SECOND DRAFT REPORT ON THE REVIEW OF RE-ESTIMATION METHODOLOGY OF INDONESIA'S ANNUAL TUNA CATCH DATA IN IOTC FOR 2010-2020

Indonesia

Prepared for the Indian Ocean Tuna Commission (IOTC) 18th Session of Working Party on Data Collection and Statistics (WPDCS18)

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Executive Summary

Catch data is essential in building a robust fisheries management strategy. However, in some Regional Fisheries Management Organization (RFMO) e.g., Indian Ocean Tuna Commission (IOTC), such data needs to be tailored due to several reasons, for example, inter-annual variation in reported catches by species, gear and fleets. However, such method often creates a distinguishable discrepancy between national catch data presented in the country's national report and those presented in the IOTC datasets.

Since the yellowfin tuna stock in IOTC was under pressure in the last five years, catch reduction was an inevitable solution for guiding it back into recovery. Nevertheless, if the new re-estimated data were to be used as the basis for catch reductions this would not reflect the real situation bearing in mind that the Indonesia waters is the largest ocean area among IOTC members. However, Indonesia appreciates the effort taken by IOTC Secretariat to work with Indonesia on developing a new methodology based on the best data available on the robust e-logbook to produce data catch for the period of 2010-2020.

Two-sessions assistance meeting (virtual and field visit) with the IOTC staffs were held consecutively between February and July to follow up the WPDCS17 recommendation. Both parties agreed that the current re-estimation methodology was somewhat confusing and based on obsolete study, thus an updated version with more recent and robust datasets is imminent. This report provided an in-depth study on how to conduct recalculation on the Indonesian tuna datasets with emphasizing on using a reliable data source and minimizing the uncertainties. In the wake that this approach will be approved as the foundation for estimating Indonesian catches for the 2010–2020 periods.

1. Purpose of this paper

This paper is presented to support Indonesia's objection on the use of re-estimated data by the Secretariat for data catches officially submitted to the IOTC for years prior 2020 and proposes re-estimation methodology of Indonesia's annual tuna catch data for 2010-2020.

2. Background

Relevant information related to the background of the development of re-estimation methodology of Indonesia's annual tuna catch data for 2010-2020 quoted from the reports below:

The report of 20th Working Party on Tropical Tunas (WPTT20)

1. The WPTT **NOTED** the large increase in the Indonesian yellowfin tuna catch and queried whether this may be a result of error in data entry or reporting. Indonesia clarified that data verification was needed and an update on this would be included in their national report to SC21.
2. The WPTT **NOTED** that it may be beneficial to include a sensitivity run in the yellowfin tuna stock assessment that investigates the potential bias due to the uncertainties in the catch estimates, which would enable comparison of results with the standard approach that uses the reconstructed catch histories estimated by the IOTC Secretariat. The WPTT further **NOTED** that this approach was not undertaken during the 2018 yellowfin tuna assessment. The WPTT **NOTED** that such an approach may require additional calculations.

The report of 14th Working Party on Data Collection and Statistics (WPDCS14)

1. The WPDCS **NOTED** the changes to the IOTC Secretariat's methodology in terms of revisions to the estimation of average catches and the species composition of Indonesia's fresh longline catches, and the range of data sources used to validate the new estimates, including:
   a. The 2013 Fishing Capacity report, published by the IOTC Secretariat;
   b. Comparisons with the species composition of catches from port sampling conducted by the Research Institute of Tuna Fisheries in Benoa, one of the main landing sites for Indonesia's fresh longline fleets.
   c. Validation of longline observer trips reports submitted by Indonesia.
   d. Comparisons of average catches of vessels unloading in Benoa.
2. The WPDCS **ACKNOWLEDGED** the work of the IOTC Secretariat to develop and improve current estimates of catches of Indonesia's fresh longline fleet. **RECOGNIZING** the need for the Secretariat to report a single nominal catch series for each CPC prior to the IOTC Working Parties, the WPDCS **AGREED** that the catch series provided by the Secretariat is likely the best available information on Indonesian fresh longline catches at present and **REQUESTED** that the possibility of revisions for years prior to 2014 be explored in order to ensure consistency in the catch trends over the longer time period.
3. The WPDCS **ENDORSED** the current methodology developed by the Secretariat to produce the new catch series for scientific use and **REQUESTED** that this methodology

be subject to frequent review so as to provide the best available information, given the ongoing uncertainties with the quality of Indonesia's official statistics.

The report of the 21st Session of the IOTC Scientific Committee (SC21)

1. The SC noted that a recent update to official figures for Indonesia nominal catches for 2017 has been received in November 2018 and is in the process of being assessed by the Secretariat. Also, the SC noted that time-area information are included by Indonesia in its national report, but that these same data is not yet submitted to the Secretariat in accordance with Resolution 15/02. Indonesia noted that it is making efforts to comply with Resolution 15/02 and that these data will be provided as soon as possible. The SC **NOTED** that the significant decline in catches reported at the Port of Benoa in 2017 could be explained by a reduction in effort due to an issue with allocating fishing permits to fishers. In response to a query around the large increase in swordfish catches since 2012, the SC noted that the Secretariat has revised its catch reconstruction for the Indonesian fresh longline fishery, and that the detected increase has been corrected resulting in higher confidence around the data in recent years (while ongoing uncertainties still remain with historical catches).
2. The SC noted that there are apparent discrepancies in the IOTC database (as this is disseminated through the IOTC website) and the catch levels in 2017 and previous years for tropical tuna species as reported during the WPTT20. The SC **ACKNOWLEDGED** that this difference was due to the need to provide two distinct nominal catch series to account for the ongoing re-estimation of Indonesian fresh-tuna longline catches, that the method to produce these revised best scientific estimates for the time series has been endorsed during the last WPDCS and that therefore these apparent discrepancies will soon disappear.
3. The SC noted the IOTC Secretariat has re-estimated the catches for Indonesia's fresh longline fleet and provided the WPB16 meeting with an alternative catch series (IOTC–2018–WPB16–DATA03b). The total catches mostly affect catches of swordfish, blue marlin, and striped marlin to a lesser extent, which have been revised downwards by as much as 30%. The SC further noted that these estimates have been reviewed by WPDCS14.

The 25th Session of the Indian Ocean Tuna Commission

Indonesia's concerns in the 25th Session of the Indian Ocean Tuna Commission and Associated Meetings are as follow:

- There were two proposals on the Interim Plan for Rebuilding Yellowfin Tuna in the IOTC Area of Competence submitted by the EU and Maldives, respectively. The Commission agreed that the Maldives proposal was used as a basis for discussion.
- The proposal used the IOTC data set which is a catch re-estimation carried out by the IOTC Secretariat.
- Regardless of the data source, the proposal proposed reducing YFT catches for developing coastal states that catch YFT >5,000 tons (in 2014) including Indonesia by 12%.
- The data re-estimation process carried out by the IOTC Secretariat on YFT catch data reported by Indonesia reduced the catch in 2014 by 45,122 tons to 25,275 tons. So that

the catch limit obtained by Indonesia when using the IOTC data set will decrease by 44% from 39,707 tons to 22,242 tons.

- Indonesia in principle supports the yellowfin tuna re-building measure, as stated at S25. However, the use of catch re-estimation caused Indonesia to raise an objection.

YFT objection letter from Indonesia described as follow:

- As shown during the 25th Session, Indonesia was abiding similar views as all other CPCs to support and agree on rebuilding Yellow Fish Tuna (YFT) stock through an interim plan, ensuring sustainability, and accelerating this high-value and economic resource recovery, particularly for developing coastal states, SIDS, and territory.
- Therefore, as a member of IOTC, Indonesia reiterates our commitment to fully comply with conservation and management measures, including catch data submission. Indonesia is open and welcome any inquiry for further consultations. In regard to this matter, we have been engaged in various intersessional discussions with CPCs and consulted with the IOTC Secretariat to explore a possible way forward on crucial matters, especially the data discrepancy issue.
- However, as a member of IOTC attending the 25th Session of IOTC, Indonesia has raised an objection to the reference used for the catch adjustment and how that proposal would negatively impact small-scale and artisanal fisheries. Indonesia consistently calls the full compliance of Agreement for the Establishment of the Indian Ocean Tuna Commission (the Agreement) and reiterate that using re-estimated data as the basis of adjustment of the catch is clearly lacks a legal basis and is tantamount to upset the agreement. By all means, the use of official reported catch is critical and undisputed.
- Based on Paragraph 1 Article XI, the Commission shall decide the scope and form of the statistics for the purposes of the Agreement. Therefore, the use of re-estimated data by the Secretariat without prior consultation with members of the commissions, including Indonesia is highly regrettable.
- Having said the above, the use of re-estimated data by the Secretariat will consequently reduce our catch limit significantly by more than 40% compared to Resolution 19/01. It will threaten the livelihood of our small-scale and artisanal fisheries. The decision on using the re-estimated data has strongly urged Indonesia to express our disappointment and compelled Indonesia to take the necessary action by declaring an objection to the adoption of the Interim Plan.
- The government of Indonesia sees the urgent need to exercise our right establishes under Article IX (5) to object to the adoption of the interim plan. Hence any implementation of the resolution on an Interim Plan for Rebuilding the Indian Ocean Yellowfin Tuna Stock in the IOTC Area of Competence adopted at the 25th Session of the IOTC shall not apply to Indonesia.

The report of 1st Indonesian tuna fisheries data workshop

1. An ad-hoc technical workshop on the status of Indonesian tuna fisheries data at IOTC was held online on the 25th, 27th and 28th of May 2021, to provide update and ongoing work on data collection an d improvement and how they may use in revising the re-estimation of Indonesia's official catches (performed in agreement with the IOTC Scientific Committee) and the current rationale for continuing to estimate the species composition of Indonesia's total catches, in particular related to the use of re-estimated data by the IOTC will

consequently reduce Indonesia's YFT catch limit significantly by more than 40% compared to Resolution 19/01. This workshop was attended by the IOTC Secretariat, the Ministry of Marine Affairs of Indonesia along with support of the International Pole and line Foundation (IPNLF)

2. Indonesia (IDN) **INDICATED** that they currently lack of understanding of the methodology used to re-estimate Indonesia's official catches by the IOTC Secretariat and that they would like to understand the current discrepancies observed between the reported information (through Forms 1-RC) and the published information (IOTC best scientific estimates) since this among other things may affect the catch limit of YFT for Indonesian fisheries (IOTC Res. 19/01), with potentially major negative consequences on Indonesian fishers and livelihoods.
3. IPNLF **STATED** that it is essential to understand the current methodology used for species and gear assignment to reconcile the catch data sources and address the gap between the position of IDN and the Secretariat with regards to catches of YFT, the extent to which the current estimation methodology was reviewed over time and when, and focus the discussions on the period 2018-2019.
4. The IOTC Secretariat **NOTED** that a key question of the workshop is in first place to understand why the IOTC Scientific Committee requested the Secretariat to re-estimate IDN catch data, **RECALLING** that the estimation procedure has been developed from the early 2000s and revised through time in collaboration with IDN, and that it also concerns fisheries from other CPCs.
5. The IOTC Secretariat **INDICATED** their interest in better understanding the data collection and validation systems in place for IDN tuna fisheries data, and provide IDN with more clarity on the origins and methods applied for the catch data re-estimation, with the objective of helping IDN clarify whether a revision of the estimation process should be discussed and presented at the next WPDCS and SC.
6. The IOTC Secretariat **RECALLED** that the methodology used for validating and re-estimating the IDN's official data has been periodically reviewed, and was last refined in 2018 (specifically, for the component relating to IDN fresh longline fisheries) as a consequence of the issues emerging from the re-estimated catch trends due to the uncertainty in the number of IDN's active fishing vessels, sampling coverage, and species composition in the catch.
7. FAO **INDICATED** that they also expected this meeting to clarify some of the inconsistencies and sharp fluctuations in IDN's official capture fisheries statistics submitted via FAO's NS-1 questionnaire, particularly since 2017 and the implementation of the One Data, and agree with IDN on the way forward to ensure transparency and a common understanding of the main data issues.
8. Conclusions and future activities
    - The WS **NOTED** the recent progress accomplished by IDN through the One Data program, with accurate information now acquired through Electronic Reporting Systems (ERS) and fishing positions validated with VMS, **ACKNOWLEDGING** that delays in data submission for the reference year 2020 are expected to occur due to the COVID-19 pandemic.
    - The WS **AGREED** on the need for the IOTC Secretariat to improve information and feedback provided to the CPCs, especially when some re-estimation of the data is performed.
    - The WS **AGREED** that new technical workshops specifically dealing with IDN tuna fisheries catch data should be conveyed to review and assess the available information

and update the methodology used for generating the best scientific estimates to be used for stock assessment and management purposes.

The report of 2nd Indonesian tuna fisheries data workshop

1. The 2nd Indonesian tuna fisheries data workshop was held online on the 20th and 21st September 2021 as a follow up one of the recommendations of the first workshop. It discussed the re-estimation methodology of Indonesia's annual tuna catch for 2017-2019 proposed by Indonesia.
2. The IOTC Secretariat **INDICATED** their acknowledgement on the proposed re-estimation methodology of Indonesia's annual tuna catch for 2017-2019 with some corrections and **SUGGESTED** Indonesia to present the paper of re-estimation methodology in the 17th working party on data collection and statistics (WPDCS).
3. The chair of Scientific Committee **SUGGESTED** to Indonesia to add some additional information regarding the data sources that is used in the proposed re-estimation methodology, such as coverage level of logbook.

The report of 3rd Indonesian tuna fisheries data workshop

1. The 3rd Workshop of Indonesian Tuna Fisheries Catch Data was held from Monday to Wednesday, July 11 - 13, 2022 at Directorate General of Capture Fisheries - Jakarta and on Thursdays to Saturday, July 14-16, 2022 in the Meeting Room of the Tuna Fisheries Research Center - Bali. The meeting was a follow-up to the recommendations of the 17th Working Party Data Collection and Statistics (WPDCS17) meeting, namely Indonesia undertook work – in collaboration with the IOTC Secretariat – to reassess their official catches (for the period 2010-2016) to ensure consistency and coherence in the longer-term catch series available for management and stock assessment purposes.
2. Recommendations from the workshop as follow:

   <u>FAO and IOTC Secretariat</u>

   1) That the reasons for high fluctuations in Indonesia's official catches for selected species/gears highlighted by FAO and IOTC in years *post* OneData, including for tuna and tuna-like species as well as non-tuna species, are further analysed and discussed intersessionally.
   2) Similarly, that major changes in Indonesia's official data (1-RC- and NS-1) pre- and post-One Data are further analysed in order to better understand the reason for the abrupt changes in the species and gear composition reported to FAO and IOTC.
   3) That FAO and IOTC continue to estimate or adjust the official catches (2010-2021+) of Indonesia for selected gears and species (IOTC) and /or species/ISSCAP groups (FAO), in order to moderate the impact of unexplained fluctuations in the catches - particularly since 2017 - subject to the findings of the additional verification and clarification requested of Indonesian scientists by FAO and IOTC.
   4) Given the uncertainty of catches in 2017, due to the transition of One Data, FAO, the IOTC Secretariat and Indonesia agree that official catches for 2017 should not be used and instead estimated until further notice.

   <u>IOTC Secretariat</u>

   5) That Indonesia categorises all relevant fishery information according to the criteria that define the limits of applicability of most IOTC resolutions, i.e., vessels LoA and area of operation.

6) That Indonesia re-assigns all information currently collected / reported for the LLTU fishery code to either LLFR (fresh tuna longliners) or LL (deep-freezing longliners), considering that LLCO is a fishery code that shall be used only for vessels of LoA <24m exclusively fishing in the EEZ;
7) That in the ad-interim period, 85 GT and 78 GT be considered as the equivalent (from a tonnage point of view) of 24m LoA for longline and purse seine vessels, respectively;
8) That Indonesia re-assigns all information currently collected and reported for the PS and PSSS fishery in agreement to points 5) and 7).

Re-estimation of tuna and tuna-like species

9) Considering the importance of logbook data have in the proposed re-estimation procedure of IDN catches for 2010-2021+:
   a. That further clarification is made on the levels of logbook coverage data for vessels of less than 5 GT by gear type (e.g., number of trips/vessels covered by logbooks; total number of fishing trips or vessels);
   b. That the coverage (or the absolute number of data points available) is expressed not only in relative, but also in absolute form (e.g., number of vessels, or trips covered by logbooks);
   c. That coverage is also calculated as the fraction of trips for which logbook data are available;
   d. That the logbook data for 2019-2020-2021 used by the new re-estimation procedure better reflect the nature of the fisheries considered (in particular, the high proportion of vessels of <5 GT that is currently missing);
   e. That in the intersessional period the IOTC Secretariat continues to provide advice and technical assistance to Indonesian scientists as necessary regarding the development and appraisal of options/scenarios of the new re-estimation procedure and how these are presented to the WPDCS;
   f. That any re-estimation produced by Indonesia for catches by species and gears in the period 2010-2021+ is documented and also assessed in the context of all Indian Ocean fisheries, to better understand the changes introduced to the global time series of sensitive species;
10) That a follow-up IOTC Data Compliance and Support mission is organised in advance of the 2022 WPDCS meeting (29 Nov - 3 Dec) to continue discussions on the re-estimation methodology and address any other related issues that remain outstanding.

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11) That before submitting data to FAO and IOTC according to the respective deadlines, workshops are organized with both institutions to improve the level of reporting and resolve any outstanding issues that might be encountered; [Timeline: before next reporting cycle (2023)].
12) That capacity delivery activities continue being implemented in Indonesia, on topics of relevance to this forum and with support from FAO, IOTC, and any other concerned stakeholder (OFCF and similar agencies) [Timeline: N/A].

The report of the 17th Session of Working Party on Data Collection and Statistics (WPDCS17)

1. The 17th Session of Working Party on Data Collection and Statistics (WPDCS17) was held virtually from 29th November to 3rd December 2021.

2. Therefore **NOTING** the unusual variabilities in some of Indonesia's official catch statistics prior to the implementation of One Data in 2017, particularly in the case of neritic and tropical tuna species, the WPDCS **REQUESTED** that Indonesia undertake work – in collaboration with the IOTC Secretariat – to reassess their official catches (for the period 2010-2016) to ensure consistency and coherence in the longer-term catch series available for management and stock assessment purposes and **RECOMMENDED** that the Scientific Committee endorse this process.
3. The WPDCS therefore **RECOMMENDED** that work is undertaken to test an alternative, more flexible, matrix-based approach developed by FAO, to help refine the characterization of fisheries in IOTC at the national and regional level, and **NOTED** that a number of CPCs (including Indonesia, Kenya, Maldives, Pakistan and Sri Lanka) expressed their interest in participating in these studies.

3. The impact of data discrepancies on Indonesian tuna and tuna-like fisheries

The yellowfin tuna stock in IOTC was under pressure in the last five years, catch reduction was an inevitable solution for guiding it back into recovery. Nevertheless, if the new re-estimated data were to be used as the basis for catch reductions this would not reflect the real situation bearing in mind that the Indonesia waters is the largest ocean area among IOTC members, as reflected by Table 1.

Table 1. The number of fishers for each fleet category from 2019-2020 in the IOTC area of competence.

FLEET	NUMBER OF FISHERS	
	2019	2020
TOTAL	**682326**	**543575**
ARTISANAL (< 30 GT)	**644542**	**518129**
Pole and Line (PL)	7202	2618
Gill Net (GI)	228273	239718
Purse Seine (PSSS)	41964	19890
Hand line (HL)	82190	68971
Longline (LLCO)	8736	6305
Troll Line (TL)	17648	12685
Others (OTH)	258529	167942
INDUSTRIAL (> 30 GT)	**37784**	**25446**
Gill Net (GI)	78	992
Purse Seine (PS)	35403	10063
Hand line (HL)	27	212
Longline (LLTU)	400	3572
Troll Line (TL)	1	1
Others (OTH)	1875	10606

4. Indonesia's annual tuna catch estimation methodology

4.1. Catch estimation methodology prior 2017

Since 2010, Indonesia has been submitting the official annual tuna catch to the IOTC Secretariat through form 1RC. The 2010-2016 data was accepted as official data, and it was published by FAO. Therefore, the said report has been used for various purposes by public as well as other institutions. Based on the IOTC Secretariat's presentation in the 1st Indonesian tuna fisheries data workshop, there were some collaborating activities between the IOTC Secretariat, relevant institutions and Indonesia Government on the review of Indonesia data collection and reporting procedures have been conducted, as the following:

1. 2011: (1) Review of fisheries data collection systems for BOBLME countries, (2) CSIRO-led project on "Capacity development to monitor, analyse and report on Indonesian tuna fisheries" (ACIAR).
2. 2012: Pilot project to improve data collection from IO artisanal fisheries (IOTC), involving (1) Several data sources from 1950-1991 e.g., IPTP, IOTC, etc., (2) Catch data reports and sheets from ports and provinces from 2003-2011 e.g., DGCF, DINAS, etc., (3) Exclusion of unlikely gear-species combinations. The project output was time series of artisanal catches by gear and species 1950-2011, using fixed gear / species ratios for Artisanal (ART) fisheries.
3. 2013: Workshop on evaluating the procedure developed by the IOTC secretariat to estimate IDN albacore catches for 2002-2012 (methodology potentially applicable to other species). For this purpose, several datasets were considered, such as:
   - Different data sources: WCPFC, DGCF, ISSF, IOTC
   - Time series of artisanal catches derived from Revision II
   - Fishing craft data on the number of deep-freezing longliners (LL)
   - TWN LL fishery: proxy for the annual catch rate and composition of IDN LL

   The final outputs were as follows:
   - Time series of IDN deep-freezing longliners, 2002-2011
   - Time series of catches of LL fisheries by species/gear, 2002-2011
   - Time series of catches of FLL fisheries by species/gear, 2002-2011

Based on the paper prepared by IOTC Secretariat in the WPDCS10, there were some capacity building activities implemented by the IOTC and its partners during 2014, in particular Indonesia, as the following:

1. Review of data collection and management systems artisanal fisheries of West Sumatra, Indonesia
2. Data collection Workshop West Sumatra Indonesia
3. Review of data collection and management systems artisanal fisheries of Bali and East Java, Indonesia
4. Pilot sampling activities in the North and West Sumatra, Indonesia

Based on the paper prepared by IOTC Secretariat in the WPDCS11, there were some capacity building activities implemented by the IOTC and its partners during 2015 in Indonesia, as the following:

1. Indonesia pilot sampling monitoring activities (North and West Sumatra)

2. Technical assistance mission: reporting of catch-and-effort, size data and Regional Observer data (Jakarta)
3. Indonesia pilot sampling: project evaluation and catch estimation workshop (Jakarta)

Based on the paper prepared by IOTC Secretariat in the WPDCS12, there were some capacity building activities implemented by the IOTC and its partners during 2016 in Indonesia, as the following:

1. Continuation of support for the IOTC/OFCF/BOBLME pilot sampling of artisanal fisheries.
2. Data compliance mission to facilitate the reporting of catch-and-effort and size data from industrial longline fleet.

As the follow up of the coordination activities above, Indonesia has submitted revised annual catch data for the concern years to the IOTC Secretariat and been acknowledged receipt as a final of Indonesia official catch data.

The data collection prior 2017 (Figure 1) was conducted based on Yamamoto method as specified below:

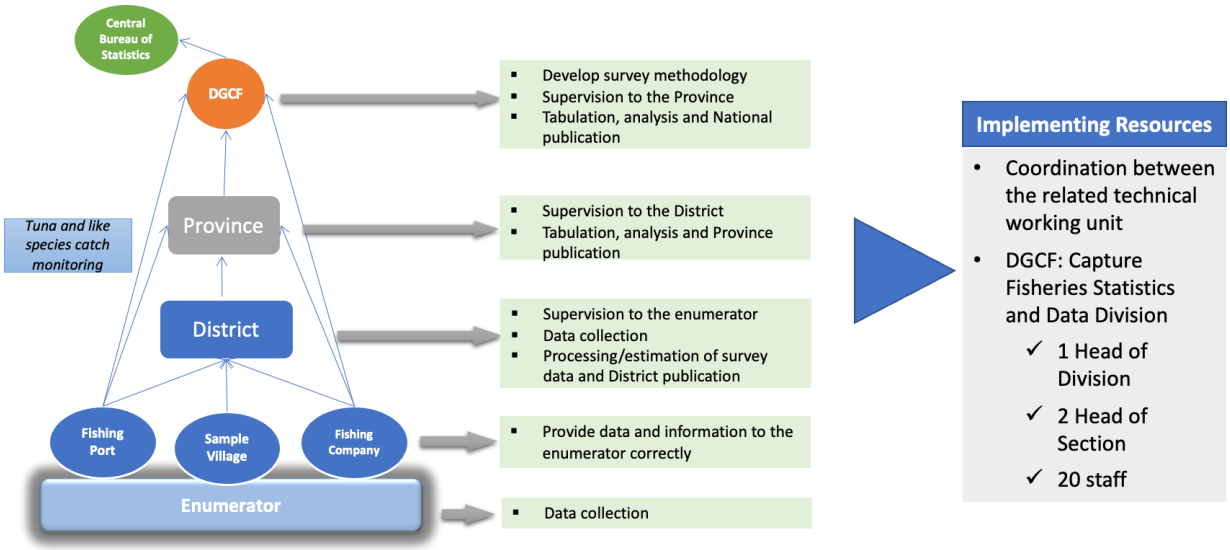


Figure 1. Fisheries statistical data collection flow chart prior 2017

Prior to submission, the official catch data of 2010-2016 (Figure 2) has been verified and scrutinized through validation scheme as described below:

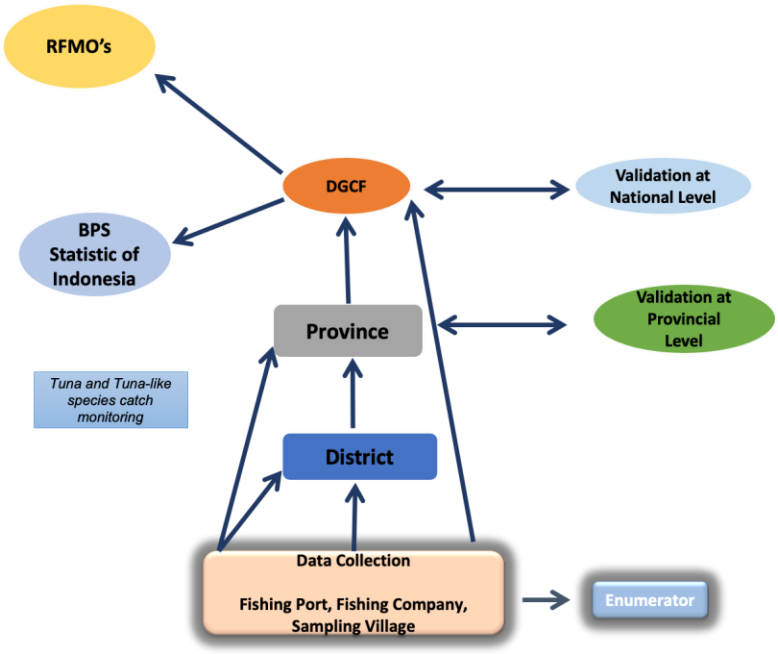


Figure 2. National catch data verification and validation flow chart prior 2017

4.2. Catch estimation methodology for 2017-2020

One Data is a National Program, aimed to provide an integrated data for a more cohesive national planning process. In the beginning of 2017, the MMAF implemented One Data of Marine and Fisheries for the very first time. By late of 2019, the Presidential Decree No. 39 about the National One Data was finally signed, and One Data became a nation-wide Program (Figure 3).

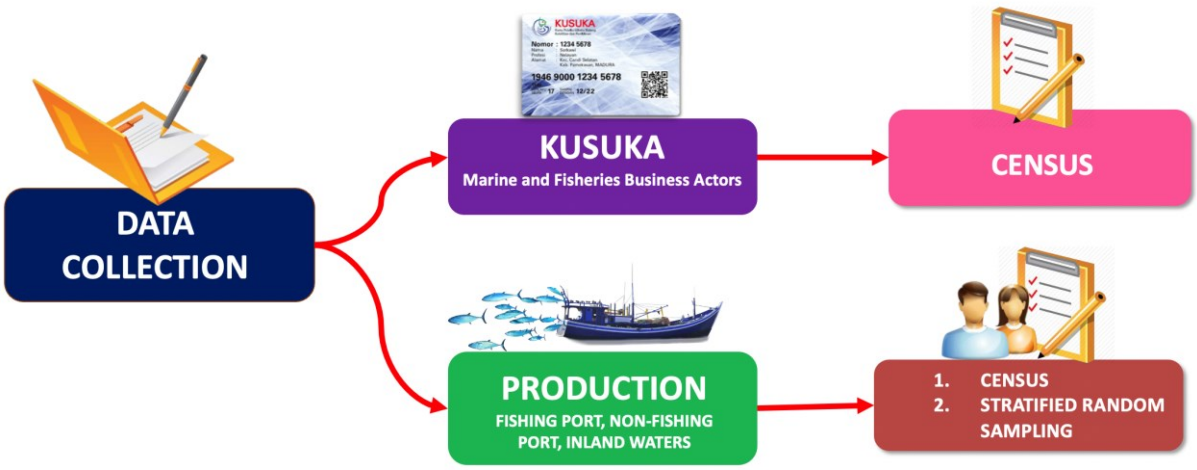


Figure 3. Type and method of data collection under the One Data program

The objective of KUSUKA data collection is collecting/updating data on marine and fishery business actors (fishermen, fish farmers, fish traders/marketers and fish processors and salt

farmers), including data on Fisheries households, facilities and types of activities of all marine and fisheries business actors according to their domicile by census.

Meanwhile, the objectives of production data collection are 1) Collecting production data at the fishing port; 2) Collecting sampling data on marine and inland capture fisheries production, aquaculture production, fish processing production and salt production; 3) As a basis for estimating district / city level to aggregate production figures.

The methodology of production data collection is described below:
1. Census for fishing port (daily)
2. Sampling, randomly selected from each population stratification in each district / city (monthly)
3. Recall where the respondent was interviewed regarding fishing activities carried out in the last month (t-1)

Respondents:
1. All vessels / units that land their catch at the fishing port
2. Fisheries household sample selected in the district / city (non-fishing port)

Data Collection Instruments:
Capture fisheries production questionnaire

Data Collection Periods:
1. Daily for fishing port
2. Monthly for non-fishing port capture fisheries production in marine and inland waters.

Aggregated Number Formulation

Sampling taken (According to the rules)	Aggregated number (A) (Representing districts)
$A = Nx\frac{p}{n}$ Where: A : Production calculation result (aggregated) N : Sum of gear population unit n : Sum of gear sampling unit p : Sum of sampling production	• The sample must derived from stratified population of gears • Sample taken from each gear

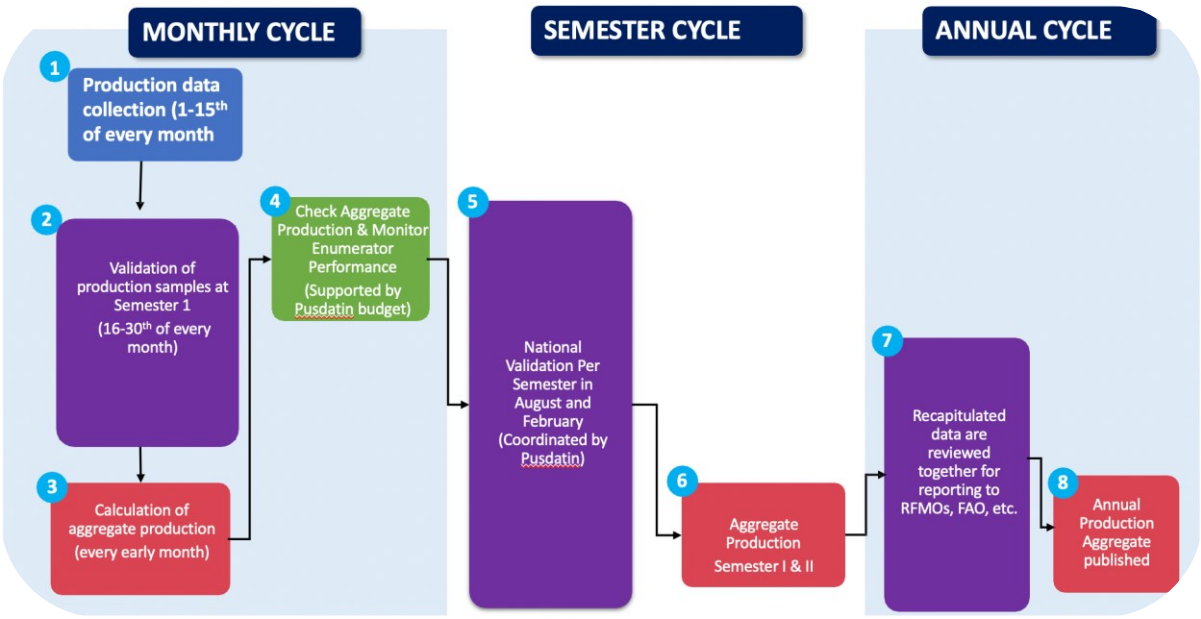


Figure 4. The process of annual statistical fisheries data publication by One Data

5. Proposed re-estimation methodology

On the previous document (IOTC-2021-WPDCS17-20) we discussed about using several sources of data (e.g., one data, port sampling, logbook and e-logbook, port landing, observer data, official arrival inspection data) to recreate the species composition for all gears and species during 2017-2019. However, although it acknowledged by the WPDCS members, further elaboration was needed on whether the methodology was sufficient enough. Therefore, we decided to modify our approach by instead of using only species composition as a basis, we did a modification on the current methodology used by IOTC Secretariat.

This approach was intended to create a more robust calculation based on the best scientific assumption and data available. Careful analysis was undertaken before included into the methodology, including the insertion of sensitivity analysis on the re-estimation models.

5.1. Data sources

5.1.1. Fisheries Logbook Data

There are several datasets used for this study. One of which was logbook information from 2019-2021. Logbook reporting was mandatory since the issuance of Marine Affairs and Fisheries Ministerial Regulation No.18/2010. In order to elevate the efficiency and optimization of data reporting, a logbook information system (SILOPI) was initiated in 2011. The number of vessels reporting logbook in national scale are increasing, from only 1,140 in 2012 to relatively stable number since 2019 between 5,852 vessels to almost 8,000 vessels in 2021 (Figure 5). The same trend also occurred in the IOTC area of competence, where the reporting rose from less than 500 into almost sixfold in 2021 (Figure 6). Thus, we consider logbook data was one of the best tools available as the base for recalculating the total catch, because it contained a large documentation of high-resolution fisheries data across gears and species. The data itself was well-maintained by the Directorate General of Capture Fisheries (DGCF), in particular since 2018, when e-logbook program was initiated.

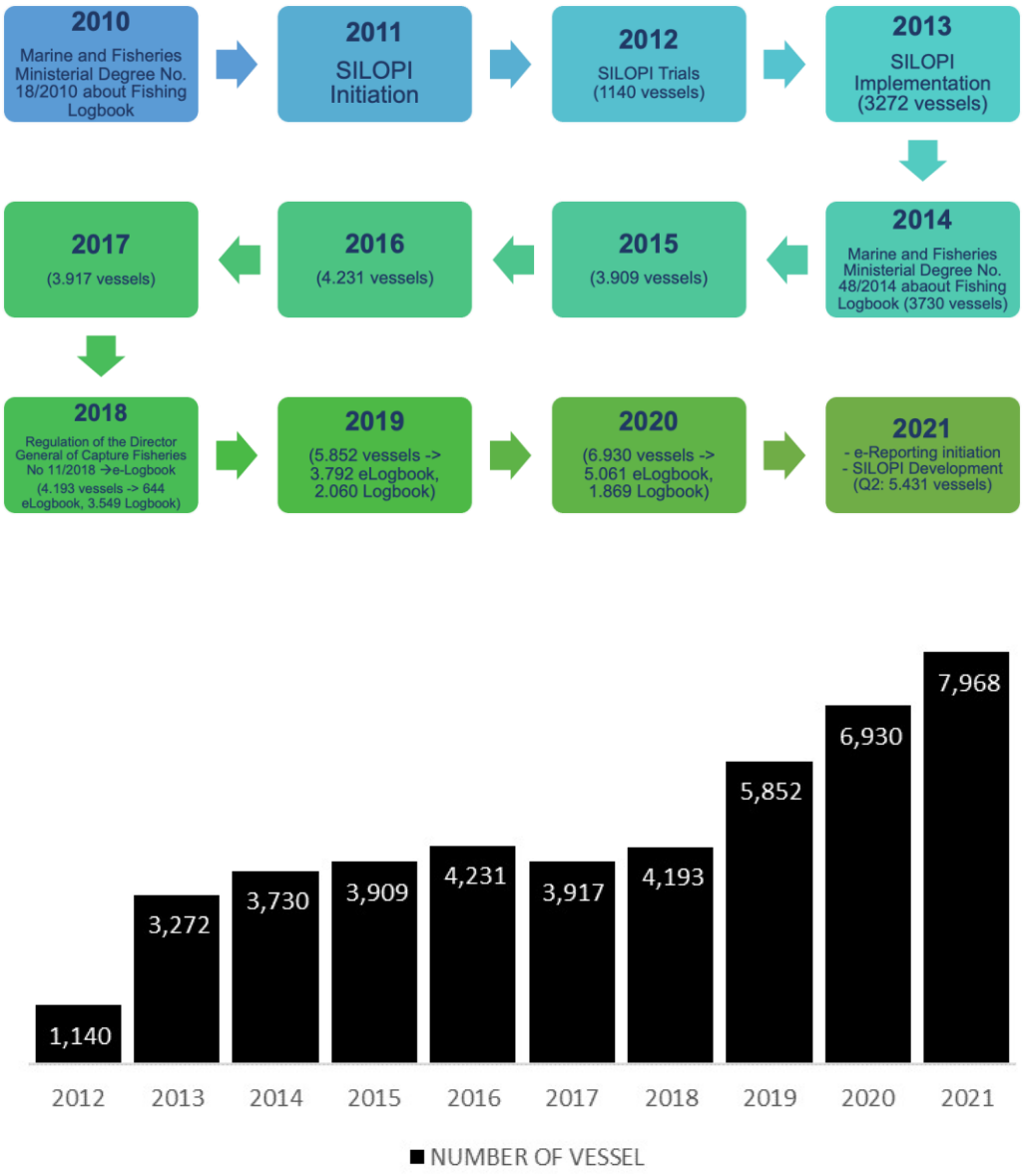


Figure 5. The development of mandatory logbook reporting at national scale.

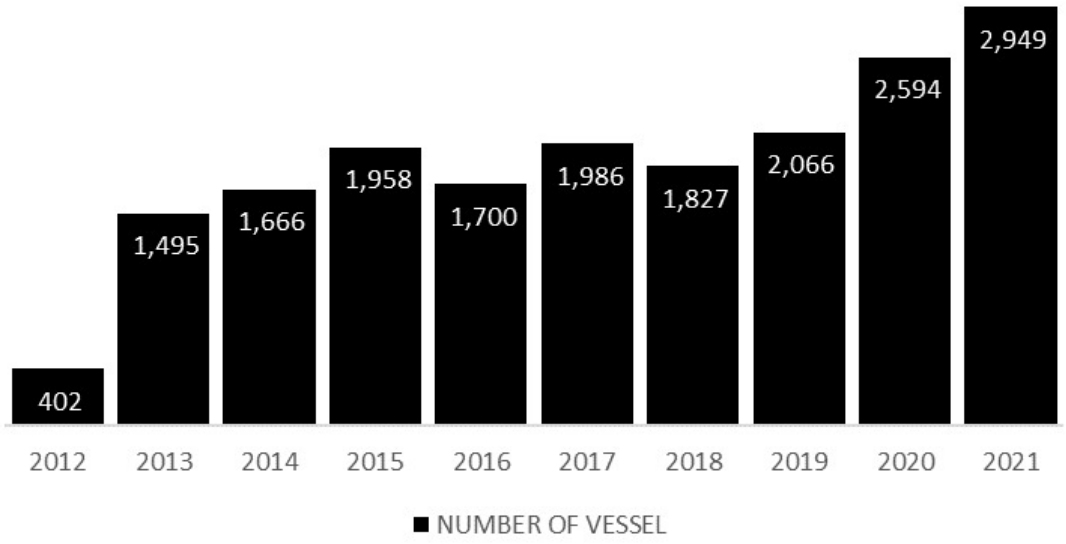


Figure 6. The development of mandatory logbook reporting within IOTC area of competence.

Prior to use the logbook data was the logbook data has been scrutinized by the port officers by consider following rules:

1. Conformity of fishing ground, gear and type of species landed
2. Suitability between total catch reported and landed
3. Compatibility between the catch reported related to the fishing capacity of each vessel
4. Confirmation of departure and landing port as mentioned in the license

To ensure a robust analysis, data cleaning and filtering were conducted prior to analysis. This was necessary, largely purposed to clear any potential inconsistencies and typos, which commonly found in logbook data (Sampson, 2011). In principle the process was commenced as follows:

1. Setting must be commenced between the departure and the arrival date
2. The number of day-at-sea should be the differential between the arrival and the departure date
3. Total sets per landing should be at least 50% of the total day-at-sea
4. Georeferenced points should not intersect with the land nor excess the boundaries from the area of interest

As a result, a total of 99,000 high resolution data were successfully generated, across six tuna-related gears, i.e., hand line, purse seine, longline, troll line, pole and line and lift net in the span of 2019-2021.

5.1.2. Port Landing (PIPP/Fishing Port Information Centre)

The fishing port information centre is an information system that includes the collection, management, analysis, storage, presentation, and dissemination of fishing port data and information. PIPP covers data and information of fishing port activities, daily, monthly, and annual operational data of fishing ports, which contain the frequency of vessel's arrival, fish production and prices, fishing gear, logistics, marketing, and labour in the form of daily data

that can be accumulated in the form of monthly, quarterly and even annually. The PIPP was built in 2000, but started well maintained by DGCF since 2015. Its website can be accessed on the https://pipp.djpt.kkp.go.id/.

Port Landing data was used to feed the sensitivity analysis, especially on the dynamic of species composition across gears and time. The only drawback was, due to different internet infrastructures, there were some inconsistencies (missing data) for one or two years. Thus, only ports which sent their data for at least 3 years will be used for analysis. Initially, there were nearly 1.5 million of daily landing records across 193 ports across Indonesia. However, after initial filtering and cleaning, only around 110,000 landing data that will be included since the area of interest only from western part of Sumatra to southern part of Java, Bali and Nusa Tenggara (Table 2).

Table 2. Number of trip data available for all gears across fishing ports in the western part of Sumatra and southern part of Java, Bali and Nusa Tenggara.

Ports	2015	2016	2017	2018	2019	2020	2021
PP. Bungus	151	102	95	304	971	1344	1600
PP. Cilacap	2731	1880	2476	2192	3805	1690	1706
PP. Kota Agung	743	2029	na	na	1084	1257	1203
PP. Labuhan Lombok	303	986	485	654	1590	1184	1194
PP. Lampulo	381	141	na	46	521	1347	288
PP. Nizam Zachman	769	897	446	783	560	1260	1773
PP. Oeba	636	167	249	499	532	1157	771
PP. Palabuhanratu	1816	1589	1045	669	1323	1089	1500
PP. Pancer	na	na	na	743	553	583	725
PP. Pengambengan	236	130	768	1686	610	1413	393
PP. Pondok Dadap	543	463	1641	2381	1502	1115	1764
PP. Prigi	2305	1777	2425	3191	2122	1887	2964
PP. Sadeng	414	593	48	581	501	711	562
PP. Sibolga	1259	1421	1555	1866	1840	1706	1650
PP. Tamperan	475	278	61	52	276	485	455
PP. Tenau Kupang	282	262	345	420	524	930	713
PU. Benoa	na	na	na	213	412	412	559
Total	13,044	12,715	11,639	16,280	18,726	19,570	19,820

Landing data also used for estimating the mean catch of industrial longline and purse seine (Figure 10). For that purpose, at least there were more than 30,000 industrial purse seine landing data across five main ports in western and southern part of Indonesia were utilized (Table 3). In addition, as much as 7,700 daily industrial longline data were analysed in the span of 2015 to 2021 (Table 4).

Table 3. Number of trip data available for industrial longline.

Ports	2015	2016	2017	2018	2019	2020	2021
PP. Nizam Zachman	746	638	312	831	265	320	736
PP. Palabuhanratu	55	21	52	62	113	14	109
PP. Bungus	na	6	6	na	na	na	na
PP. Cilacap	na	35	25	4	31	10	34
PU. Benoa	na	na	na	432	783	940	1134
Total	801	700	395	1329	1192	1284	2013

Table 4. Number of trip data available for industrial purse seine.

Ports	2015	2016	2017	2018	2019	2020	2021
PP. Bungus	25	3	18	61	31	11	4
PP. Lampulo	27	0	0	0	0	44	26
PP. Nizam Zachman	2942	3148	1685	2224	1505	3076	3601
PP. Palabuhanratu	8	0	0	22	0	0	5
PP. Sibolga	623	1800	1889	2518	1530	1415	1518
PP. Cilacap	0	21	9	0	19	42	32
PU. Benoa	0	0	0	30	55	110	230
Total	3625	4972	3601	4855	3140	4698	5416

5.2. Re-estimation methodology

5.2.1. Re-definition of artisanal and industrial fisheries

Indonesia defined the term artisanal and industrial fisheries by how their fishing license categorized. Artisanal fleets are justified as vessels under or equal with 30 GT which the license is issued by local government, whereas industrial fleet refers to those above 30 GT and under management of central government. Both terms became the basis for determining the separation between artisanal (LLCO) and industrial (LLTU) longline as well as artisanal (PSSS) and industrial (PS) purse seine fleets according to types of fisheries for IOTC species (IOTC Secretariat, 2014) as mentioned in Appendix 1. However, the coding became blurry when cross-checked with classification and dimensions of fisheries (IOTC Secretariat, 2014) as mentioned in Appendix 2. It is due to the present of “semi-industrial” term which defined as motorised inboard, fishing within and/or outside EEZ and less than 24 m. Such terminology could not be found or did not match with the type of operation column in the Appendix 1. For example, PSSS was defined as small purse seine but its type of operation belongs to semi-industrial fleet, whereas no artisanal purse seine definition in the table. Hence Indonesia **ENCOURAGE** the simplification and clarity of vessel type categorization used by IOTC Secretariat.

5.2.2. Current methodology

IOTC Secretariat has been conducting a re-estimation on CPC’s (Cooperating Party and Contracting) national catch for various reasons, including Indonesia. This data labelled as “best scientific estimate” which ranged from 1950-2020. The catch estimation from 1950-2011 was resulted from a series of workshop from 2011-2013, in collaboration with various institution. On the other hand, the re-estimation process for 2012-2018 datasets was conducted on 2018 using fixed gear/species ratios for artisanal fisheries and fixed species composition for fresh tuna longline.

As shown in **Figure 7**, the re-estimation process involved both artisanal and industrial fleets. Fixed proportion of total catch for each species and gear was used determined the total catch from artisanal fisheries. Since Indonesia reported all purse seine catch under PSSS prior to 2017, therefore no industrial purse seine (PS) mentioned in the datasets. For longline fisheries, although it reported under LLTU (industrial longline) and LLCO (artisanal longline) since 2012, but the IOTC Secretariat decided to recalculate the catch for LLTU based on assumption of annual productivity for fresh tuna longline was 30 ton/year. The coefficient then multiplied by the total active vessel list before broke down into species composition based on landing data in Benoa Port (Geehan, 2018). No estimation was made for either PS and LLTU for 2019 onward.

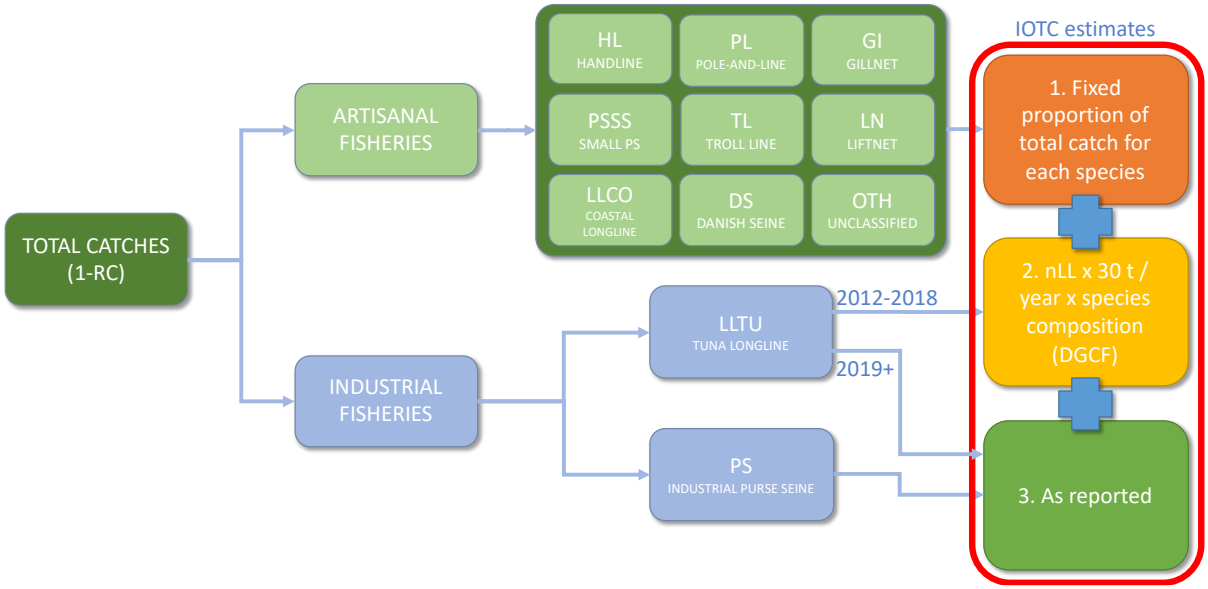


Figure 7. Current re-estimation procedures conducted by the IOTC secretariat (Source: Presentation of IOTC Secretariat during 1st Workshop Data 2021)

Fixed proportion of total catch for each species by gear was derived from study by Moreno & Herrera (2013). They assumed that the catch composition across artisanal gears was similar, thus they came up with a single table as presented in Table 5. On the other hand, the gear allocation was derived by the percentage of gear composition by each species (pers. comm.). The actual figure is unknown since it is not included on any IOTC field reports.

Table 5. Fixed catch composition by species used for re-estimation purposes in 2012-2018.

Species	Percentage	Species	Percentage	Species	Percentage
ALB	1.82%	FRI	17.85%	SFA	0.31%
BET	4.93%	GUT	3.93%	SKJ	24.03%
BLM	0.50%	KAW	12.50%	SPN	0.46%
BLT	0.69%	LOT	7.36%	SWO	0.27%
BSH	4.64%	MAK	0.24%	THR	1.26%
BUM	0.08%	MLS	0.12%	UNCL	0.38%
COM	12.67%	POR	0.01%	YFT	5.95%

The current catch composition raised some concern, especially on whether it truly reflect the actual fisheries. It wasn't clear on how the proportion was created since not many reliable data available at the time of the study commenced and also how the sampling was conducted. For example, the ratio of yellowfin tuna was quite small (5.95%), even smaller than longtail tuna (7.36%) and narrow-barred Spanish mackerel with staggering 12.67%. The latest two species are not very abundant in western and southern part of Indonesia. Also, imbalance proportion between bullet tuna (0.69%) and frigate tuna, which almost 20 times higher seemed unrealistic. It probably a result of pooling all of the species composition regardless the gear used. Hence, gear specific species composition should be addressed in the new methodology in order to minimize the bias.

5.2.3. New proposed re-estimation methodology

Considering the pros and cons of the current methodology, we proposed a several modifications in the wake of reducing bias and uncertainty in order to provide a better representation of the Indonesian fisheries (artisanal and industrial) in the period of 2010-2020. The steps were relatively similar, which total catch were breaking down into three categories, namely artisanal, industrial and catch of southern bluefin tuna (SBF). For artisanal fisheries, the catch separated based on dynamic annual gear allocation based on form 1-RC. All the individual catches, including industrial fisheries then projected against species composition by gear based on port landing (PIPP) 2015-2021 and logbook data 2019-2021 (Figure 8).

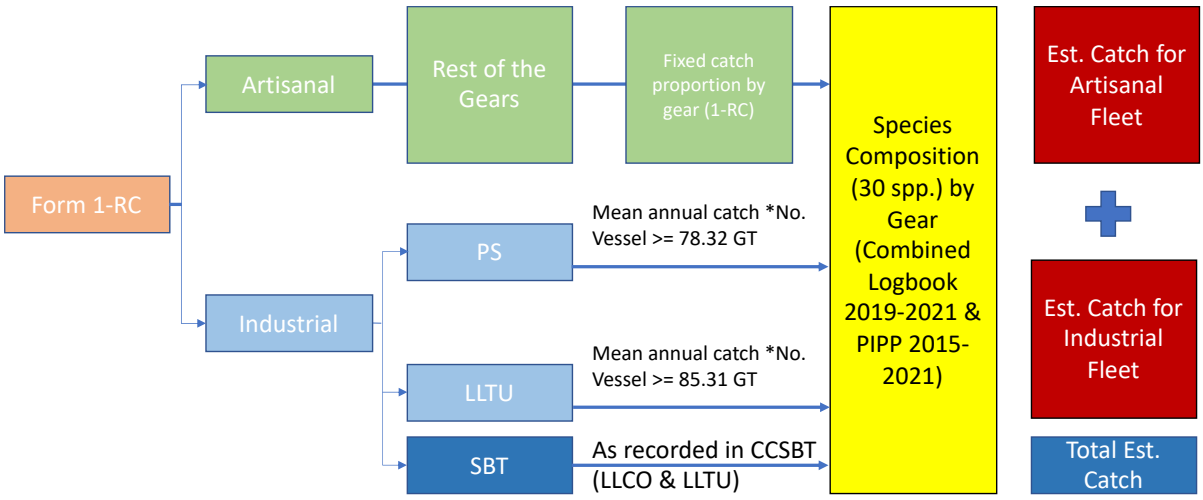


Figure 8. The new proposed re-estimation methodology flow chart

5.2.3.1. Definition of the fisheries

1. Artisanal fisheries

Most of the Indonesian fishers are categorized as small-scale and scattered into various landing ports. Since the characteristic of each fishing gear is different, so it resulted in a various species composition. Using a single proxy for the entire artisanal fleets is absolutely not ideal, therefore we proposed an individual species composition for each artisanal gear. The species composition was generated from the logbook data 2019-2021. We also expand the number of species covered up to 31 species based on the submitted Form 1-RC from 2010-2021.

2. Industrial fisheries

As previously mentioned in sub-chapter 5.2.1, industrial fisheries are categorized as above 24 meter in length and operated in both EEZ and high seas. Since previous category submitted by Indonesia based 30 GT as threshold, therefore, there is a need for recalculating the existing industrial catch based on the IOTC definition. We used the non-linear relationship between LoA and GT for each gear (LLTU and PS) based on the IOTC vessel datasets from 2010-2021 to create the segregation (Figure 9). The conversion factor for industrial purse seiners was 24 m ≅ 78.32 GT, while for industrial longliners 24 m was equal as approximately 85.31 GT.

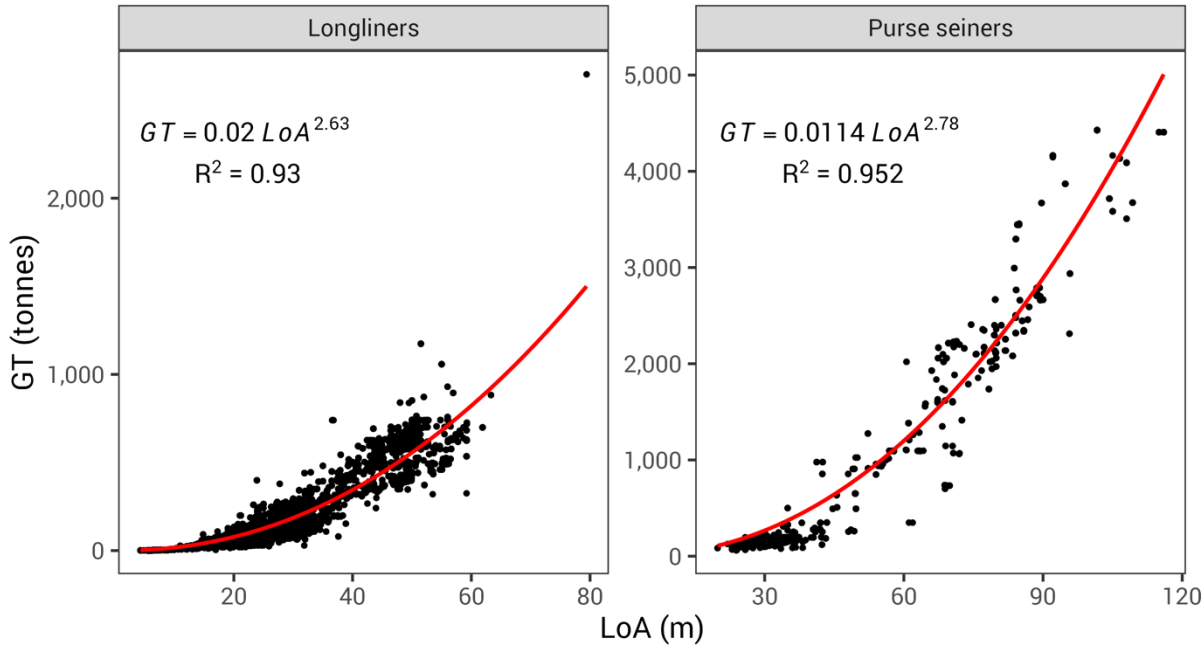


Figure 9. The non-linear relationship of LoA (m) and GT (tonnes) from industrial purse seine and longline fleets.

Once the conversion factor was determined, we need to calculate the mean annual catch for each gear. For that particular purpose, we plotted the PIPP data (landing data) from each vessel and calculated the mean values. The result showed that the mean annual catch for LLTU and PS were 56.49 tonnes and 89.83 tonnes, respectively (Figure 10).

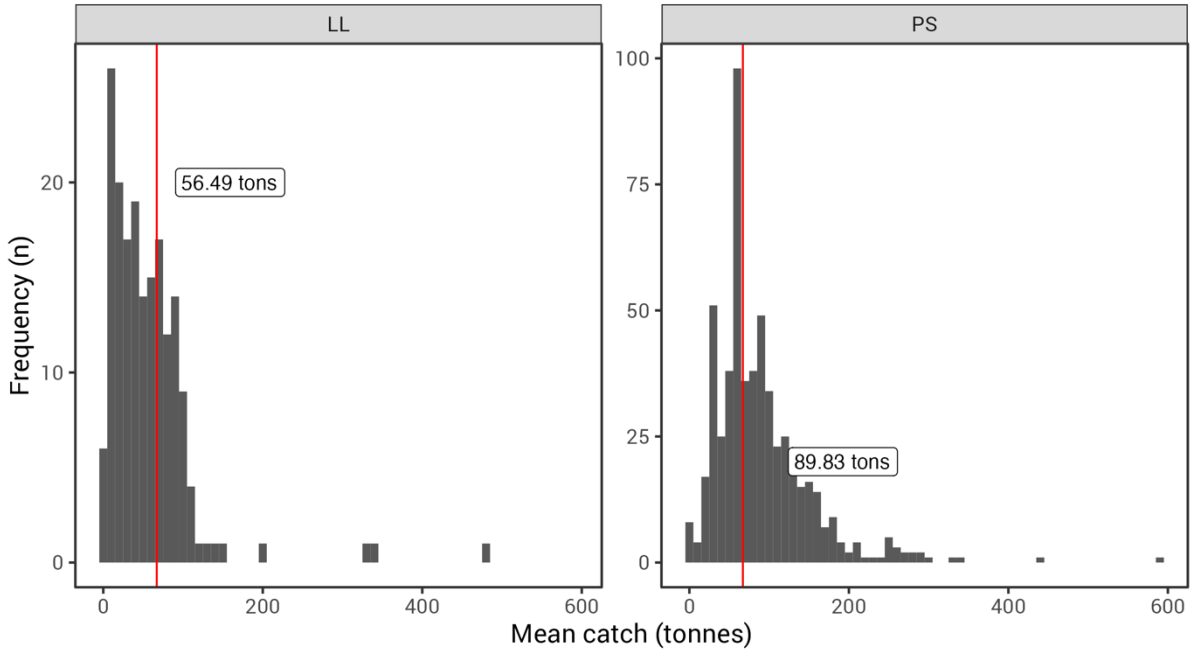


Figure 10. Mean annual catch for industrial gears (LLTU and PS) based on PIPP datasets

The proportion of industrial fleets against total catch was calculated using the following assumption:

$C_y = \bar{x_i} * n_i$ ..... 1)

Where:

C_y : Estimated catch for industrial fleets (LLTU and PS)

$\bar{x_i}$: Mean annual catch, derived from PIPP dataset

n_i : Number of active vessel list, derived from the Indonesian official vessel registry

Thus, the catch estimation of each industrial fleets (LLTU and PS) then excluded from the total catch (Table 6).

Table 6. Catch reference used for proposed re-estimation methodology

Year	Total Catch	PS	LLTU	SBF	Artisanal Catch
2010	367,162	26,590	23,104	580	316,888
2011	385,830	31,351	18,868	769	334,843
2012	399,236	40,513	14,687	817	343,219
2013	446,865	40,513	14,687	722	390,942
2014	378,185	44,735	11,016	1,187	321,247
2015	375,477	35,842	7,005	593	332,037
2016	347,844	46,173	7,965	601	293,106
2017	428,322	47,340	8,756	835	371,390
2018	337,385	40,873	5,931	1,087	289,494
2019	409,856	45,274	6,779	1,206	356,597
2020	474,916	56,773	8,812	1,298	408,033

3. Southern bluefin tuna fishery

Since the catch of southern bluefin tuna (SBT) is already reported to the CCSBT, thus it excluded from the artisanal or industrial catch composition and labelled as individual proxy. In addition, all SBT catch were proportionally separated into LLCO and LLTU category.

5.2.3.2. Gear allocation

Gear allocation for artisanal fisheries are refers to Form 1-RC and applied for each year[1]. This approach was chosen because (i) they account for both fishing and non-fishing ports, (ii) align with the data provided to the IOTC over 2010-2021, (iii) inline with all the work of consolidated performance, including the OneData initiative and (iv) it also has showed a better consistency with the previous works. Instead of using a fixed gear allocation every year, we used a dynamic proportion in order to grab any development on catch for each gear annually (Table 7).

5.2.3.3. Species Composition

Logbook data contains high resolution datasets. However, it lacks coverage, especially on artisanal gears. On the other hand, landing data has a better coverage but lacks detail on species composition (there possibly some species missing due to own consumption or not for sale). Therefore, the species composition for lift net (LN), gillnet (GI), pole and line (PL), danish seine (DS) and others (OTH) were derived from landing data, whereas the rest were compiled

[1] The missing PSSS catch in 2017 was replaced by its mean value.

from logbook data 2019-2021, including species composition for industrial longline (LLTU) and industrial purse seine (PS) (Table 8).

Table 7. Proposed gear allocation for artisanal fisheries

Gear Code	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
DS	0.08	0.04	0.14	0.10	0.09	0.13	0.03	0.07	0.05	0.06	0.06
GI	0.19	0.21	0.17	0.12	0.12	0.19	0.25	0.15	0.23	0.24	0.12
HL	0.04	0.02	0.06	0.09	0.09	0.09	0.14	0.14	0.15	0.21	0.20
LLCO	0.08	0.09	0.10	0.07	0.07	0.05	0.07	0.05	0.09	0.03	0.03
LN	0.02	0.02	0.03	0.03	0.03	0.05	0.05	0.07	0.12	0.08	0.06
OTH	0.21	0.14	0.10	0.10	0.11	0.15	0.13	0.21	0.06	0.08	0.12
PL	0.02	0.01	0.04	0.05	0.05	0.03	0.01	0.04	0.02	0.01	0.01
PSSS	0.26	0.31	0.25	0.32	0.32	0.22	0.26	0.26	0.18	0.20	0.34
TL	0.11	0.16	0.12	0.12	0.12	0.08	0.08	0.01	0.10	0.11	0.07

Table 8. Proposed species composition by gear for artisanal and industrial fisheries

Gear code	FRI	ALB	BET	BIP	BLM	BLT	BSH	BTH	BUM	BXQ	CCB	COM	DOL	DOT	FAL	GES	GUT	KAW	LAG	LEC	LOT	MLS	SBF	SFA	SKJ	SMA	SPL	SWO	TIG	WAH	YFT
DS	0.02	0.00	0.00	0.02	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.12	0.27	0.00	0.04	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00
GI	0.01	0.02	0.24	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.48	0.00	0.00	0.03	0.00	0.00	0.07
HL	0.00	0.04	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.49
LLCO	0.00	0.24	0.18	0.00	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.03	0.00	0.00	0.27	0.01	0.09	0.00	0.00	0.09	0.00	0.00	0.24
LLTU	0.00	0.29	0.08	0.00	0.01	0.00	0.04	0.00	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.00	0.00	0.73	0.01	0.01	0.00	0.00	0.10	0.00	0.00	0.32
LN	0.36	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.01	0.00	0.21	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.01
OTH	0.04	0.00	0.12	0.01	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.01	0.00	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.11
PL	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.23
PS	0.01	0.00	0.04	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.06
PSSS	0.07	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.05
TL	0.01	0.05	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.25

5.3. Sensitivity analysis

5.3.1. Gear allocation

During the IOTC data compliance mission workshop held in Jakarta on 1-3 November 2022, a collaborative effort to analyse the existing Indonesian fisheries data (i.e., 1-RC, landing data) resulted in several recommendations. In general, the catch contribution of each gear from Form 1-RC to the total artisanal catch showed a better consistency with previous work/IOTC estimates, except for artisanal longline (LLCO) and others (OTH) (Figure 11), whereas the landing data (PIPP) data didn't show the same consistency (Figure 12). Because it excludes most small fishing gears for which the catches are not landed in fishing ports, which strongly downweighing the importance of these gears. Therefore, we chose the gear allocation for artisanal fleets from the Form 1-RC.

5.3.2. Species composition

During 3rd Indonesian tuna fisheries data workshop held in Bali, 14-16 July 2022. The representatives from IOTC Secretariat and FAO suggested to consider sensitivity analysis for catch composition used. The rationale for this purpose was to investigate the dynamic of catch composition over time (2010-2020) for each gear used. It is due to the short span logbook dataset used (2019-2021) to estimate a longer time series of data (2010-2020). If there are no significant changes in catch composition over time, then it is assumed that the current logbook data is suitable for re-estimation purpose. Hence, we utilized the PIPP data from 2015-2021 which covered 17 ports across western part of Sumatra, and southern part of Java, Bali and Nusa Tenggara as explained in sub-chapter 5.1.2. Apart from several small noises on non-target species composition, especially on artisanal gears, the species composition for main tuna species among gears was relatively consistent for the last seven years. Indicated there were no radical changes in the fishery, nor shifting in fishing practices (Figure 13).

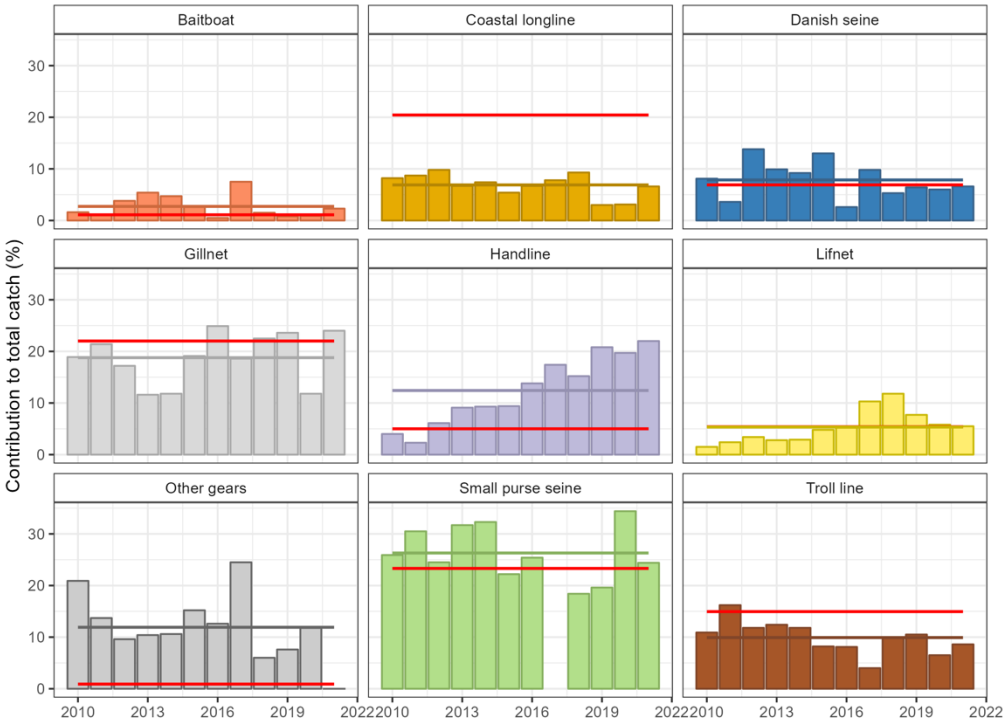


Figure 11. The annual contribution of each gear derived from the 1RC data to the total artisanal catch (remark: color-specific line is mean value from 1RC data, red line is mean value from IOTC estimate)

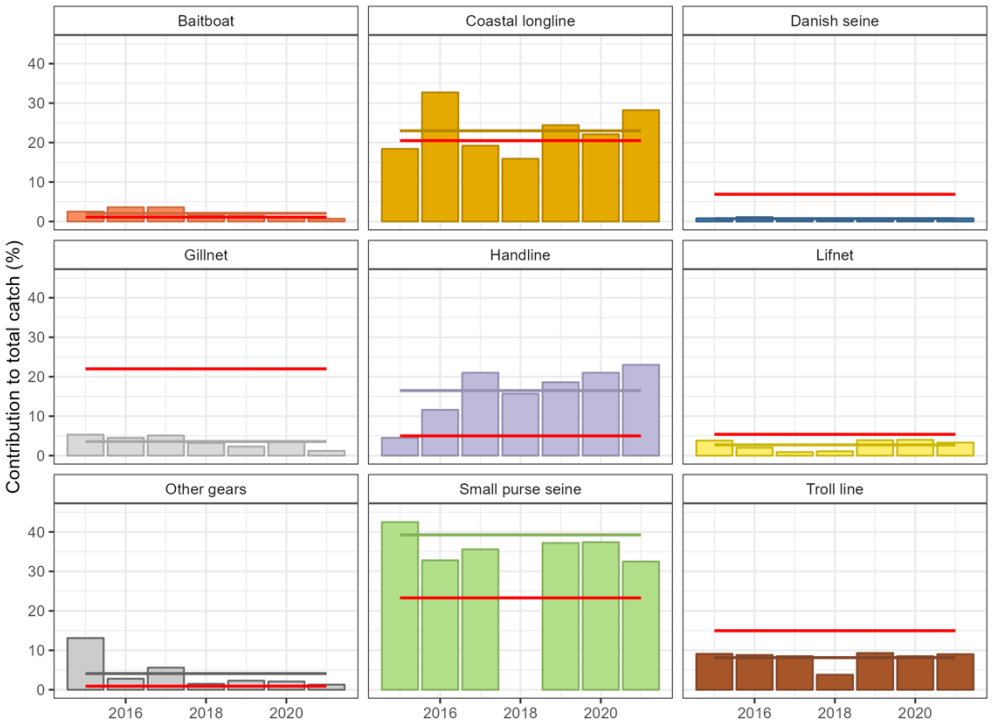


Figure 12. The annual contribution of each gear derived from the PIPP data to the total artisanal catch (remark: color-specific line is mean value from PIPP data, red line is mean value from IOTC estimate)

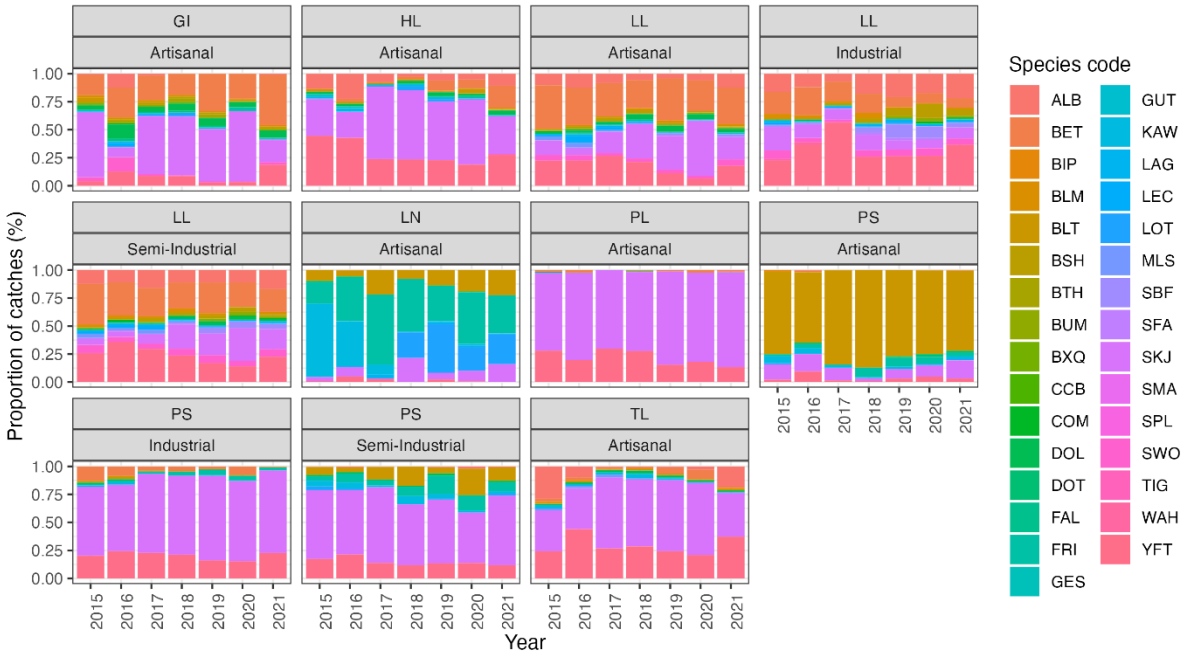
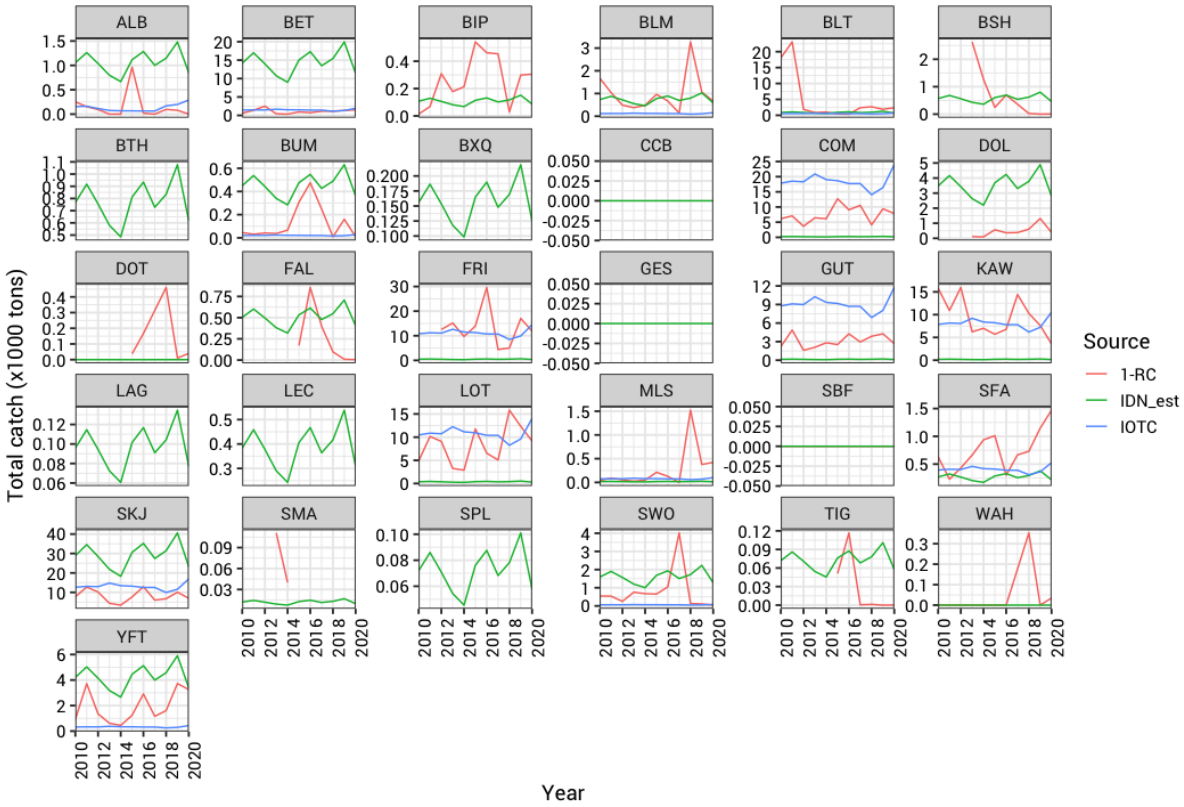


Figure 13. Sensitivity analysis for species composition across gear and species

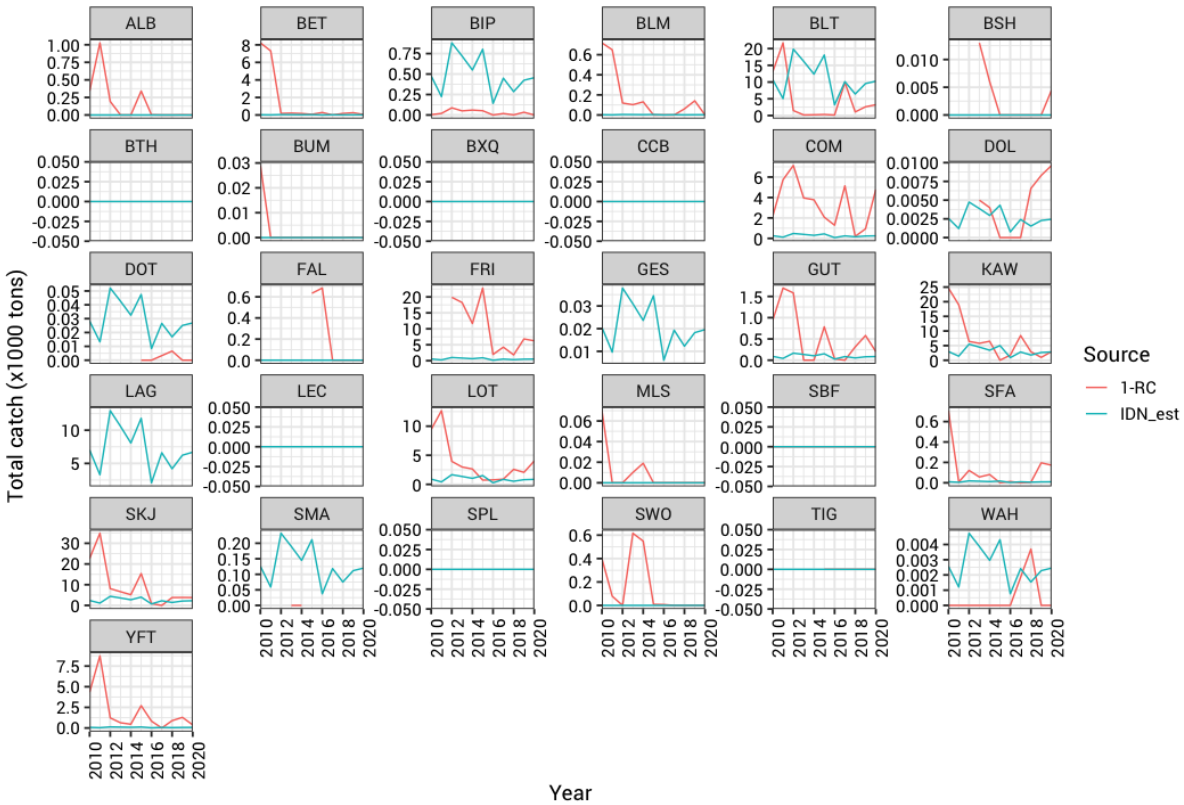
6. Result

The result showed that the new proposed re-estimation methodology is quite robust to be implemented to the Indonesian datasets. Because it managed to stabilize the annual catch series from 2010-2020 and reduce the uncertainty regarding the inter-annual species-specific catch. It also covers wider range of species (31) compared to the existing IOTC estimates (17) as reflected in subsection 6.1. to 6.10.

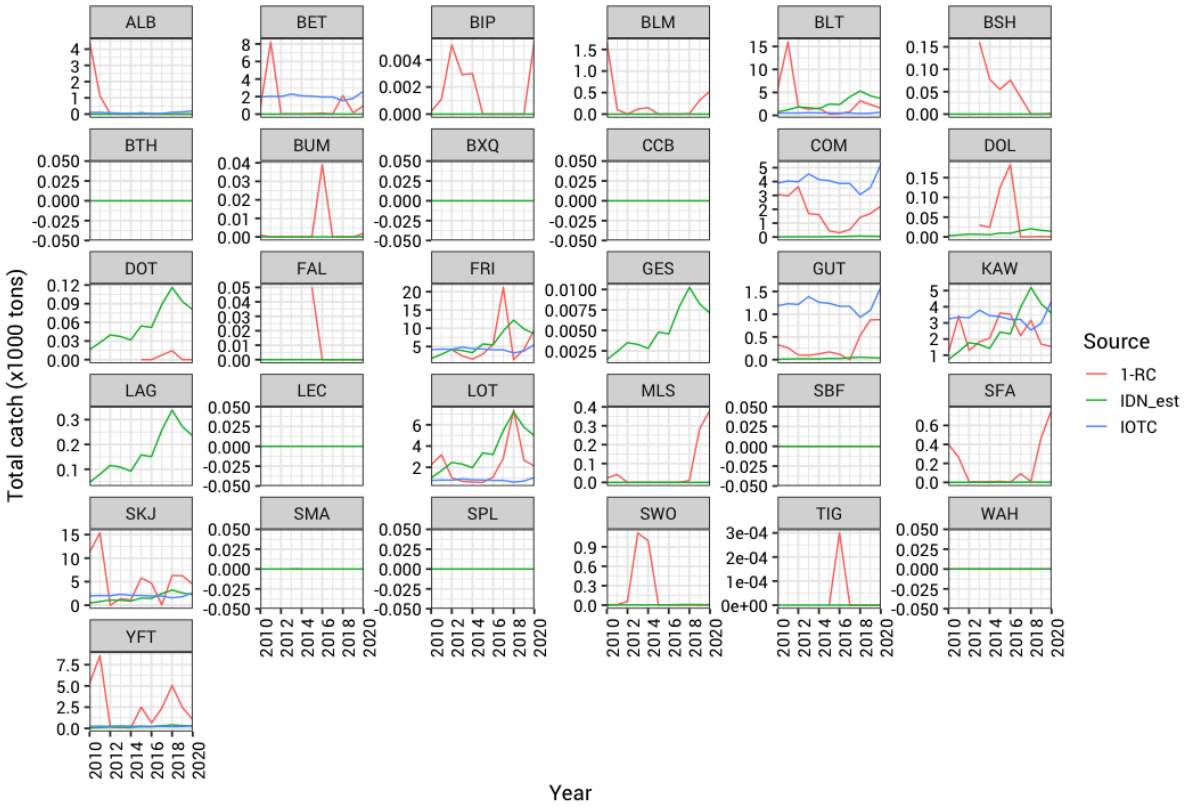
6.1. Gillnet (GI)



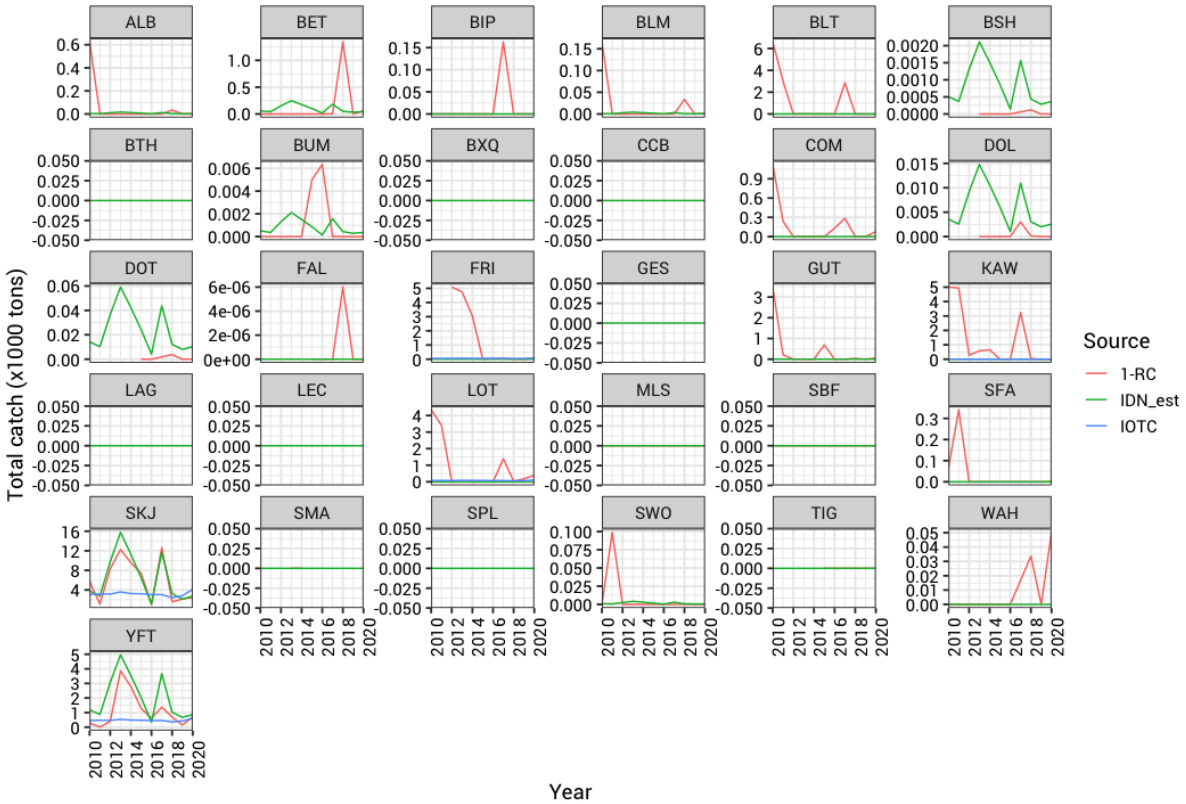
6.2. Danish Seine (DS)



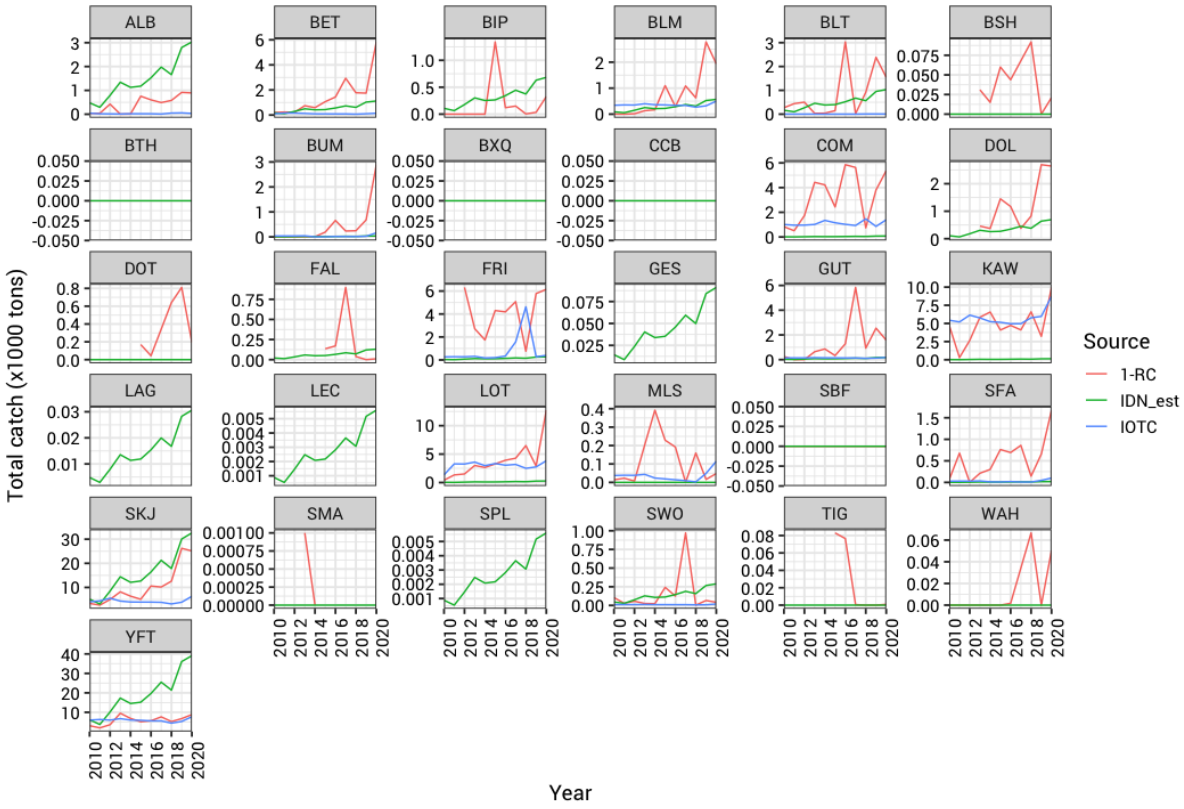
6.3. Liftnet (LN)



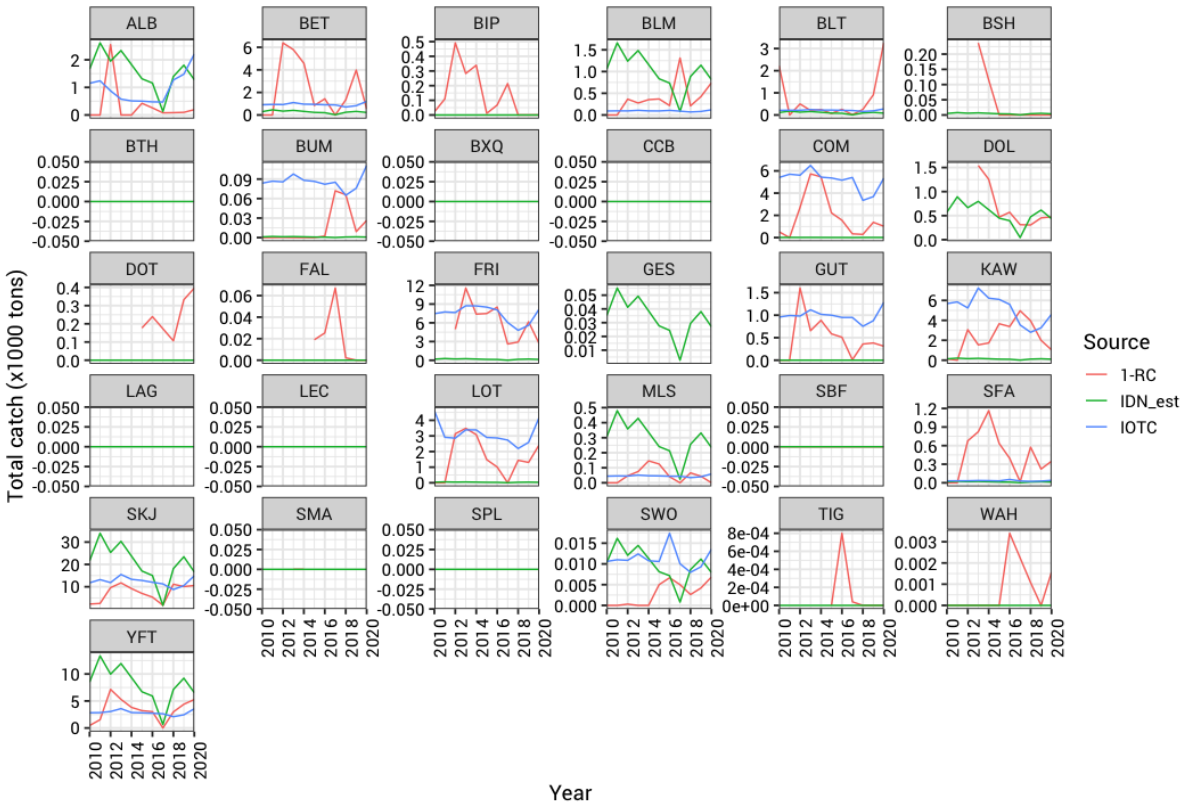
6.4. Pole and Line (PL)



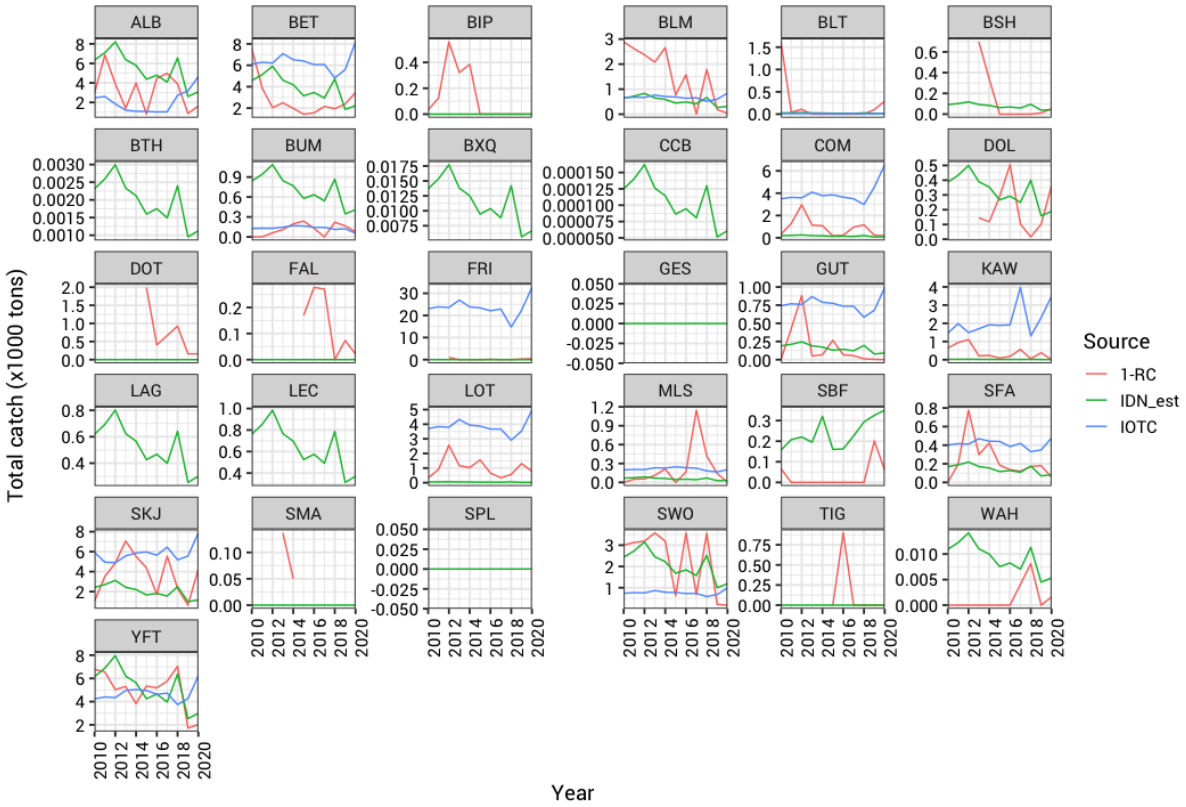
6.5. Hand Line (HL)



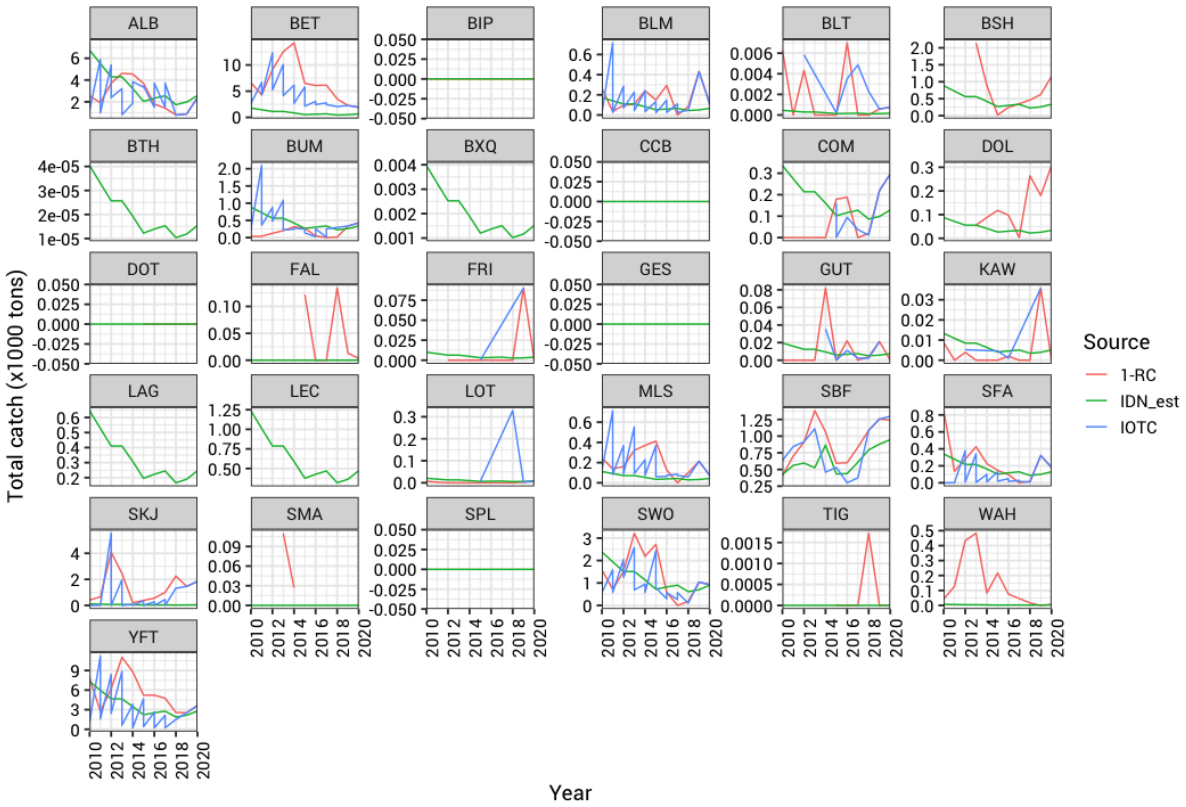
6.6. Troll Line (TL)



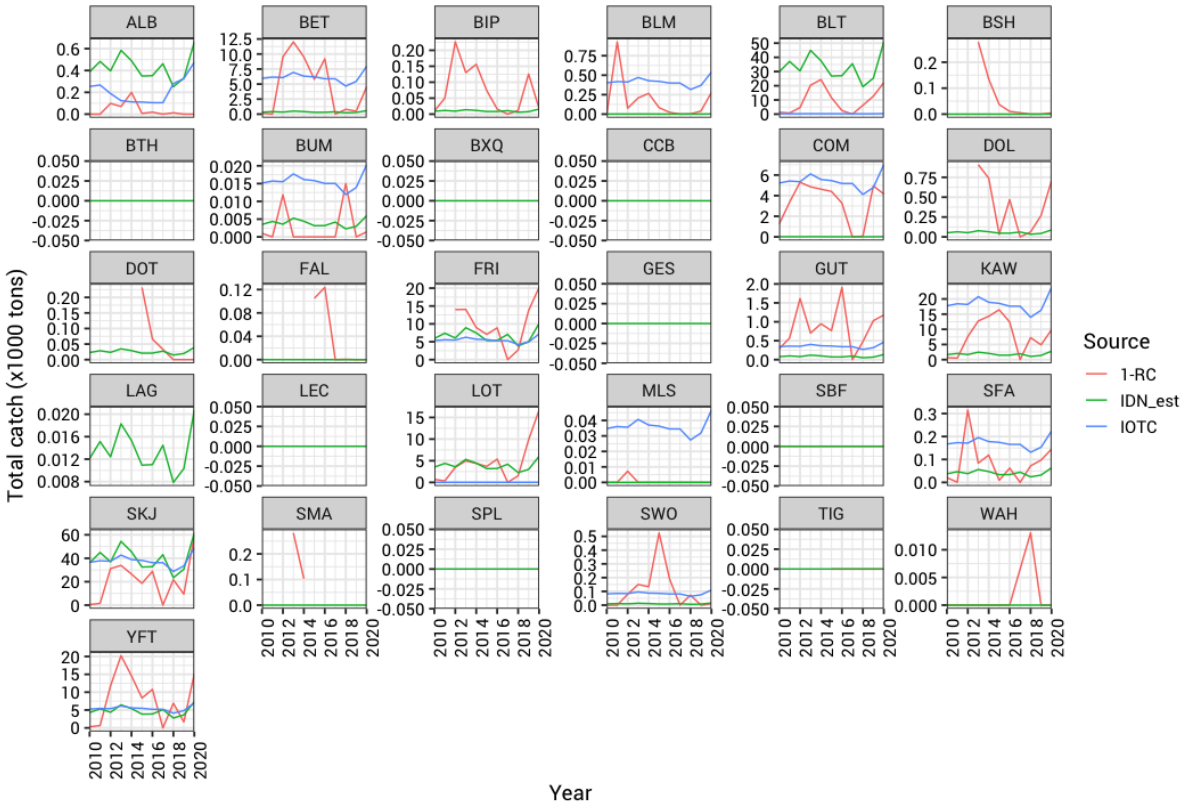
6.7. Artisanal Longline (LLCO)



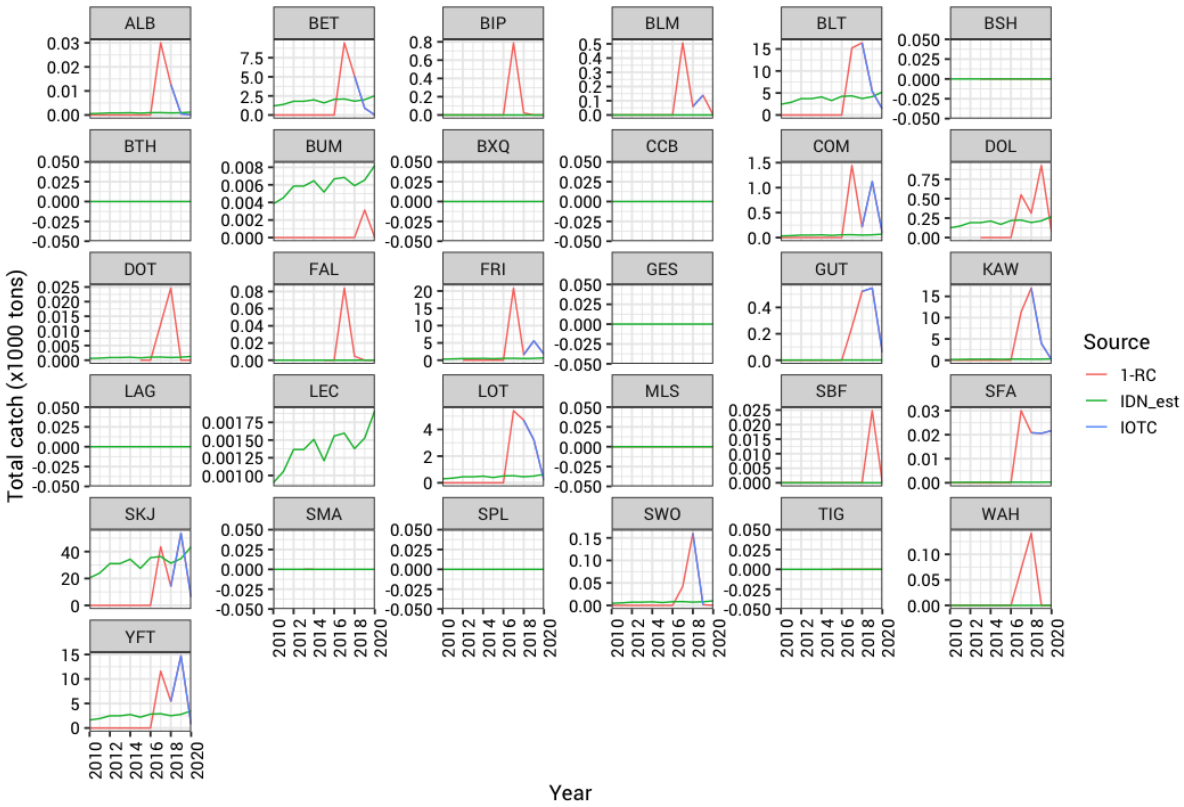
6.8. Industrial Longline (LLTU)



6.9. Artisanal Purse Seine (PSSS)



6.10. Industrial Purse Seine (PS)



7. Recommendation

Overall, the new proposed re-estimation method proven to be effective on dealing the highly fluctuated datasets (Form 1-RC and IOTC) and brought more consistency across gears and species. We strongly encourage this new methodology to be used to adjust the Indonesian datasets period 2010-2020.

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Appendix 1. Types of fisheries for IOTC species

IOTC Code	Type of Operation	English name
BS	Artisanal	Beach seine
CN	Artisanal	Cast net
DS	Artisanal	Danish seine
DSD	Artisanal	Demersal Danish seine
GI	Artisanal	Gillnet
GIDR	Industrial	Driftnet
GIOF	Semi-industrial	Offshore gillnet
HL	Artisanal	Handline
HLPA	Artisanal	Handline on anchored-FAD
DL	Artisanal	Dropline (vertical handline)
DLLS	Artisanal	Dropline on anchored-FAD
HR	Artisanal	Harpoon
LL	Industrial	Drifting longline (over 1800 hooks)
LLCO	Artisanal	Smalll longline
LLEX	Industrial	Drifting longline (exploratory)
LLFR	Industrial	Drifting longline (up to 1800 hooks)
LLGI	Semi-industrial	Gillnet/longline
LLSI	Semi-industrial	Swordfish longline (semi-industrial)
LLSK	Industrial	Shark longline
LLSW	Industrial	Swordfish longline (Florida longline)
LLTU	Industrial	Tuna longline
LN	Artisanal	Liftnet
LNPA	Artisanal	Liftnet on anchored-FAD
PL	Artisanal	Pole and line
PLIN	Industrial	Industrial pole and line
PLPA	Artisanal	Pole-and-line on anchored-FAD
PLFS	Artisanal	Free-school pole-and-line
PLDF	Artisanal	Dolphin associated school pole-and-line
PLME	Artisanal	Pole and line (mechanized boats)
PLNM	Artisanal	Pole and line (non-mechanized boats)
PLOF	Semi-industrial	Offshore pole and line
PS	Industrial	Tuna purse seine
PSFS	Industrial	Free-school tuna purse seine
PSLS	Industrial	Log-school tuna purse seine
PSSA	Semi-industrial	Coastal purse seine on anchored-FAD
PSSF	Semi-industrial	Free-school coastal purse seine
PSRN	Artisanal	Ringnet
PSRP	Artisanal	Ringnet with anchored-FAD
PSSP	Industrial	Support vessel industrial purse seiner
PSSS	Semi-industrial	Small purse seines
SN	Artisanal	Setnet
SP	Artisanal	Sport fishing
TL	Artisanal	Trolling
TLME	Artisanal	Trolling (mechanized boats)
TLNM	Artisanal	Trolling (non-mechanized boats)
TP	Artisanal	Trap
TR	Semi-industrial	Trawl

Appendix 2. Classification and dimensions of fisheries (Modified from Moreno & Herrera (2013))

Type of boat	Boat size	Area of Operation	Fleet
Non-motorised	All	Flag state EEZ only	Artisanal
Motorised outboard	All	Flag state EEZ only	Artisanal
Motorised inboard	<15 m	Flag state EEZ only	Artisanal
Motorised inboard	15-24 m	Flag state EEZ only	Semi-industrial
Motorised inboard	<15 m	Includes other EEZ areas and/or high seas	Semi-industrial
Motorised inboard	15-24 m	Includes other EEZ areas and/or high seas	Industrial
Motorised inboard	≥ 24 m	Anywhere	Industrial

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