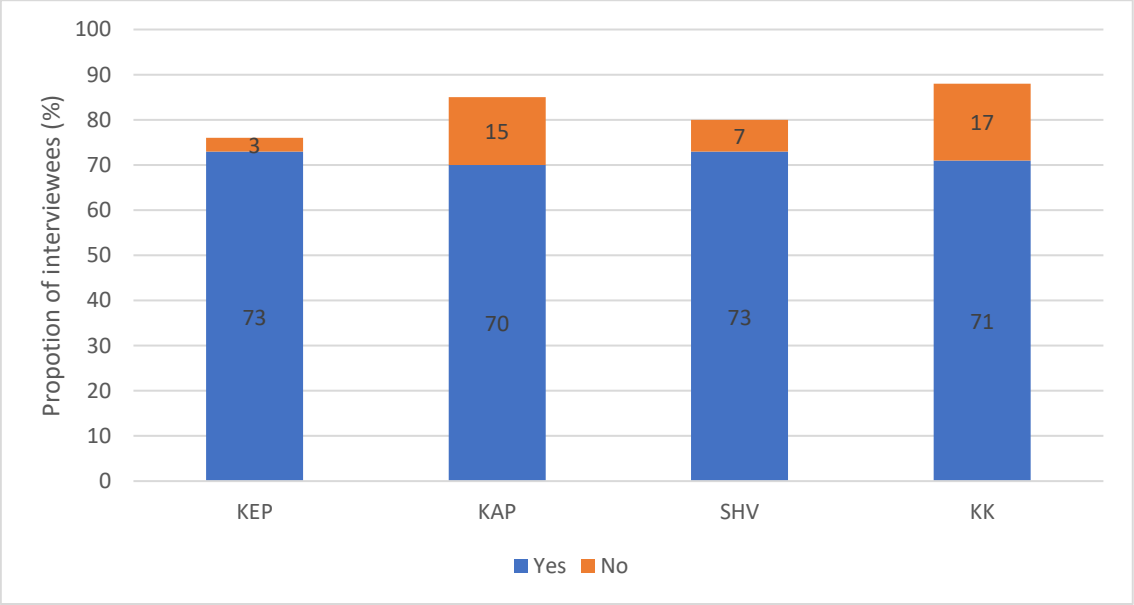

Figure 9. Responses to “Are there locations where you regularly see turtles?”

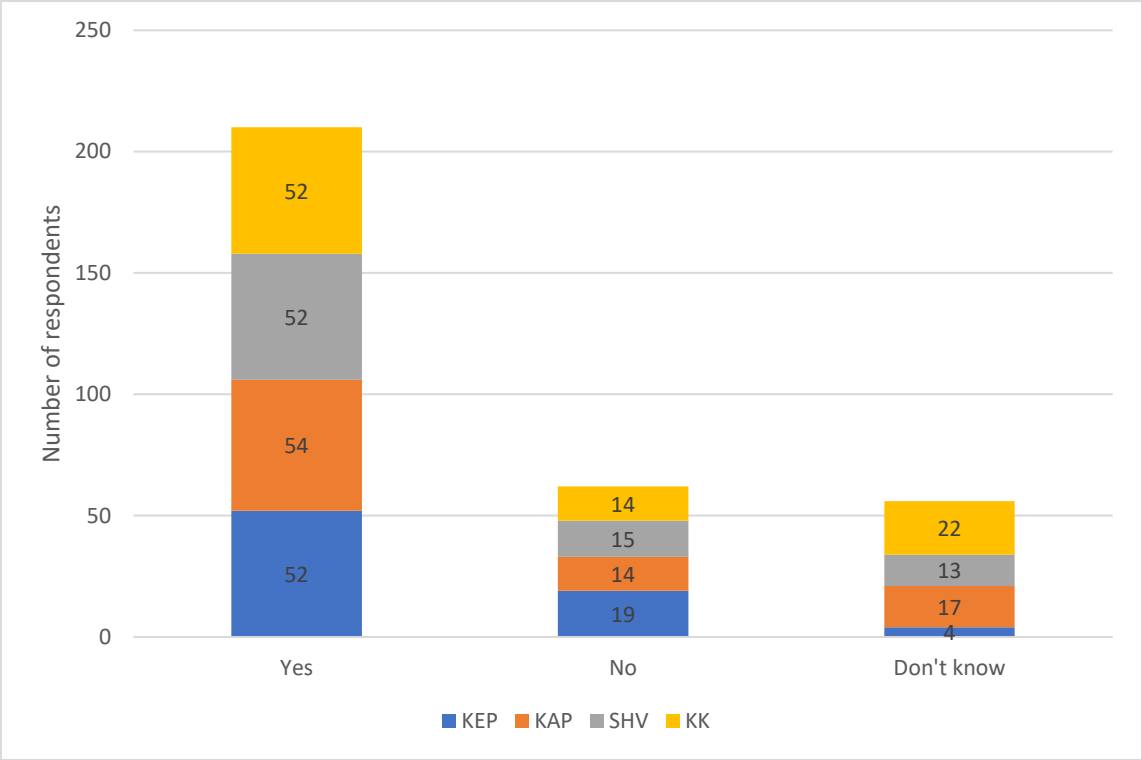

Figure 10. Responses to “do the areas where you see turtles change over time?”

Table 1. Locations cited by 3 or more respondents as places where turtles are regularly seen

Province	The most commonly cited location of regular sea turtle sightings	Number of participants who mentioned this site
KEP	In front of Kep & Koh Troal	5
KEP	Koh Svay & Koh Mteh	3
KAP	Prek Tnoat & Koh K’tias	15
SHV	Thmor Reang	14
SHV	Koh Dong	9
KK	Koh Sdach	11
KK	Koh Smach	11

Out of 329 fishers surveyed, three knew of targeted hunting of turtles by members of their communities, two in Chroysvay Lech village (KK), and one in Angkol village (KEP). All fishers were concerned that Vietnamese trawlers come to Cambodia’s water-targeting species of turtles.

Koh Svay, Koh Mteh, in front of Kep, Koh Traol, Koh Tbal, Thmor Reang, Prek Tnoat, Koh K'tias, Koh Dong, Koh Tonsai, Koh Sdach, Koh Smach, Koh Ses were the most cited location for sea turtle bycatch. Moreover, the frequently sighted locations at Koh Kras, Koh Rong, Koh Kjong, and Koh Thmey (Table 2).

Table 2. Locations of bycatch incident reports

Location	Province	Number of Bycatch Incidents Reported (N= 329)
In front of Kep & Koh Traol	KEP	80
Koh Svay & Koh Mtes	KEP	77
Koh Dong	SHV	57
Koh Kbal	KEP	51
Thmor Reang	SHV	46
Koh Kteah	SHV	38
Koh Sdach	KK	34
Koh Ton Say	KEP	31
Koh Kras	KK	30
Koh Ses	SHV	25
Koh Rong	SHV	24
Koh Smach	KK	21
Koh Por	KAP	18
Koh Khyang	KK	18
Koh Kjong	SHV	18
Koh Thmey	SHV	14
Koh Ampel	KK	11
Ream	SHV	10

Koh Svay & Koh Mtes, Koh Kbal, and Koh Ton Say are located near each other in Kep with 1,005 ha of mangrove forest and 2,790 ha of seagrass beds (Fisheries Administration, 2021; MAFF, 2022). They are key foraging grounds for green turtles, making sighting and bycatch incidents more common (Monica et al., 2015). Moreover, most of the respondent fishers from Ang Kol and Oumpeng villages stated that there was more sea turtle bycatch at locations near Koh Tral, in front of Kep, Koh Svay & Koh Mtes because of illegal fishing trawling from both Khmer and Vietnamese fishers (Table 2).

Koh Dong, Tmor Reang, Koh Kteah, Koh Ses, Koh Rong, Koh Kjong, Koh Thmey, and Ream are located in Preah Sihanouk, which contains 13,500 ha of mangrove forest and 600 ha of seagrass beds, Keo Phos (MAFF, 2022). Koh Dong, Tmor Reang, Koh Kteah, Koh Rong, and Koh Ses are high-potential ecological systems, providing spawning, nursery, and feeding habitats for green and hawksbill turtles (FiA 2010). However, the respondents reported that illegal fishing and sea turtle bycatch happened at Koh Ses by Vietnamese fishers a short distance from the Vietnamese island Phu Quoc and the Vietnam- Cambodia border.

Koh Sdach, Koh Kras, Koh Smach, Koh Khyang, and Koh Ampel are located in Koh Kong province where there is a high occurrence of sea turtle foraging habitats (West, 2015). These locations were most likely important areas for sea turtle by-catch due to the high fishing effort within the areas.

4.3 Sea Turtle Bycatch Frequency and Trends

4.3.1 Frequency of Sea Turtle Bycatch Incidents and What Happened post-bycatch

Out of 329 fishers surveyed, 302 fishers confirmed that they have caught sea turtles by accident during their fishing career. A comparison between the number of sea turtles caught by accident and the number of sea turtles released back at sea over the last 5 years and in the last year has shown that both activities are increasing (Figure 11).

Encouragingly from the calculations of incidents reported, 491 accidentally caught sea turtles were released back into the sea. 96 were discarded due to mortality, 199 were sold, and 92 were eaten (Figure 12). There are a high number of sea turtles released at KAP (155), SHV (115), and KK (122) compared to KEP (99) are less. Then, the high occurrence of trade in KEP (151), KAP (40) for local and international demand, SHV (7), KK (1) along with consumption at SHV (36), KEP (34), KK (14), KAP (8), discard at KK & SHV are same (34), KAP (17) and KEP (11) (Figure 13).

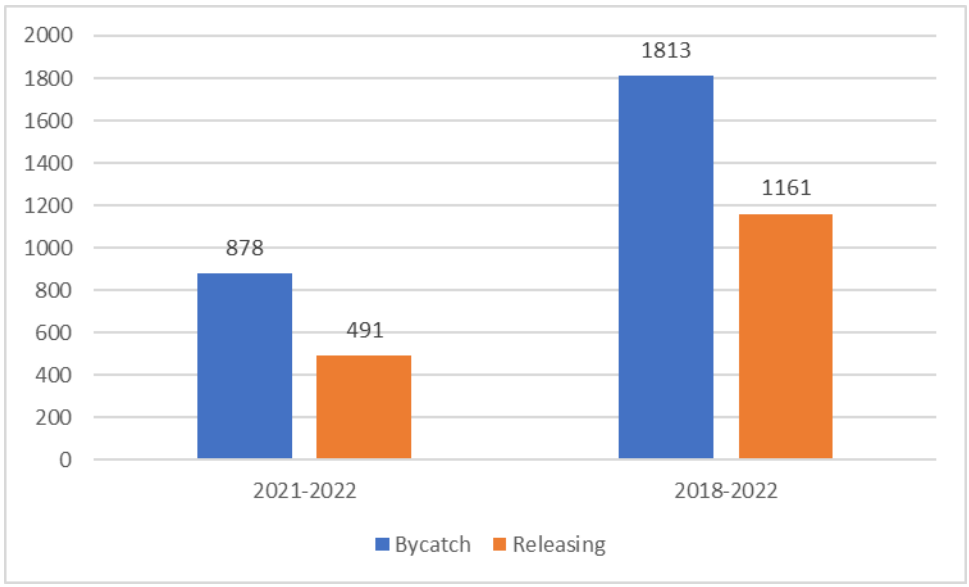

Figure 11. Sea turtles bycatch incident reported 1 Year (2021-2022) & 5 Years (2018-2022)

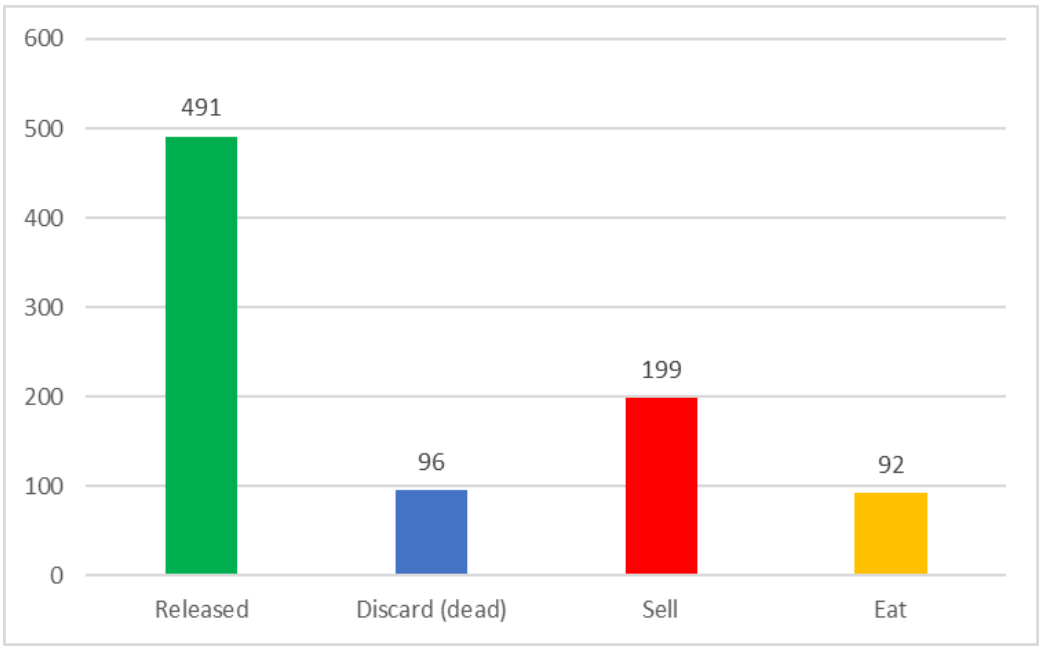

Figure 12. Responses to “what happened to sea turtle bycatch?”

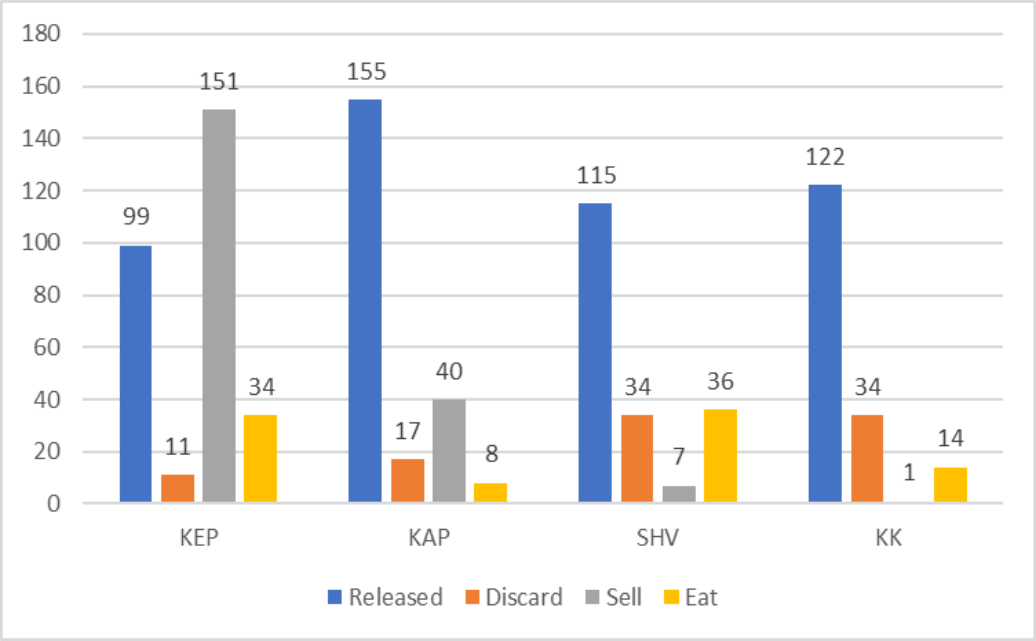

Figure 13. Actions are taken by fishers after accidental sea turtle bycatch is divided by province

4.3.2 Comparison of Sea Turtle Bycatch Current Rates Compared with Assessment Report 2018

Table 3. A comparison of sea turtle bycatch with assessment report 2018

Province	**Bycatch 5 years (N=329)**	**Bycatch 1 year (N=329)**	**Bycatch, 2018 (N=221)**
KEP	453	295	37
KAP	404	220	46
SHV	504	192	114
KK	452	171	47
KEP, KAP, SHV, KK	**1813**	**878**	**244**

This study's result of sea turtle bycatch of 878 incidences per year is higher compared to assessment report 2018. This may be due to differences in the methodology, for example, the locations surveyed in 2022 were hotspots where sea turtle bycatch is expected to be higher but the survey in 2018 was conducted at landing sites which were randomly selected. Despite these differences in methodology, the 2022 assessment supports some trends coming out of the 2018 survey, with bycatch rising from 83 to 515 incidences for both KEP and KAP, showing them to be high-risk areas, while results from KK and SHV show cause for concern (Table 3).

4.3.3 Trend in Sea Turtle Bycatch Over Time

From the majority of the fishers interviewed in the age range of 40 – 60 years old, 78.42% (n=258) reported that there was less sea turtle bycatch compared to when they started fishing since the 1980s, a fewer stated more, 13.98% (n=46). The fishers have shown concern about the decline in sea turtles because of higher fishing efforts by gear such as trawl nets in locations where sea turtles occur. Some fishers within the age range of 25-40 years old reported that there has been the same amount of sea turtle bycatch, 4.56% (n=15) compared to when they started fishing since the 2000s while 2.74% (n=10) stated they don't know (Figure 14).

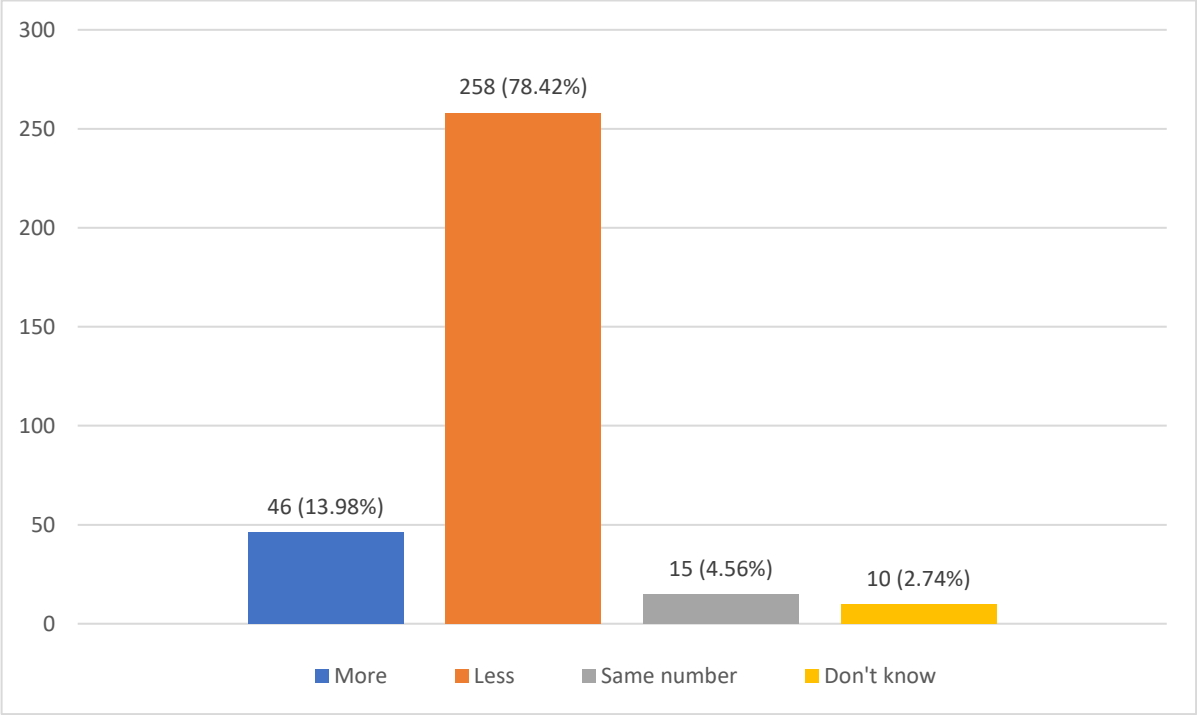

Figure 14. Preception of fishers on trend of sea turtles bycatch compared to when they started fishing.

4.4 Attitude of Fishers Towards Sea Turtle Bycatch

Table 4. Attitudes of fishers toward sea turtle bycatch

Type of attitude	Attitude toward bycatch	Frequency (N=329)	Percentage
Positive	Discard[1)]	12	0.11
	Release[3)]	329	37.47
	Discard & release	110	12.52
	Total	***451***	***50.10***
	Eat	32	3.64
	Sell	17	1.93
	Discard & sell	2	0.22
	Discard, release & sell	75	8.54

Negative or Opportunistic	Eat & release[4)]	49	5.58
	Eat & discard[2)]	17	1.93
	Eat, sell, discard, & release	93	10.59
	Eat, sell & release	27	3.07
	Eat, discard, & release	52	5.92
	Sell & release	61	6.94
	Other use	2	0.22
	Total	***427***	***48.58***

Notes:

1) *"Discard" in positive attitude refers to when a fisher caught a sea turtle accidentally but discard it to the sea when it is dead.*
2) *"Discard" in negative or opportunistic refers to when a sea turtle bycatch is dead and a fisher discards it to the sea because its meat has decomposed, which cannot be eaten.*
3) *"Release" in positive attitude refers to when a fisher releases a bycatch sea turtle alive to the sea.*
4) *"Release" in negative or opportunistic refers to when a fisher releases a bycatch sea turtle alive to the sea when it is too small to eat or sell.*

There are three types of fishers' attitudes toward sea turtle bycatch: positive, negative or opportunistic. A positive attitude defines those who would be happier and more willing to conserve the species as well as be aware of Fishery Laws. A negative or opportunistic attitude defines those who reject or break the Fishery Laws protecting sea turtles. This includes trading, domestic consumption, and discarding only when a sea turtle is dead and its meat has decomposed. Some of the fishers stated that both trawlers run by Vietnamese and Khmer fishers violate the Law of Fisheries as a lack of enforcement and systematic corruption leads to illegal practices.

As shown in Table 4, a small majority of fishers surveyed have a positive attitude toward bycatch (50.10%; n=451) than negative or opportunistic (48.58%; n=427). 37.47%; n=329 of fishers are happy to release sea turtles when they are captured in their fishing gear. The most frequent negative or opportunistic response stated fishers would eat, sell, discard, and release, 10.59%, n=93. This implies most fishers who break the fishery law do not have a specific preference for what to do with a turtle.

Most of the respondents claimed that killing sea turtles is legal (49.24%) while 34.95 % knew that it was illegal. However, they presented a contradiction as most of the respondents are aware that killing sea turtles is illegal by accident with 84%, 3.04% legal, and 12.16% don't know. This might be due to interviewees recognizing when they might be admitting to illegal activity and altering their responses, though further research is needed to confirm this.

Table 5. Awareness of the legality of killing turtles, both deliberately and by accident

Answer	**Is it illegal to (intentionally) kill a turtle?**	**It is illegal to kill a turtle by accident?**
Yes	115 (34.95%)	**279 (84.8%)**
No	**162 (49.24%)**	10 (3.04%)
Don't know	51 (15.5%)	40 (12.16%)
Don't answer	1 (0.30%)	0
Total	329	329

In addition, in table 6, 94.53% of respondents agreed that the survival of turtles is important and 3.95% is not. When we asked for their reasoning, 290 of the 311 respondents stated that they were important for tourism within the community. Furthermore, only 49 respondents stated sea turtles were an endangered species while others said sea turtles were common.

Table 6. Perception on the importance of having sea turtles in marine habitats

Do you think having turtles around is important?	**Frequency**	**Percentage**
Yes	311	94.53%
No	13	3.95%
Don't answer	5	1.51%

46.2% of interviewees stated they knew of local customs, beliefs, rituals, or stories related to sea turtles. By province, fishers in KK 50%, KAP 41%, KEP with 31%, and Preah Sihanouk 30% stated that they followed a custom or belief about turtles. Additionally, in Kampot and Kep some fishers are Muslim and their elders advised them not eat or to capture the turtles. However, 53.19% of interviewees stated they did not know any local customs, beliefs, rituals, or stories related to sea turtles (Figure 15).

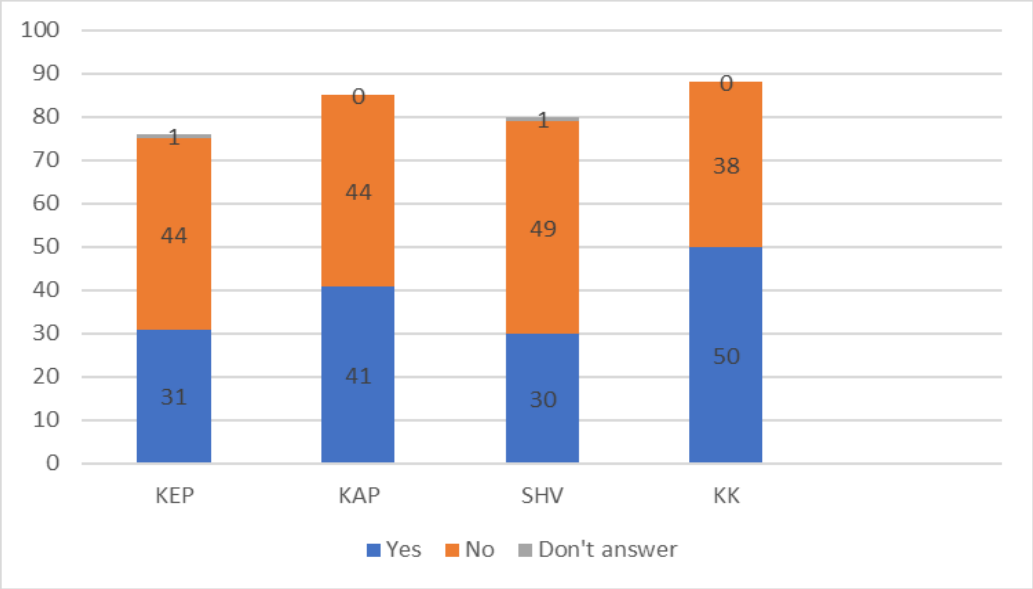

Figure 15. Proportional responses to "are there any local customs, beliefs, or rituals or stories related to turtles?" by province

49 respondents believed that it was bad luck to catch, kill or bring a turtle on the boat while other fishers release with a prayer for good luck (23 respondents), thought release brought happiness (24 respondents), and perfumed the oil on turtles with prayer for luck (22 respondents) when releasing the turtles. Others stated that should not eat (15 respondents) and committed sin 5 respondents (Table 7). These cultural and religious beliefs present an opportunity for turtle conservation as it may be possible to enhance them and expand their reach within communities through awareness raising.

Table 7. Summary of stated beliefs related to sea turtles

Beliefs/customs related to turtles	**Number of participants**	**Percentage of people who claimed to have related beliefs**
Bad luck to catch, kill, or bring on the boat	49	35
Perfume on turtles with prayer for luck	22	15.7
Do not eat it	15	10.7
Releasing with praying for luck	23	16.4
Carve name of releaser	1	0.71
Good luck or brings happiness	24	17.14
Long life to release	1	0.71
Sin to catch, kill, and eat	5	3.57

V: Conclusions and Recommendations

The sea turtle bycatch survey was conducted with 329 fishers from 23 landing sites and fishing villages across the four coastal, KK, SHV, KAP, and KEP provinces. Key findings from the study include:

- Targeted sea turtle fishing in the communities is rare, both outsiders and insiders of trawling at KEP, KAP, and SHV were increasing.
- About half of the fishers said “No” when asked if killing turtles is illegal and only 35 percent said “Yes” that it was illegal.
- There is a very high significant difference in high incident bycatch between the current study and assessment report 2018,
    - Rising from 83 to 515 incidences of bycatch KEP and KAP are high-risk points.
    - Results from KK and SHV show the cause of concern because of more bycatch by trawlers.
- Green and hawksbill turtles were most regularly encountered.
- Actions of respondents towards sea turtle bycatch were shown to be a mixture of positive (56%) released by themselves or handed the animals to CFis, local FiAC, and negative with some consuming (11.6%), trading (15%) or selling sea turtles to local brokers and Vietnamese at KEP, influencers (tykun, rich people or government higher ranking as excellency), and discarded (12.2%).
- There is a perceived reduction of sea turtle bycatch in the last 5 years compared to when the fishers started fishing.

Below are the recommendations to reduce sea turtle bycatch, based on the findings of the study:

1) Both trawling of Vietnamese and Khmer fishers violates fisheries law due to a lack of enforcement leads to an increase in illegal behaviors. Therefore, improving patrolling and strengthening law enforcement towards destructive fishing practices and gears are in need.
2) Sea turtle rescue and release should be promoted with all fishers along the coastal provinces. Share photos and videos from activities on our FB, and disseminate awareness materials.
3) Regulating, and monitoring fishing activity near turtle sightings, bycatch hotspots, and key habitat areas by utilizing SMART.
4) Long-term monitoring of threats to sea turtles should be conducted every five years for bycatch, IWT. Other stressors should also be assessed including the construction of ports, coastal urbanization marine debris, and plastic and chemical discharge.
5) More awareness-raising activists in each community, and should and looking for more volunteers for community capacity building as Sea Turtle Focus Group.

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Appendices

Appendix 1. Names and locations of survey sites and number of samples from each of the 23 sites

N^0	Name of survey site (Fishing port or village)	Number of Samples	Location (N=4)	Total Number of Sample (N=329)
1	Ang Kol	17	KEP	76
2	Ou Krasar	17		
3	Oumpeng	25		
4	Phum Tmey	17		
5	Changhorn	3	KAP	85
6	Doun Tork	42		
7	Prek Tnoat	30		
8	Trapeang Ropov	10		
9	Keo Phos	6	SHV	80
10	Koh Kjhong	16		
11	Phum 1	9		
12	Phum 2	20		
13	Phum 4	10		
14	Prek Pros	2		
15	Prek Songkea	9		
16	Rithy 1	3		
17	Tmor Reang	5		
18	Chomlong Kor	12	KK	88
19	Chroysavy Lech	24		
20	Koh Sdach	23		
21	Nesat	9		
22	Sre Trav	3		
23	Thmor Sor	17		

Appendix 2. Bycatch questionnaire

Questionnaire number:……..Interviewer Name:_____ + QN……Date:_____
_____Data Sheet Serial Number:_____Village:_____Commune:_____District:_____
_____Province:_____
GPS Coordinate:_____

Introduction statement

Note: Reading this statement to the interviewee is compulsory. It ensures all interviews are treated equally.
My name is_____. I would like to study marine resources in Cambodia including sea turtle bycatch.
Information from our research could be used to help reduce the accidental bycatch of sea turtles maybe through community support for our goals, or possibly through more effective regulations and enforcement. Your participation in this survey is voluntary and confidential. We will not record your name or any personal information you share with us unless this is ok with you. Individual answers will be collated and reported on as a group to provide a general idea of current status, and we will absolutely not share your individual answers to anyone outside of the research team. You do not have to answer questions you do not want to.

Interviewee Background

Note: Please tick the boxes to the left of any questions not asked. Provide appropriate ID charts and maps for interviewee to point to during the interview.

1. Name:_____
2. Age:_____
3. Gender: Male ☐ Female ☐
4. For how many years has fishing been your occupation?_____
5. Were your parents fishers? Yes ☐ No ☐ Grandparents? Yes ☐ No ☐
6. Is fishing the main way you earn a living? Yes ☐ No ☐
7. Is fishing the only way you earn a living? Yes ☐ No ☐
   If No, what is (or are) your other occupation(s)?_____
8. Which months do you normally fish (out of the last 12)?_____
   (*if seasonal, indicate season start and end*)
9. How many days each week do you fish? days (low season)_____days (peak season)
10. Is the boat motorized? Yes ☐ No ☐ (if yes) Inboard ☐ Outboard ☐
11. Have you ever seen sea turtles? Yes ☐ No ☐ Do you have another name for them?___
12. What species of turtles do you see? Green ☐ Hawksbill ☐ Olive Ridley ☐ Loggerhead ☐
    Flatback ☐ Leatherback ☐ Don't know ☐
    Do you know the difference between these turtle species? Yes ☐ No ☐ Don't know ☐
    (*Note to Interviewer; Show ID chart or graphics*)
    Please describe:_____
    Do they have different names? If yes, please list:_____(*determine for each species*)
13. How do you see turtles? Seen while fishing ☐ Seen while travelling to fishing areas ☐
    Coming ashore to lay eggs ☐ Accidentally caught in nets ☐ Hunted ☐
    Stranded on the beach ☐
    (*Note to interviewer: Refer to and complete attached table and mark all locations on maps*)
14. In what places do you normally fish?_____
    (*Use prepared road maps, charts, Google maps and have interviewee point out areas*)
15. What type of your fishing gear? Bottom Longline ☐ Cast net ☐ Dragged basket ☐ Gillnet ☐ Hook ☐ Siene net ☐ Towed longline ☐ Trap ☐
    Trawl ☐ Gleaning ☐ Other ☐
16. Specie caught: Fish ☐ Squid ☐ Octopus ☐ Ray ☐ Shark ☐ Crab ☐ Shrimp ☐ Seashell ☐ Other ☐
17. Habitat type: Seagrass ☐ Reef ☐ Fine sediment ☐ Mangrove ☐ Rock ☐ Estuary ☐ Other ☐

18. Do you use different gear in different areas? Yes ☐ No ☐ If yes, please describe:……

19. How long do you think a turtle lives?_____Don't know ☐

20. Do you have any turtle experts in your village? Yes ☐ No ☐ Who?_____

21. What about in other villages? Yes ☐ No ☐ Who?_____What village?_____

22. Have people in your community ever hunted turtles? Yes ☐ No ☐ Don't Know ☐
    If yes, how many?_____

23. Do they do so now? Yes ☐ No ☐ Don't Know ☐

24. Do people from other villagers / communities hunt turtles? Yes ☐ No ☐ Don't Know ☐
    Who?_____What village?_____Any other details?_____

25. Compared to when you started fishing, are there more ☐, less ☐, or the same number of turtles captured in fishing gear? ☐Don't Know ☐ (*Note to interviewer: based on <u>actual</u> numbers, not perception*)
    If higher or lower, why do you think this?_____

26. Do you know of any areas where turtles <u>regularly</u> occur? Yes ☐ No ☐
    Where are these turtle areas?_____

27. Do these turtle areas change over time? Yes ☐ No ☐ Don't Know ☐

28. Do you see mating turtles? Yes ☐ No ☐ When?_____Where _____☐

29. When do you see turtles? (*indicate months or seasons*):_____

30. Have you incidental sea turtle bycatch in your fishing boat? Yes ☐ No ☐
    If yes, how many per year?_____

31. How many you released?_____

32. What species? Green ☐ Hawksbill ☐ Olive Ridley ☐ Loggerhead ☐
    Flatback ☐ Leatherback ☐ Don't know ☐ location: _____

33. Other animals incidentally caught? _____

34. What do you do (or would you do) with a turtle if you caught one?
    Eat ☐ Sell ☐ Use as Bait ☐ Other Use ☐ Discard (*dead*) ☐ Release (*alive*) ☐
    (*do not lead interviewee*)
    (*Note differences by species where possible and if available*)
    What happened to the animal?_____

35. What would you do or did you do if you found a stranded turtle?_____

36. Do you think there will always be turtles in the sea? Yes ☐ No ☐ Don't Know ☐
    If yes or no, why?_____

37. Do you think having turtles around is important? Yes ☐ No ☐ Why?_____
    _____

38. It is illegal to (intentionally) kill a turtle? Yes ☐ No ☐ Don't know ☐
    What about by accident (maybe caught in a net unintentionally)? Yes ☐ No ☐ Don't know ☐

39. Are there any local customs, beliefs, legends or rituals or stories related to turtles?
    Yes ☐ No ☐
    If yes, please describe:_____
    Where / from whom did you hear this?_____

Appendix 3. A comparation of current bycatch locations incident per year and report 2018

N^0	Location	Province	Current # Bycatch Incidents (N= 329)	Report 2018, # By-catch, (N=221)
1	Koh Tbal	KEP	51	5
2	Koh Tonsai		31	5
3	Koh Angkrong		6	2
4	Koh Aichses		3	1
5	In front of Kep & Koh Traol		80	1
6	Koh Svay & Koh Mteh		77	0
7	Koh Por	KAP	18	5
8	Prek Tnoat		8	1
9	Prek Smach		1	0
10	Phnom Doung		8	1
11	Trapeang Ropov		9	0
12	Kilo 12		3	0
13	Thmor Reang	PSH	46	13
14	Keo Phos		7	10
15	Koh Rong		24	9
16	Steung Hav		4	8
17	Koh Dong		57	8
18	Koh Thmey		14	3
19	Koh Kchorng		18	2
20	Thmor Runtiashbagn		6	1
21	Koh Ses		25	12
22	Koh Kteah		38	1
23	Koh Thas		4	1
24	Koh Russey		1	1
25	Koh Pring		3	1
26	Koh Dekkol		9	0
27	Ream		10	0
28	Koh Sdach		34	11
29	Koh Kras		30	10

30	Koh Smach	KK	21	6
31	Koh Ampel		11	6
32	Koh Mnois		9	5
33	Sre Trav		2	4
34	Thmor Ondaet		1	3
35	Thmor Sor & Chom Long Kor		5	10
36	Koh Khyang		38	0
37	Koh Touch		6	2
38	Chroy Svay Lech		2	0
39	Nesat		6	0
40	N/A	KEP, KAP, SHV, KK	152	
		KEP, KAP, SHV, KK	**878**	**206**

Key findings:

- ❑ Targeted sea turtle fishing in the communities is rare, both outsiders and insiders of trawling at KEP, KAP, and SHV were increasing.
- ❑ About half of the fishers said "No" when asked if killing turtles is illegal and only 35 percent said "Yes" that it was illegal.
- ❑ There is a very high significant difference in high incident bycatch between the current study and assessment report 2018: Rising from 83 to 515 incidences of bycatch KEP and KAP are high-risk points. Results from KK and SHV show the cause of concern because of more bycatch by trawlers.
- ❑ Green and hawksbill turtles were most regularly encountered.
- ❑ Actions of respondents towards sea turtle bycatch were shown to be a mixture of positive (56%) released by themselves or handed the animals to CFis, local FiAC, and negative with some consuming (11.6%), trading (15%) or selling sea turtles to local brokers and Vietnamese at KEP, influencers (tykun, rich people or government higher ranking as excellency), and discarded (12.2%).
- ❑ There is a perceived reduction of sea turtle bycatch in the last 5 years compared to when the fishers started fishing.

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