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# Catch Monitoring Survey at Marine Landing Sites, Cambodia

MaFReDI Technical Report

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**Marine Fisheries Research and Development Institute (MaFReDI)**

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## Abbreviations

|              |   |
|--------------|---|
| CPUE         | Catch per Unit Effort                               |
| EU           | European Union                                      |
| $\epsilon\%$ | Relative Standard Error                             |
| FAO          | Food and Agriculture Organization                   |
| FCMAS        | Fish Catch Monitoring Assessment Survey             |
| FiA          | Fisheries Administration                            |
| FiAC         | Fisheries Administration Cantonment                 |
| KHR          | Khmer Riel  |
| MaFReDI      | Marine Fisheries Research and Development Institute |
| MT           | Metric Tons   |
| nei          | not elsewhere included                              |
| SD           | Standard Deviation                                  |
| US\$         | United States Dollars                               |

## Executive Summary

The data for August 2023 shows that the CPUE for middle-scale fish traps is the highest<sup>1</sup> at 322.1 kg/day, followed by Trawl (164.8 kg/day), Halfbeak gillnet (120 kg/day), Shrimp gillnet (83 kg/day), Mackerel Gillnet (71.5 kg/day) and Octopus trap longline (68.5 kg/day). There is a distinct difference in the CPUE for small and large trawlers, with trawlers of 6-12 meters reporting an average daily catch of 62.4 kg and trawlers 12-18 meters reporting 307.5 kg/day.

A total of 33 individual species are recorded with *Encrasicholina heteroloba* (shorthead anchovie) contributing more than 33.5% of the total recorded catch for 224 landings of **65,999.5** kg. In general, fish contribute 68.1% of the total reported catch, followed by Cephalopods 8.9%, Shrimps 10.6% and Crabs at 6%. The total value of the reported catch is **386,189,450** Riels, with Cephalopods contributing 23.8%, fish 23.8%, Crabs 28.9% and shrimp 23.1%.

The total estimated catch for August 2023, is calculated at 6,711.2 MT, with most of it from trawl fishing (59.9%) and with small-scale fishing contributing more than 22.3%. The total value of the estimated catch, using the average reported price, is **39,269,867,000** KHR or US\$ **9,578,016**.

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<sup>1</sup> Technically other gears, are higher, but since the gear isn't recorded, this is ignored

## 1. Introduction

With technical assistance from FAO CAPFISH project under EU budget support, Marine Fisheries Research and Development Institute (MaFReDI) has been conducting scientific catch monitoring at landing site in four provinces since August 2021. The aim of the survey is to estimate the Catch per Unit of Effort (CPUE) in kg/fishing day, for the main fishing gears used, the monthly fishing effort, species catch and value, as well as the total estimated catch, from data collected at the main landing sites in Kampot, Kep, Koh Kong and Preah Sihanouk provinces. This report describes the main results for marine fish catch monitoring at national level in Cambodia for August 2023.

Additional details on findings for individual provinces based on priority needs and requests from fisheries administration cantonment (FiAC) are included in a number of annexes.

## 2. Methodology

The methodology, sampling design and survey form for the Fish Catch Monitoring Assessment Survey (FCMAS) is included in a manual, which is available from the FiA web-site:

Fisheries Administration (FiA) 2021. Manual for Fish Catch Monitoring Assessment for Marine Fisheries in Cambodia. Marine Fisheries Research and Development Institute of the Fisheries Administration, Phnom Penh, Cambodia. 38 pages.

## 3. RESULTS

### 3. 1. Number of vessels/landings recorded in August

Data collection for August 2023 was conducted at 8 fishing landing sites, two in each coastal province (Table 1). Overall, landings for 56 small-scale vessels and 169 middle-scale vessels were recorded. Middle-scale vessels includes vessel length 12-24 and all trawlers regardless of size, as well as all vessels operating blood cockle dragnet.

Table 1. Number of the landings recorded by province and landing site.

| Province              | Landings        | Vessel Class |              | Grand Total |
|-----------------------|-----------------|--------------|--------------|-------------|
|                       |                 | Small Scale  | Middle Scale |             |
| <b>Kampot</b>         | Kampong Kandal  | 1            | 27           | 28          |
|                       | Trapeang Ropov  | 21           | 7            | 28          |
| <b>Kep</b>            | Ampeng          | 10           | 18           | 28          |
|                       | Ou Krasar       | 2            | 27           | 29          |
| <b>Koh Kong</b>       | Oknha Lyon Phat | 4            | 24           | 28          |
|                       | Thmasar         | 16           | 12           | 28          |
| <b>Preah Sihanouk</b> | Stueng Hav      |              | 28           | 28          |
|                       | Tumnup Rolok    | 2            | 26           | 28          |
| <b>Grand Total</b>    |                 | <b>56</b>    | <b>169</b>   | <b>225</b>  |

All landing sites are covered for the same four consecutive survey days, recording the catches for (at least) seven random landings for each day, through a combination of interviews (recall survey) and trader/fisher records.

### 3. 2. Catch per Unit of Effort by main gears

As the FCMAS uses random sampling of landings, the number of records for fishing gears varies between months, but reflect the occurrence and frequency of gears used at the landing sites covered by the survey. Only gears with 2 or more observations, are included in Table 2, as this allows to assess the statistical accuracy by calculating the relative standard error ( $\epsilon\%$ ) of the average CPUE. Although other gears are reported with the highest CPUE at 509.1 kg/fishing day, it is unclear if different records represent the same unknown gear and is therefore meaningless. In light of the high relative standard error, this value is ignored. It does highlight that the gear type always should be recorded. The fishing gear with the second highest CPUE is fish trap with 393kg/day, but this has a very high value for  $\epsilon\%$ , and because of that should also be ignored. This means that the trawl with 164.8 kg/day has the highest CPUE, followed by shrimp gillnet (83.7 kg/day), fish gillnet (83.0 kg/day), Mackerel Gillnet (71.5 kg/day), and Octopus trap long line (68.5 kg/day). The highest CPUE for small-scale fishing is found for fish gillnet (55.7 kg/day) and Mackerel gillnet (46.7 kg/day) and CPUE for small-scale fishing are somewhat lower for the same gears used by middle-scale vessels.

Table 2. CPUE (kg/day) for main small- and middle-scale gears.

| <b>Middle Scale</b>   | <b>CPUE</b> | <b>N</b> | <b>SD</b> | <b><math>\epsilon\%</math></b> |
|-----------------------|-------------|----------|-----------|--------------------------------|
| Unspecified gears     | 509.1       | 3        | 702.3     | <b>79.6%</b>                   |
| Fish trap             | 322.1       | 2        | 393.0     | <b>200.0%</b>                  |
| Trawl                 | 164.8       | 92       | 216.8     | 13.7%                          |
| Shrimp gillnet        | 83.7        | 8        | 110.6     | <b>46.7%</b>                   |
| Fish gillnet          | 83.0        | 2        | 32.5      | <b>27.7%</b>                   |
| Mackerel Gillnet      | 71.5        | 10       | 29.4      | 13.0%                          |
| Octopus trap longline | 68.5        | 5        | 8.8       | 5.7%                           |
| Crab trap             | 39.7        | 11       | 24.6      | 18.7%                          |
| Centipede trap        | 27.2        | 9        | 11.5      | 14.1%                          |
| Crab gillnet          | 22.4        | 24       | 13.0      | 11.8%                          |
| <b>Small-scale</b>    | <b>CPUE</b> | <b>N</b> | <b>SD</b> | <b><math>\epsilon\%</math></b> |
| Fish gillnet          | 55.7        | 15       | 25.6      | 11.9%                          |
| Mackerel Gillnet      | 46.7        | 3        | 15.3      | 18.9%                          |
| Push net              | 23.8        | 5        | 4.9       | 9.2%                           |
| Centipede trap        | 17.4        | 8        | 10.5      | 21.4%                          |
| Crab trap             | 13.9        | 6        | 5.8       | 17.1%                          |
| Crab gillnet          | 11.0        | 14       | 6.9       | 16.8%                          |

The value for  $\epsilon\%$  indicates the statistical precision, or the expected margin of the estimated average CPUE around the real value of the CPUE. If the value for the  $\epsilon\%$ , is higher than 25%, this indicates that the estimated average value is not reliable and should not be used. As Table 2, shows this only is an issue for a few middle-scale gears that have a high variation relative to the estimated CPUE, most likely caused by differences in the amount of gear deployed. For most gears, the statistical precision is acceptable.

Table 3. CPUE (kg/day) for trawlers by vessel size.

| Trawlers            | CPUE  | N  | SD    | ε%    |
|---------------------|-------|----|-------|-------|
| Small-scale 6-12m   | 62.4  | 54 | 106.6 | 23.3% |
| Middle-scale 12-18m | 307.5 | 37 | 252.3 | 13.5% |

Gears operated both by small- and middle-scale vessels see some small differences, except for active fishing gears like trawlers. The CPUE for trawlers sees a high difference between vessel size class (

Table 3), with the CPUE for middle-scale trawlers 12-18 meter at over 307.5 kg/day, more than 4 times higher than for 6–12-meter trawlers at 62.4 kg/day.

### 3. 3. Catch proportion by main gears

Trawlers have the highest contribution to the reported catch, with 68.6% of the reported catch. Fish gillnet have the highest contribution to the reported catch for small-scale vessels. Middle-scale fisheries, contribute almost 97% of the total recorded catch, besides trawl fisheries, other middle-scale fishing contributing another 28.2% of the reported catches. Small-scale fishing only contributes 3.2% of the total recorded fisheries yield.

Table 4. Proportion of catch by main fishing gear for small-scale and middle-scale gears

| Middle Scale (96.80%)     | Catch (%) |
|---------------------------|-----------|
| Trawl                     | 68.6%     |
| Unspecified gears         | 5.9%      |
| Shrimp gillnet            | 4.3%      |
| Mackerel Gillnet          | 3.8%      |
| Octopus trap longline     | 2.7%      |
| Crab trap                 | 2.6%      |
| Fish gillnet              | 2.5%      |
| Crab gillnet              | 1.8%      |
| Halfbeak gillnet          | 1.8%      |
| Fish trap                 | 1.7%      |
| Bottom longline for Squid | 0.5%      |
| Centipede trap            | 0.4%      |
| Squid trap                | 0.2%      |

| Small Scale (3.2%) | Catch (%) |
|--------------------|-----------|
| Fish gillnet       | 1.3%      |
| Crab gillnet       | 0.5%      |
| Mackerel Gillnet   | 0.2%      |
| Centipede trap     | 0.2%      |
| Push net           | 0.2%      |
| Others             | 0.9%      |

|                    | Total    | Kampot | Kep  | Koh Kong | Preah Sihanouk |
|--------------------|----------|--------|------|----------|----------------|
| Trawl              | 45,255.2 | 2.2%   | 1.1% | 22.4%    | 74.3%          |
| Other middle-scale | 18,603.6 | 29.5%  | 7.2% | 50.3%    | 13.1%          |



|             |          |       |      |       |       |
|-------------|----------|-------|------|-------|-------|
| Small-scale | 2,140.7  | 38.2% | 9.9% | 42.0% | 9.9%  |
| Total       | 65,999.5 | 11.3% | 3.0% | 30.8% | 55.0% |

In addition, when considering the fisheries production by province, for August 2023, the vast majority of the trawl fisheries production is reported from Preah Sihanouk followed at considerable distance by Koh Kong, with Kampot and Kep only contributing 3.3%. Most of the production by other middle-scale fisheries is by Kampot and Koh Kong, with most of the small-scale production reported in Koh Kong (see for additional details Annex 3).

### 3.4. Species group catch contribution by landed weight

The total reported catch for all species group was 65,999.5 kg, fish dominate the total reported catch with almost 68.1% of total weight followed by Cephalopods 8.9%, Shrimps at 10.6%, Crabs at 6.0% and unspecified species group at 2.8% (see Annex 1). Other species groups (sharks and rays), contribute only 0.06%.

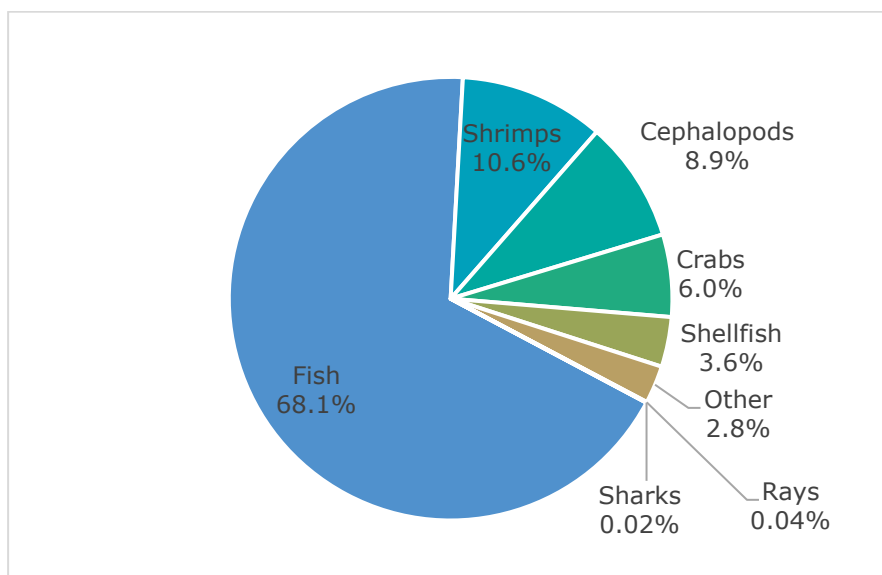


Figure 1. Catch composition by species group for all landings combined.

### 3.5. Species catch composition by reported catch weight for all landings

The total reported catch for August was 65,999.5 kg. The proportional catch by species is shown in Table 5. The most abundant species is the Shorthead anchovy (*Encrasicholina heteroloba*), which contributes 33.5% of the total reported catch. Other fish nei contributes 15.2%, this is followed by a number of species groups, *Penaeus* sp. (7.2%), Swimming crab (5.3%), Short mackerel (3.6%) and other catch nei (2.8%) and Mollusks nei with 2.7% and Squids nei with 2.6%. The top 20 species contribute 95.7% of the reported catch. Other fish (unsorted and unspecified) has a relative high contribution this month, indicating higher catches of relative low value species.

Table 5. Catch composition by species for all landings.

| Scientific name                  | English Name      | Khmer name      | Catch (kg) | Catch (%) |
|----------------------------------|-------------------|-----------------|------------|-----------|
| <i>Encrasicholina heteroloba</i> | Shorthead anchovy | កាកីម           | 22,105.0   | 33.5%     |
|                                  | Other fish nei    | ប្រភេទត្រីចំរុះ | 10,038.0   | 15.2%     |
| <i>Penaeus</i> sp.               | Prawns nei        | បង្កា           | 4,740.6    | 7.2%      |

|                                |                              |                             |                 |      |
|--------------------------------|------------------------------|-----------------------------|-----------------|------|
|                                | trash fish                   | ត្រីដី                      | 3,783.0         | 5.7% |
| <i>Portunus pelagicus</i>      | Swimming crab                | ក្ដាមសេះ                    | 3,476.1         | 5.3% |
| <i>Rastrelliger brachysoma</i> | Short mackerel               | ត្រីធ្លាតូ ឬត្រីកាម៉ុងខ្លី  | 2,370.0         | 3.6% |
| <i>Rastrelliger faughni</i>    | Island mackerel              | ត្រីប៉ាឡាំង                 | 1,845.0         | 2.8% |
|                                | Other catch nei              | ផ្សេងៗ                      | 1,818.0         | 2.8% |
|                                | Mollusks nei                 | សប្បីសត្វ ពពួកខ្យង គ្រី ងាវ | 1,800.0         | 2.7% |
|                                | Squids nei                   | មីក                         | 1,722.5         | 2.6% |
|                                | Octopus nei                  | មីកពីងពាង                   | 1,509.0         | 2.3% |
|                                | Octopus                      | ពពួកមីកពីងពាង               | 1,287.2         | 2.0% |
|                                | Needlefish nei               | ត្រីធ្នាំង                  | 1,218.0         | 1.8% |
| <i>Metapenaeus spp.</i>        |                              | បង្កាឌីខាក់                 | 956.8           | 1.4% |
| <i>Suborder Sepiina</i>        | Cuttlefish                   | មីកស្លុក                    | 919.0           | 1.4% |
| <i>Anodontostoma chacunda</i>  | <b>Chacunda gizzard shad</b> | ត្រីកាម៉យ                   | 860.0           | 1.3% |
|                                | Tuna                         | ត្រីឈាម                     | 800.0           | 1.2% |
|                                | Small mixed shrimp nei       | តី                          | 783.0           | 1.2% |
|                                | Shellfish nei                | ខ្យង មីក ក្ដាមផ្សេងៗ        | 600.0           | 0.9% |
| <i>Decapterus macrosoma</i>    | Shortfin scad                | ត្រីកាម៉ុងឬត្រីព្នាតូ       | 503.0           | 0.8% |
|                                | Other species                |                             | 2,865.3         | 4.3% |
| <b>Grand total</b>             |                              |                             | <b>65,999.5</b> |      |

### 3.6. Species group contribution by landed value

The total reported value for August was 386,189,450 Riels, Crabs contribute 28.9%, followed by Fish (23.8%), Shrimps (23.1%) and Cephalopods 20.5%. Unspecified species groups contribute 3.1%, while Sharks, rays and shellfish contribute 0.08% of the total value (more details are included in Annex 2).

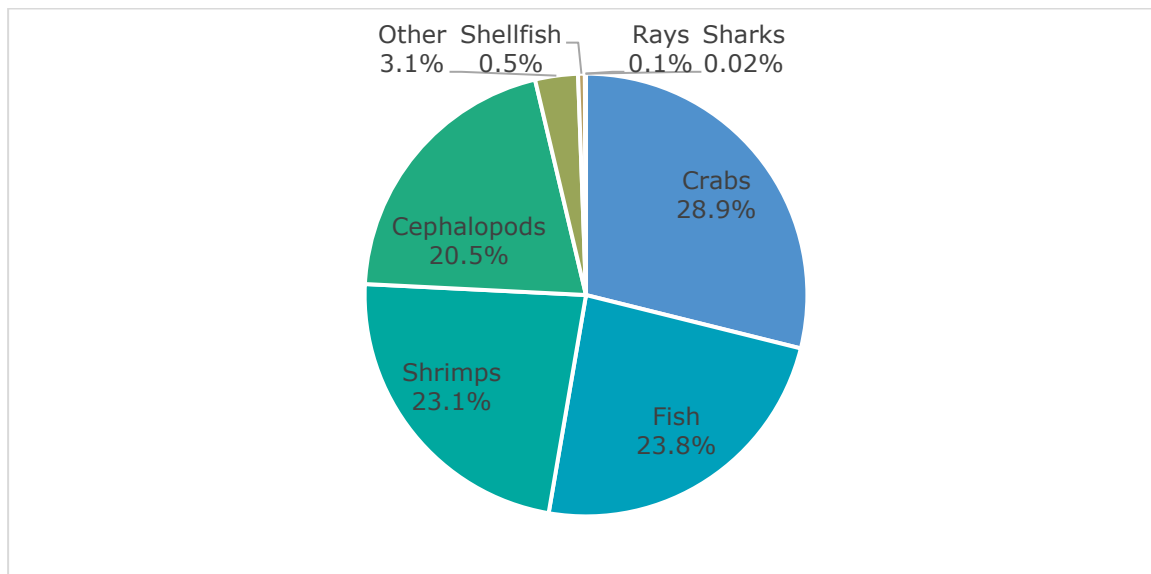


Figure 2. The value of the catch by main species groups for all landings

### 3.7. Species catch composition by reported catch value for all landings

The total reported value for August was 386,189,000 Riels for all species and species groups combined, the value and price for the top 20 species is shown in Table 6. The species (group) with the highest reported value is Swimming crab (27.2%), followed by Prawns nei (12.3%) and Squids nei (5.6%). Besides other fish nei (5.6%), Cuttlefish (4.8%), Octopus (4.6%) and Short mackerel (4.5%), also are important, either through their bulk or high prices. Unlike for previous months, the relative low contribution of anchovies and lower average price, means that Shorthead anchovy only contributes 3.3% of the total value.

Table 6. Total value (1000 Riel) by species for all landing

| Species name                     | Common name                     | Value (1000 Riels) | Value (%) | Price (Riel/kg) |
|----------------------------------|---------------------------------|--------------------|-----------|-----------------|
| <i>Portunus pelagicus</i>        | Swimming crab                   | 104,913            | 27.2%     | 26,539          |
| <i>Penaeus sp.</i>               | Prawns nei                      | 47,505             | 12.3%     | 15,381          |
| <i>Metapenaeus spp.</i>          |                                 | 29,287             | 7.6%      | 25,870          |
|                                  | Squids nei                      | 21,488             | 5.6%      | 14,611          |
|                                  | Other fish nei                  | 21,435             | 5.6%      | 2,986           |
| <i>Suborder Sepiina</i>          | Cuttlefish                      | 18,698             | 4.8%      | 16,709          |
|                                  | Octopus                         | 17,609             | 4.6%      | 12,211          |
| <i>Rastrelliger brachysoma</i>   | Short mackerel                  | 17,210             | 4.5%      | 5,250           |
|                                  |                                 | 15,624             | 4.0%      | 12,152          |
| <i>Encrasicholina heteroloba</i> | Shorthead anchovy               | 12,553             | 3.3%      | 548             |
|                                  | Other catch nei                 | 12,064             | 3.1%      | 17,519          |
| <i>Rastrelliger faughni</i>      | Island mackerel                 | 9,215              | 2.4%      | 4,917           |
| <i>Lutjanus argentimaculatus</i> | Mangrove red snapper            | 8,650              | 2.2%      | 16,500          |
|                                  | Cephalopods (squids/cuttlefish) | 5,790              | 1.5%      | 11,400          |
|                                  | Shrimps nei                     | 5,100              | 1.3%      | 18,000          |
|                                  | Needlefish nei                  | 4,927              | 1.3%      | 6,464           |
|                                  | Crabs nei                       | 4,800              | 1.2%      | 24,000          |
|                                  | Small mixed shrimp nei          | 3,132              | 0.8%      | 4,000           |
| <i>Epinephelus coioides</i>      | Orange-spotted grouper          | 2,900              | 0.8%      | 25,000          |

|                              |                        |                |      |       |
|------------------------------|------------------------|----------------|------|-------|
| <i>Siganus canaliculatus</i> | Whitespotted Spinefoot | 2,883          | 0.7% | 4,813 |
|                              | Other species          | 20,409         | 5.3% |       |
| <b>Grand Total</b>           |                        | <b>386,189</b> |      |       |

The comparatively low reported catch for August, low contribution by anchovies and conversely a higher proportion of more valuable species, means that the average price is about 5850 KHR/kg.

### 3.8. Total calculated catch

The total estimated catch is calculated separately for a number of vessel-gear classes to reduce the variability in the observed CPUE. In view of the importance of trawl fisheries and high variability in CPUE which is closely related to vessel length and engine power, trawlers are separated into three size-based classes<sup>2</sup>, in addition to standard FiA vessel classes. Monthly vessel yield is based on independent estimates for the CPUE (average daily catch) and the monthly fishing days, while extrapolation uses number of vessels for each vessel-gear category obtained from the 2018 vessel census, while assuming only 85% are operating<sup>3</sup>.

The total calculated catch for August 2023, is 6,711.2 MT. As for the reported catch, by far the largest contribution to the total estimated catch is by trawlers, for a total of 50.9%, with small-scale vessels contributing more than 22%. Because of insufficient observations for some vessel-gear categories for individual months, the monthly total estimated catch calculation in Table 7, is using the annual average values for the CPUE and Effort for Small-scale < 6-meter, Trawler 18-24 meter and Large-scale > 24 meter. Only a few landings for these vessel-gear classes are recorded over the year, the value for ε% therefore represents the annual values.

Table 7. Total estimated catch by main vessel gear categories.

| Vessel-gear category                | Recorded landings | CPUE    | ε%      | Effort | Monthly vessel yield (kg) | Active Vessels (85%) | Total Monthly yield (MT) | %Total |
|-------------------------------------|-------------------|---------|---------|--------|---------------------------|----------------------|--------------------------|--------|
| Very small<6 meter                  | 0                 | 5.5     | (7.0%)  | 5.0    | 27.5                      | 775.2                | 21.3                     | 0.3%   |
| Small-scale 6-<12 meter             | 56                | 35.2    | 21.9%   | 15.8   | 555.8                     | 2658                 | 1,477.2                  | 22.0%  |
| Trawl 6-<12 meter                   | 54                | 62.4    | 23.3%   | 19.2   | 1,195.9                   | 952                  | 1,138.5                  | 17.0%  |
| Trawl 12-18 meter                   | 37                | 307.5   | 13.5%   | 20.4   | 6,282.3                   | 339.15               | 2,130.7                  | 31.7%  |
| Trawl 18-<24 meter                  | 1                 | 220.8   | (88.7%) | 16.0   | 3,533.3                   | 42.5                 | 150.2                    | 2.2%   |
| Other gears 12-18 m                 | 68                | 67.8    | 30.5%   | 13.7   | 926.7                     | 1588.7               | 1,472.2                  | 21.9%  |
| Other gears 18-<24 m                | 9                 | 94.4    | 36.5%   | 21.1   | 1,992.6                   | 55.25                | 110.1                    | 1.6%   |
| Large-scale 24+ meter               | 0                 | 1,340.7 | (63.8%) | 17.5   | 23,462.5                  | 9                    | 211.2                    | 3.1%   |
| <b>August Total Estimated Catch</b> |                   |         |         |        |                           |                      | <b>6,711.2</b>           |        |

While the values for ε%, for the CPUE for some of the vessel-gear categories are acceptable, in addition to vessels larger than 18 meters, the statistical precision for all middle-scale non-trawler vessels is insufficient. As a consequence, since these vessel-gear classes contribute more than 23% of the total estimated catch, there is limited confidence in the level of the estimated total catch for August and the estimate should only be considered indicative.

Using the average reported price (5850 KHR/kg), the total value of the estimated catch can be calculated as **39,269,867,000 KHR** or **US\$ 9,578,016**.

<sup>2</sup> Trawl gears are not reported by type in the 2023 data

<sup>3</sup> Based on information by FiAC staff



Annex 1. Catch composition by species group for all landing, by weight and value.

| <b>Species group</b> | <b>Total weight (kg)</b> | <b>Total weight% (kg)</b> |
|----------------------|--------------------------|---------------------------|
| Fish                 | 44,949                   | 68.11%                    |
| Shrimps              | 6,973.2                  | 10.57%                    |
| Cephalopods          | 5,854.7                  | 8.87%                     |
| Crabs                | 3,963.6                  | 6.01%                     |
| Shellfish            | 2,401                    | 3.64%                     |
| Other                | 1,818                    | 2.75%                     |
| Rays                 | 26                       | 0.04%                     |
| Sharks               | 14                       | 0.02%                     |
| <b>Grand Total</b>   | <b>65,999.5</b>          |                           |

| <b>Species Group</b> | <b>Total value (1000 Riels)</b> | <b>Total value (%)</b> |
|----------------------|---------------------------------|------------------------|
| Crabs                | 111,535                         | 28.88%                 |
| Fish                 | 919,94                          | 23.82%                 |
| Shrimps              | 89,163                          | 23.09%                 |
| Cephalopods          | 79,208                          | 20.51%                 |
| Other                | 12,063                          | 3.12%                  |
| Shellfish            | 1,902                           | 0.49%                  |
| Rays                 | 245                             | 0.06%                  |
| Sharks               | 8                               | 0.02%                  |
| <b>Grand Total</b>   | <b>386,189</b>                  |                        |
|                      |                                 |                        |
| <b>Average price</b> | <b>5850 KHR/kg</b>              |                        |

Annex 2. Catch contribution by gear type and province.

| Gear Type                 | Koh Kong     | Preah Sihanouk | Kampot       | Kep         | Grand Total (kg) |
|---------------------------|--------------|----------------|--------------|-------------|------------------|
| Trawl                     | 22.4%        | 74.3%          | 2.2%         | 1.1%        | 45,255.2         |
| Others (not specified)    | 40.6%        | -              | 59.4%        | -           | 4,291.0          |
| Shrimp gillnet            | 89.0%        | 11.0%          | -            | -           | 2,832.1          |
| Mackerel Gillnet          | 24.7%        | 75.3%          | -            | -           | 2,655.0          |
| Fish gillnet              | -            | -              | 99.4%        | 0.6%        | 2,485.0          |
| Octopus trap longline     | 100.0%       | -              | -            | -           | 1,780.0          |
| Crab trap                 | 48.5%        | -              | 9.0%         | 42.4%       | 1,779.7          |
| Crab gillnet              | 42.4%        | 21.0%          | -            | 36.6%       | 1,539.5          |
| Halfbeak gillnet          | -            | -              | 100.0%       | -           | 1,200.0          |
| Fish trap                 | 100.0%       | -              | -            | -           | 1,130.0          |
| Centipede trap            | 62.3%        | -              | 3.0%         | 34.7%       | 403.0            |
| Bottom longline for Squid | 100.0%       | -              | -            | -           | 350.0            |
| Squid trap                | 100.0%       | -              | -            | -           | 120.0            |
| Push net                  | 100.0%       | -              | -            | -           | 119.0            |
| Mullet gillnet            | -            | -              | 100.0%       | -           | 42.0             |
| Fish hook                 | 100.0%       | -              | -            | -           | 14.0             |
| Hand push net             | -            | -              | 100.0%       | -           | 4.0              |
| <b>Grand Total</b>        | <b>30.8%</b> | <b>55.0%</b>   | <b>11.3%</b> | <b>3.0%</b> | <b>65,999.5</b>  |

### Annex 3. Calculated CPUE by province

| Province              | Vessel Class        | Gear Type             | Average CPUE     | N    | SD    | ε%    |
|-----------------------|---------------------|-----------------------|------------------|------|-------|-------|
| <b>Kampot</b>         | <b>Middle Scale</b> | Crab trap             | 16.3             | 5    | 7.8   | 21.5% |
|                       |                     | Fish gillnet          | 83.0             | 2    | 32.5  | 27.7% |
|                       |                     | Others                | 103.7            | 2    | 11.8  | 8.0%  |
|                       |                     | Trawl                 | 41.1             | 24   | 8.1   | 4.0%  |
|                       | <b>Small Scale</b>  | Crab trap             | 15.8             | 5    | 3.6   | 10.1% |
|                       |                     | Fish gillnet          | 58.6             | 14   | 23.8  | 10.9% |
|                       |                     |                       |                  |      |       |       |
| <b>Kep</b>            | <b>Middle Scale</b> | Centipede trap        | 23.3             | 4    | 10.5  | 22.6% |
|                       |                     | Crab gillnet          | 22.4             | 20   | 9.4   | 9.4%  |
|                       |                     | Crab trap             | 63.3             | 4    | 14.3  | 11.3% |
|                       |                     | Trawl                 | 28.6             | 17   | 5.8   | 4.9%  |
|                       | <b>Small Scale</b>  | Centipede trap        | 11.8             | 4    | 1.3   | 5.4%  |
|                       |                     | Crab gillnet          | 10.6             | 7    | 2.5   | 9.0%  |
| <b>Koh Kong</b>       | <b>Middle Scale</b> | Centipede trap        | 30.4             | 5    | 12.4  | 18.3% |
|                       |                     | Crab gillnet          | 21.8             | 3    | 33.1  | 87.4% |
|                       |                     | Crab trap             | 50.7             | 2    | 1.0   | 1.4%  |
|                       |                     | Fish trap             | 322.1            | 2    | 393.0 | 86.3% |
|                       |                     | Mackerel Gillnet      | 64.4             | 8    | 28.7  | 15.8% |
|                       |                     | Octopus trap longline | 68.5             | 5    | 8.8   | 5.7%  |
|                       |                     | Trawl                 | 154.0            | 7    | 134.4 | 33.0% |
|                       | <b>Small Scale</b>  | Centipede trap        | 26.7             | 3    | 13.3  | 28.8% |
|                       |                     | Crab gillnet          | 6.0              | 5    | 3.5   | 26.1% |
|                       |                     |                       | Mackerel Gillnet | 46.7 | 3     | 15.3  |
|                       |                     | Push net              | 23.8             | 5    | 4.9   | 9.2%  |
| <b>Preah Sihanouk</b> | <b>Middle Scale</b> | Mackerel Gillnet      | 100.0            | 2    | 0.0   | 0.0%  |
|                       |                     | Shrimp gillnet        | 44.6             | 7    | 5.3   | 4.5%  |
|                       |                     | Trawl                 | 286.6            | 44   | 256.6 | 13.5% |
|                       | <b>Small Scale</b>  | Crab gillnet          | 25.3             | 2    | 0.7   | 2.0%  |



Annex 4 Species catch by province

| Scientific name                  | English Name           | Khmer name                      | Koh Kong | Preah Sihanouk | Kampot | Kep   | Catch (kg) | Catch (%) |
|----------------------------------|------------------------|---------------------------------|----------|----------------|--------|-------|------------|-----------|
| <i>Encrasicholina heteroloba</i> | Shorthead anchovy      | កាកឹម                           | 6.8%     | 93.2%          | -      | -     | 22,105.0   | 33.5%     |
|                                  | Other fish nei         | ប្រភេទត្រីចំរុះ                 | 63.9%    | 33.6%          | 1.2%   | 1.3%  | 10,038.0   | 15.2%     |
| <i>Penaeus sp.</i>               | Prawns nei             | បង្កា                           | 55.1%    | 40.3%          | 0.6%   | 4.0%  | 4,740.6    | 7.2%      |
|                                  | trash fish             | ត្រីជី                          | 1.6%     | 96.1%          | -      | 2.2%  | 3,783.0    | 5.7%      |
| <i>Portunus pelagicus</i>        | Swimming crab          | ក្តាមសេះ                        | 37.5%    | 21.0%          | 6.0%   | 35.5% | 3,476.1    | 5.3%      |
| <i>Rastrelliger brachysoma</i>   | Short mackerel         | ត្រីផ្កាឆូ ឬត្រីកាម៉ុងខ្លួនខ្លី | 23.2%    | 76.2%          | -      | 0.6%  | 2,370.0    | 3.6%      |
| <i>Rastrelliger faughni</i>      | Island mackerel        | ត្រីប៉ាឡាំង                     | 2.4%     | -              | 97.6%  | -     | 1,845.0    | 2.8%      |
|                                  | Other catch nei        | ផ្សេងៗ                          | -        | -              | 100.0% | -     | 1,818.0    | 2.8%      |
|                                  | Mollusks nei           | សប្បីសត្វ ពពួកខ្យង គ្រំ ងាវ     | 96.7%    | -              | -      | 3.3%  | 1,800.0    | 2.7%      |
|                                  | Squids nei             | មីក                             | 73.0%    | 25.8%          | 1.2%   | -     | 1,722.5    | 2.6%      |
|                                  | Octopus                | មីកពីងពាង                       | 63.0%    | 22.9%          | 11.6%  | 2.5%  | 1,509.0    | 2.3%      |
|                                  |                        | ពពួកមីកពីងពាង                   | -        | 100.0%         | -      | -     | 1,287.2    | 2.0%      |
|                                  | Needlefish nei         | ត្រីធ្មោង                       | -        | -              | 98.5%  | 1.5%  | 1,218.0    | 1.8%      |
| <i>Metapenaeus spp.</i>          |                        | បង្កាឌីខាក់                     | 9.3%     | 90.7%          | -      | -     | 956.8      | 1.4%      |
| <i>Suborder Sepiina</i>          | Cuttlefish             | មីកស្តុក                        | 45.7%    | 46.9%          | 3.4%   | 4.0%  | 919.0      | 1.4%      |
| <i>Anodontostoma chacunda</i>    | Chacunda gizzard shad  | ត្រីកាម៉យ                       | -        | -              | 100.0% | -     | 860.0      | 1.3%      |
|                                  | Tuna                   | ត្រីឈាម                         | 100.0%   | -              | -      | -     | 800.0      | 1.2%      |
|                                  | Small mixed shrimp nei | គី                              | -        | 100.0%         | -      | -     | 783.0      | 1.2%      |
|                                  | Shellfish nei          | ខ្យង មីក ក្តាមផ្សេងៗ            | 100.0%   | -              | -      | -     | 600.0      | 0.9%      |

|                                  |                                 |   |        |       |        |        |       |      |
|----------------------------------|---------------------------------|---|--------|-------|--------|--------|-------|------|
| <i>Decapterus macrosoma</i>      | Shortfin scad                   | ត្រីកាម៉ុងឬត្រីប្លាធូ                               | -      | 0.6%  | 99.4%  | -      | 503.0 | 0.8% |
|                                  | Cephalopods (squids/cuttlefish) | ពពួកមីកស្តុកនិងមីកបំពង់                             | 95.9%  | 0.5%  | 3.6%   | -      | 417.0 | 0.6% |
|                                  | Shrimps nei                     | ពពួកបង្កាគ្រប់ប្រភេទទាំងអស់                         | 99.5%  | 0.5%  | -      | -      | 372.0 | 0.6% |
| <i>Rastrelliger kanagurta</i>    | Indian mackerel                 | ត្រីកាម៉ុងខ្លួនវែង                                  | -      | -     | 100.0% | -      | 350.0 | 0.5% |
| <i>Lutjanus argentimaculatus</i> | Mangrove red snapper            | ត្រីអាងក៏យក្រហម                                     | 100.0% | -     | -      | -      | 350.0 | 0.5% |
| <i>Siganus canaliculatus</i>     | Whitespotted Spinefoot          | ត្រីកន្តាំងក្រអូម                                   | 88.0%  | -     | 12.0%  | -      | 284.0 | 0.4% |
|                                  | Crabs nei                       | ពពួកក្តាម (រួមទាំងក្តាមសេះ ក្តាមថ្ម ក្តាមជ័រ ជាដើម) | 100.0% | -     | -      | -      | 200.0 | 0.3% |
| <i>Epinephelus coioides</i>      | Orange-spotted grouper          | ត្រីតុកកែកៅ   | 100.0% | -     | -      | -      | 120.0 | 0.2% |
| <i>Portunus spp.</i>             | Swimming crabs                  | ក្តាមសេះ  | 100.0% | -     | -      | -      | 100.0 | 0.2% |
|                                  |                                 | ក្តាមផ្សេងៗ   | -      | -     | -      | 100.0% | 98.0  | 0.1% |
| <i>Episesarma versicolor</i>     | Violet vinegar crab             | ក្តាមជ័រ  | 100.0% | -     | -      | -      | 74.0  | 0.1% |
|                                  | Mantis shrimp                   | បង្កងកណ្តុប   | 7.7%   | -     | 92.3%  | -      | 65.2  | 0.1% |
| <i>Lutjanus gibbus</i>           | humpback red snapper            | ត្រីឆ្មុងក្រហម                                      | 100.0% | -     | -      | -      | 60.0  | 0.1% |
|                                  | Parrot fish                     | ត្រីសេក   | -      | -     | 82.8%  | 17.2%  | 58.0  | 0.1% |
|                                  |                                 | បង្កងប៉ាក   | -      | 91.9% | -      | 8.1%   | 55.6  | 0.1% |
| <i>Lutjanus malabaricus</i>      | Malabar blood snapper           | ត្រីក្រហម   | -      | -     | 100.0% | -      | 50.0  | 0.1% |
| <i>Crenimugil seheli</i>         | Bluespot mullet                 | ត្រីក្បក  | -      | -     | 100.0% | -      | 42.0  | 0.1% |
|                                  | squirrelfish                    | ត្រីក្រហម   | -      | -     | 100.0% | -      | 40.0  | 0.1% |

|                              |                              |                               |        |       |        |        |                 |      |
|------------------------------|------------------------------|-------------------------------|--------|-------|--------|--------|-----------------|------|
| <i>Gazza minuta</i>          | Toothpony                    | ត្រីសំបោរហៀរ "គ្មាន<br>រំអិល" | 100.0% | -     | -      | -      | 20.0            | 0.0% |
|                              | Congers nei                  | អន្ទង់សមុទ្រ                  | -      | -     | -      | 100.0% | 18.0            | 0.0% |
| <i>Chiloscyllium griseum</i> | Grey bambooshark             | ឆ្កាមគីងក់ឬឆ្កាមឆ្កួត         | -      | -     | -      | 100.0% | 14.0            | 0.0% |
|                              | Rays nei                     | បបែល                          | -      | -     | 100.0% | -      | 13.0            | 0.0% |
| <i>Brevitrygon imbricata</i> | Scaly whipray                | បបែលមាន់                      | -      | -     | -      | 100.0% | 13.0            | 0.0% |
| <i>Scylla serrata</i>        | Mud crab                     | ក្តាមថ្មី                     | 100.0% | -     | -      | -      | 10.5            | 0.0% |
| <i>Pseudorhombus arsius</i>  | Large tooth flounder         | ត្រីអណ្តាតផ្តែ                | 42.1%  | 15.8% | -      | 42.1%  | 9.5             | 0.0% |
| <i>Scomberomorus sp.</i>     | Spanish mackerel species nei | ត្រីបេកា                      | 100.0% | -     | -      | -      | 9.0             | 0.0% |
| <i>Sillago sihama</i>        | Silver sillago               | ត្រីព្រលួស                    | -      | -     | 100.0% | -      | 7.5             | 0.0% |
| <i>Episesarma sp.</i>        | Vinegar crab                 | ក្តាមជ័រ                      | 100.0% | -     | -      | -      | 4.0             | 0.0% |
| <i>Terapon jarbua</i>        | Jarbua terapon               | ត្រីត្រសក់កន្ទុយរែក           | -      | -     | 100.0% | -      | 3.0             | 0.0% |
|                              | Pony fishes                  | ត្រីកិ                        | -      | -     | 100.0% | -      | 2.0             | 0.0% |
|                              | Lizardfish                   | ត្រីក្តុចិន                   | -      | -     | 100.0% | -      | 2.0             | 0.0% |
| <i>Sphyræna obtusata</i>     | Obtuse barracuda             | ត្រីអង្រែ                     | -      | -     | 100.0% | -      | 1.0             | 0.0% |
| <i>Thalamita crenata</i>     | Crenate swimming crab        | ក្តាមថ្មីខៀវ                  | -      | -     | -      | 100.0% | 1.0             | 0.0% |
| <i>Pampus argenteus</i>      | Silver pomfret               | ត្រីចាបស                      | -      | -     | -      | 100.0% | 1.0             | 0.0% |
| Anadara granosa              | Blood cockle                 | ត្រែងឈាម                      | 100.0% | -     | -      | -      | 1.0             | 0.0% |
| <b>Grand Total</b>           |                              |                               |        |       |        |        | <b>65,999.5</b> |      |