Guidelines on indicators to measure compliance in fisheries

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Introduction

Article 7.2 of the Specific Control Implementation Procedure (SCIP) includes the possibility that Member States may apply target benchmarks, "*expressed in terms of improved compliance levels according to the harmonised methodology established in cooperation with EFCA*".

This document represents an overview of the methodology to guide this process, introducing the concept of indicators, explaining how they can be used to measure compliance in fisheries, listing the properties that characterise a good indicator and detailing how the procedure of incorporating indicators can take place at national and regional level. With the use of these tools and following the methodology proposed, harmonised compliance-based benchmarks can be obtained and a level playing field will be achieved.

Indicators, in this context, are tools to measure progress towards an objective or target that needs to be established in accordance with the objectives of the Common Fisheries Policy, the Control Regulation and agreed at regional level. As will be explained in the document, progress towards the set target can take place over different time scales, leading to different rates of improved compliance per unit of time to be achieved. These aspects need to be considered when determining both the time frame and the compliance levels to be achieved by MS at every time step. MS are ultimately responsible for defining and implementing the control and inspection effort as well as the strategy to achieve the improved compliance levels.

To ensure a common approach, a suite of eight indicators to measure the likelihood of compliance in relation to two of the main identified threats of non-compliance with the current legislation (related with the Landing Obligation and related to reporting obligations of species and areas), are presented. The scope, rationale, legal background, data needed, metrics and methodology for calculation, among other characteristics of the indicator, are described following a common format, designated as info-sheet. The use of a common format will facilitate the access to the relevant information and ensure a coherent application of the indicators.

Because the ultimate choice of benchmark to be used lies with the MS different types can coexist (i.e., with the targets based on number of inspections, as has been done in the past, or with targets based on compliance levels). Integrating this disparate information can be a challenge at regional level.

This document should be considered as a living document that should receive frequent updates, either to incorporate new indicators or to add details to the indicator info-sheets.

Indicators and the characteristics that define a good indicator

An indicator is a way to measure something, but indicators are much more than simple metrics. Indicators are widely used because they are able to summarise and simplify reality, reducing the complexity inherent

in a system or a situation. By using indicators, information can be easily and directly communicated to different audiences.

Indicators are used in an increasing number of fields, with many examples available in, for example, news bulletins to measure the status of the economy, the health of a population, the viability of a biological resource, the severity of an anthropogenic threat in an ecosystem, the sustainability of a fishery, etc. Sometimes, individual (or groups of) species are considered to be good indicators because they are believed to define a characteristic of the environment or because its/their population dynamics reflect the health of the ecosystem, etc.

In the context of monitoring, control and surveillance on fisheries, indicators can be used to reveal and monitor the compliance (or lack of) by participants in a fishery with the existing regulations, and how compliance is evolving in relation to a planned target value. In addition, they could be utilized as a tool for the compliance-based benchmarks described in the SCIP.

Indicators can be tailored for each of the main threats identified in relation to non-compliance with the current fishery-related legislation:

- non-compliance with the landing obligation;
- misrecording;
- use of Illegal gears;
- fishing in closed areas.

Indicators (as represented in Figure 1, based on the compliance example) measure specific characteristics that are believed to be related to the threats being analysed. Indicators can provide an estimate of the current situation and, by providing values which show how the situation is changing, they can be used to measure progress towards a goal (target) (Figure 1).

Figure 1. Schematic representation of four indicators and how they can measure progress towards the target (full compliance with the fishery legislation in place).

Sometimes, intermediate thresholds values can be set, defined as ranges of values of the indicator metric that identify different degrees of compliance (Figure 2). These thresholds can be used when setting intermediate targets to ensure that a) fisher behaviour is compliant with legislation and does not diverge from the required trajectory or b) the final target is reached within a set time frame.

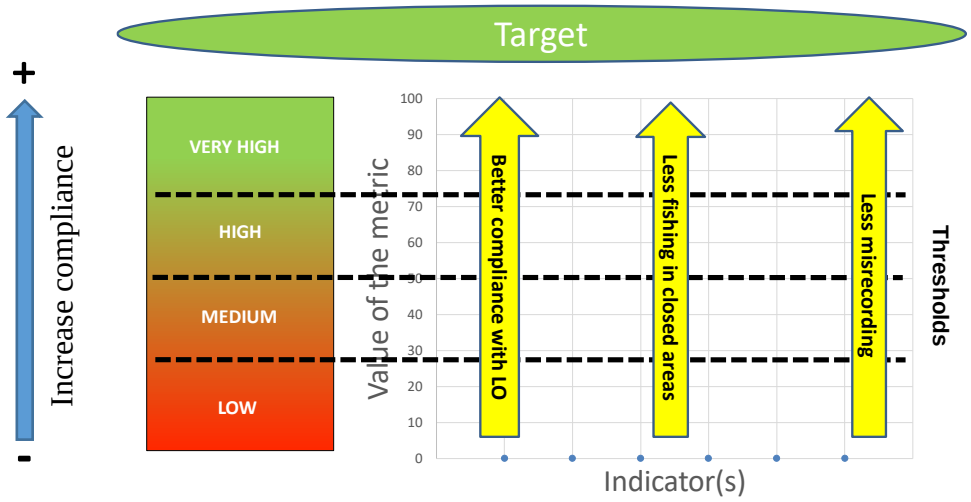

Figure 2. Schematic representation of three indicators and how they can measure progress towards the target (full compliance with the fishery legislation in place). Intermediate thresholds values, defined as ranges of values in the indicator metric that separate different degrees of compliance (in the figure represented as "very high", "high", "medium" and "low") are shown.

Because indicators are increasingly used as tools to help managers make decisions, their selection and design is crucial. There are several reviews listing the characteristics that a good indicator should have and here we provided a summary, adapted from the four categories of properties provided by Newson et al. (2009).

A - Communication properties

- Because the objective of an indicator is to summarise and simplify complex information that needs to be communicated efficiently, an indicator should be easy to understand by all target audiences, e.g., managers.
- In addition, an indicator needs to capture the "net impact" of a threat, since this is what we want measured. This arises because sometimes an external stressor can have positive and negative effects and the indicator needs to capture the net impact. Therefore, the indicator needs to be related to the property we want to measure and to follow its increases and/or decreases in response to the stressor.

B - Statistical properties

- An indicator should be specific to the threat under consideration and it should not respond to other threats. In addition, an indicator should be sensitive to the threat, i.e. a change in the threat should result in a change in the indicator, with bigger changes in the indicator preferred. An indicator should also be

responsive to the threat, e.g. been able to allow the detection of changes in fishermen behaviour as soon as they happen with no or limited delay.

- Finally, there should be a good theoretical basis for the use of the indicator. The relationship between the indicator and the threat should not be coincidental but there should be a clear causal relationship between both.

C - Data requirements, feasibility and utility

- The data for the indicator need to be available (in sufficient quantity) and be of sufficient quality to allow the calculation of meaningful values.
- The indicators should ideally be widely applicable (i.e., in similar situations in other places) and the continuity of the data collection in the future needs to be ensured.

Other authors have provided or adapted alternative sets of criteria for good indicators. One of the best known sets is "SMART" (Doran, 1981), i.e. Specific, Measurable, Assignable, Realistic and Time-related, originally coined in the context of management objectives. In the context of indicators, this also addresses the practical issues of the cost of collecting the necessary information, the assignment of responsibility for undertaking the work and assurance of timely delivery.

An example of the evaluation of the misreporting trip ratio indicator is presented in Annex 1, where the indicator properties are scored against the criteria required of a good indicator summarised in Table 1. It is very important to conduct an overall analysis on the appropriateness of an indicator as shown in Annex 1 and to document its evaluation to guide the interpretation of the results obtained when calculating the indicator. Some of the indicators presented do not fulfil all criteria listed in Table 1.

Table 1. Overview of the properties needed for a good indicator and possible scores to be obtained when evaluating indicators.

Classification	Property	Score
Communication properties	*Is it easy to understand?*	Yes / Partial / No
	Does it capture the net impact?	Yes/ Partial / No
Statistical properties	*Is it specific?*	Yes / Partial / No
	Is it sensitive?	Yes / Partial / No
	Is it responsive?	Yes / Partial / No
	Theoretical basis	Yes / Partial / No
Data requirements + feasibility	*Are the data available?*	Yes / Partial / No
	Is the quality assured?	Yes / Partial / No
	Is it applicable?	Yes / Partial / No
	Is the continuity of the data collection assured?	Yes / Partial / No

How compliance indicators can be used in the compliance-based benchmarks

With the new SCIP coming into effect in 2019, MS will be able to select what type of benchmarks to use following a process that can be visualised in Figure 3. If MS decide to define benchmarks in terms of improved compliance levels, indicators can be used to measure progress towards the achievement of the selected target levels.

To ensure coherence at regional level, it is recommended that common indicators are used by the MS operating in the same region. A minimum common number of indicators should be selected and, if appropriate, only one indicator could be considered in the initial phase.

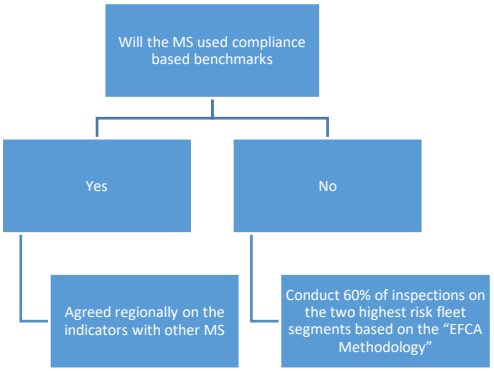

Figure 3. Decision tree of the SCIP benchmarks.

Once the indicator (or group of indicators) is selected, the current value of the indicator needs to be calculated to establish the baseline, i.e., the starting point, on the non-compliance scale. Afterwards, the values which will delimit the LOW, MEDIUM, HIGH and VERY HIGH non-compliance ranges need to be defined. Compliance benchmarks could then be set either as a defined decrease in non-compliance value or as a decrease in the level of non-compliance from VERY HIGH to HIGH, from HIGH to MEDIUM, or from MEDIUM to LOW. In those cases, where levels are already in the LOW non-compliance category, the compliance benchmark could be set as maintenance of non-compliance levels within this category.

To calculate some indicators, e.g., indicators to measure the likelihood of misrecording of one species as another, the selection of species is clear and described in the indicator scope. For other indicators, like the ones designed to measure the likelihood of non-compliance with the landing obligation, the selection of species and / or area should ensure consistency among MS, since results need to be comparable within the same region. It is suggested that the indicator is calculated for the main/target species/areas of a fleet segment. It may be worth considering a minimum threshold value of total catch volume which should be met in order for a species to be eligible for use in the calculation of the indicator.

If a given MS is already computing compliance indicators that are not yet proposed in the current document, and aims to use those indicators as a compliance based benchmark for the SCIP, the indicators should be submitted to a review process by EFCA together with other MS for possible update of the guidelines, before being included in the list of indicators to be used in the compliance-based benchmarks.

It is important to highlight that the improved compliance is not only dependent on control and inspection activities. Some non-compliance situations could sometimes be efficiently resolved with a change in the managements measures (e.g., via the issuing of single area licences in cases of misreporting of area). Actions to improve voluntary compliance may also help, e.g., by providing information on how to correctly fill in the logbook, misreporting could be reduced.

Proposed indicators

Indicators have been proposed to measure the likelihood of non-compliance in relation to the misreporting threat (5 indicators) and in relation to non-compliance with the Landing Obligation (3 indicators). The eight indicators proposed show different levels of complexity in relation to their calculation and require different data sources. For example, the indicators related to the non-compliance with the LO require reference data while the indicator No-PNO does not, etc.

To facilitate the access to the relevant information and the comparison of characteristics of different indicators, an indicator info-sheet, has been designed and it is presented in Annex 2.

Table 2 summarises the main aspects of each of the eight indicators proposed, side by side, to facilitate comparison between indicators. This summary table is intended to work as a tool box to help MS identify the most appropriate indicators for their needs, a decision that it is also helped by listing what would be the data needed for their calculation. Once the indicator is chosen, the detailed description provided in the relevant info-sheet guides the process by specifying the methodology needed for its calculation.

Table 2. Overview of the indicators proposed by EFCA.

Threat	Misrecording of species		Misrecording of area	Misrecording of species		Non-compliance with the landing obligation		
Name of indicator	Ratio of trips without a PNO.	Ratio of trips exceeding the MOT.	Ratio of no VMS and AIS transmission.	Ratio of trips with misrecording.	Ratio of catches with misrecording.	BMS discards rate.	Discard rate of fish above MCRS (high-grading).	Difference in species rate.
Rationale for the indicator	No PNO indicates avoidance of inspection and possibly misrecording of species and weight in logbook.	Exceeding the MOT indicates misrecording of catches in the logbook.	Missing VMS- and AIS signals at sea indicates avoidance of inspection and possibly misrecording of area of catches.	Differences in the proportion of herring and sprat in BS between reference and non-reference data indicates misrecording of herring and sprat species in the logbook.	Differences in the proportion of herring and sprat in BS between reference and non-reference data indicates misrecording of herring and sprat species in the logbook.	Differences in ratio fish below MCRS between reference and non-reference data indicates discard and non-compliance of the LO.	Differences in the proportion of the grade of fish above MCRS between reference and non-reference data indicates discard and non-compliance of the LO.	Differences between the landed species ratio and the estimated species ratio calculated from reference data can be used as an indicator of compliance with the LO.
Scope	Evaluation of likelihood of misrecording of catches.			Evaluation of likelihood of misrecording of catches.		Evaluation of likelihood of illegal discard of fish below MCRS.	Evaluation of likelihood of illegal discard of fish above MCRS. Only for fish with defined grade sizes.	Evaluation of likelihood of illegal discard of fish below and above MCRS.
	Segment/areas/time periods or limited to one species/ To be used in national and regional risk assessment and as compliance based benchmarks							

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Threat	Misrecording of species		Misrecording of area	Misrecording of species		Non-compliance with the landing obligation		
Name of indicator	Ratio of trips without a PNO.	Ratio of trips exceeding the MOT.	Ratio of no VMS and AIS transmission.	Ratio of trips with misrecording.	Ratio of catches with misrecording.	BMS discards rate.	Discard rate of fish above MCRS (high-grading).	Difference in species rate.
Metric (unit of measuring)	Ratio of no PNO is the number of trips with No PNO divided by the total numbers of trips. No PNO is defined as a trip for which no PNO was received in FS before the time of arrival to the actual landing port.	Ratio of the number of trips exceeding the MOT is the number of trips exceeding the MOT for one or more species divided by the total number of trips in which the species are caught. Exceeded MOT is defined as a difference > 10 % between the weight in logbook and the weight in the landing declaration.	Ratio of no VMS and AIS transmission is the number of hours in intervals of more than three hours without VMS and AIS divided by the total numbers of hours with VMS and AIS. Travelling time could be excluded. No VMS and AIS is defined as a period of three hours or more at sea without transmission of VMS and AIS.	Ratio of misrecorded trips is the number of trips considered to be misrecording divided by the total number of trips in a unit of analysis.	Ratio of misrecorded catches is the added amounts of herring or the amounts of sprat that are considered to be misreported in each trip divided by the figure of the total catch of herring or sprat in a unit of analysis.	The BMS discards rate is calculated as the difference in the ratios of BMS obtained from reference data and from the reported BMS in the logbook of non-reference data. These rates are calculated dividing the BMS quantities in the catch of a given species by the total catch (BMS + Legal Size Catch (LSC)).	The HG discards rate is the estimated quantity of discarded fish above the MCRS divided by the total catch of fish above the MCRS (landings and estimated discards). The estimates of discards of fish above MCRS are calculated as the difference between the proportions of the grade sizes obtained from reference data and the proportions of grade sizes reported in the sales notes of non-reference data.	The discard rate of *Species A* is calculated dividing the discarded component of *Species A* by the total catch of *Species A*. To estimate the total catch of *Species A,* the known catches of *Species B* is used and also the ratio between *Species A* and *Species B* (derived from the reference data). Once the total catch of *Species A* is obtained, the discarded component is calculated as the difference between the total catches of *Species A*, and the reported catch in the logbook.

Threat	Misrecording of species		Misrecording of area	Misrecording of species		Non-compliance with the landing obligation		
Name of indicator	Ratio of trips without a PNO.	Ratio of trips exceeding the MOT.	Ratio of no VMS and AIS transmission.	Ratio of trips with misrecording.	Ratio of catches with misrecording.	BMS discards rate.	Discard rate of fish above MCRS (high-grading).	Difference in species rate.
Reference values	No reference values			The reference level (expected proportion of herring or sprat) is obtained based on the mean and 95% confidence intervals calculated from the weight of the samples taken during the inspections of unsorted landings.		The reference data are the size catch composition of the species split in two components (above and below MCRS) collected during detailed inspections at sea, designated as Last Haul (LH), or from catch data from vessels operating with CCTV.	The reference data are the grade size catch composition of the species above MCRS collected during detailed inspections at sea, designated as Last Haul (LH), or from catch data from vessels operating with CCTV declared in the sale notes.	The reference data are the catch quantities of the two species considered (Species *A* and Species *B)*, collected during inspections at sea, designated as Last Haul (LH), or from catch data from vessels operating with CCTV.
Compliance criteria	The ratio of no PNO is translated into four levels of likelihood, not yet defined.	The ratio of trips exceeding MOT is translated into four levels of likelihood, not yet defined.	The ratio of no VMS and AIS transmission is translated into four levels of likelihood, not yet defined.	Possible compliance criteria for this indicator are under discussion and a target level has not been defined.		<5% Low 5-15% medium >15% high >15% for more than one species – very high		
	Compliance benchmarks could be set on national and regional level.							

Threat	Misrecording of species		Misrecording of area	Misrecording of species		Non-compliance with the landing obligation		
Name of indicator	Ratio of trips without a PNO.	Ratio of trips exceeding the MOT.	Ratio of no VMS and AIS transmission.	Ratio of trips with misrecording.	Ratio of catches with misrecording.	BMS discards rate.	Discard rate of fish above MCRS (high-grading).	Difference in species rate.
Data source and format	Logbook and associated PNO.	Logbook and associated landing declaration.	VMS, AIS and logbook.	Reference data: the amount of herring and sprat in the samples of the landings taken by inspectors. Non reference data: the amount of herring and sprat declared in the logbooks.		The non-reference data are reported information (BMS/LSC/DIS/ RET) from the logbooks. The reference data could be either data from inspection at sea (LH), or reported BMS from logbook of vessel operating with CCTV.	The non-reference data are reported grades by species from sales notes. The reference data could be either data (in grades) from inspection at sea (LH), or reported grades from sales notes of vessel operating with CCTV.	The non-reference data are reported information (BMS/LSC/DIS /RET) from the logbooks. The reference data could be either data from inspection at sea (LH), or reported catches from logbook of vessel operating with CCTV.
	Analyses performed in MS – final evaluation and RRA in EFCA/MS					To analyse on segment level, data from logbook (gear, mesh size and area) are needed.		
Quality control	Trips and PNO not included in the analyses because of data quality should be identified.	Trips not included in the analyses because of data quality should be identified.	Trips not included in the analyses because of data quality should be identified.	Samples taken during the inspections should follow the agreed guidelines.		Crosschecks between different data sources should be performed. Corrections, errors and excluded data should be documented.		
Assumptions and verification	Evaluation of the rationale of the indicator through verification against results from landing inspection.			The appropriateness of the indicator depends on the existence of sufficient and sufficiently representative reference data.		The method assumes a uniform species composition of the catch. The appropriateness of the indicator to estimate the likelihood of non-compliance with the LO depends on the representativeness of the reference data.		
Reporting	Annual output from MS in formatted report. Aggregated results and evaluation in RRA. Although computed annually for the SCIP compliance based benchmarks, MS are encouraged to conduct more frequent checks					Annually report from EFCA at regional level and by MS at national level. Although computed annually for the SCIP compliance based benchmarks, MS are encouraged to conduct more frequent checks		

References

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Annex 1. Example of an indicator and its properties

To explain the application of these criteria to the selection of an indicator, it is easiest to start with an example. EFCA has proposed the *misrecording trip ratio* (MTR) as an indicator to estimate the likelihood of misreporting taking place in pelagic fisheries in the Baltic Sea when fishers land unsorted catches. These fisheries mainly target herring and sprat in a mixed fishery operated by trawlers using nets with a range of different mesh sizes. The proportion of herring and sprat in the catches depends on the mesh size but also varies with area and season. Fish taken by these fisheries is mainly used for animal feed, fish oil and fish meal, and catches are landed unsorted making it difficult to accurately estimate the species composition of these catches. Since the late 1990s, when the quotas for both species started to limit the fishery, it is believed that systematic misreporting of herring and sprat has been taking place both in the logbooks and landing declarations.

The MTR indicator is calculated by dividing the number of trips considered to be misreporting by the total number of trips in a unit of analysis. The unit of analysis is the fleet segment/subdivision combination.
The data used to calculate the indicator are the average values (and the 95% confidence intervals calculated using bootstrap methods) of herring and sprat samples taken by inspectors (reference data), expressed as percentages. The non-reference data, that are compared with the reference data, consist of the declared catches in the logbooks and derived from the ERS.

Table 1 shows the scores awarded to the MTR indicator for each of the properties listed for a good indicator. The misreporting trip ratio indicator expresses the number of trips for which misreporting is believed to have taken place in relation to the total number of trips undertaken in a subdivision within a fleet segment. In relation to its communication properties, the concept of this indicator is considered to be easy to understand and it is believed to capture the likelihood of misreporting in these fisheries.

The statistical properties of this indicator are considered suitable since it is believed to be specific to the threat of misreporting, sensitive to changes in fishing behaviour (if there is an increase in misreporting, the indicator will reflect it and it will do so immediately, therefore it is also considered to be responsive). In addition, the indicator is based on a clear existing relationship with the threat under consideration (misreporting). Finally, in relation to data requirements, the indicator relies on the existence of enough good quality reference (inspection) data to be able to derive meaningful averages and confidence intervals for the expected proportion of herring and sprat in the catches. Reference data exist for some subdivisions of some fleet segments but there are at present not enough inspection data to calculate the indicator for all subdivisions of the fleet segments landing unsorted landings of herring and sprat. In relation to the quality of the data, efforts have been made to agree on sampling guidelines that would ensure that representative samples of the catch are taken. Providing these guidelines are followed, reference data should be representative of the catches of the fleet and would allow good estimation of the number of trips where misreporting is taken place. Finally, the indicator could be applied to other areas/fleet segments, but it requires that sampling (inspection) takes place at an appropriate level in relation to both the amount of the

catch of a trip being sampled and the number of trips being sampled. For the unsorted landings of pelagic fisheries in the Baltic Sea, the continuation of the data collection is therefore encouraged to permit future monitoring of the threat of misrecording with this indicator.

It is important that each proposed indicator is similarly evaluated against the characteristics that define a good indicator to determine if it would be suitable for the task.

Table A.1.1. Scores (yes, partial, no) awarded to the misreporting trip ratio indicator in relation to the properties highlighted as needed for a good indicator.

Classification	Property	Score
Communication properties	*Is it easy to understand?*	Yes
	Does it capture the net impact?	Yes
Statistical properties	*Is it specific?*	Yes
	Is it sensitive?	Yes
	Is it responsive?	Yes
	Theoretical basis	Yes
Data requirements + feasibility	*Are data available?*	For some subdivisions
	Is quality assured?	Yes (if sampling guidelines are followed)
	Is it applicable?	Yes but sampling isneeded
	Continuity of the data collection?	Yes?

Annex 2: Compliance indicator info-sheet template

1. **Name of indicator:**

2. **Rationale for the indicator (i.e., why to develop the indicator) and legal basis**

3. **Scope (spatial and temporal limit of the indicator, e.g., unsorted pelagic fisheries in the Baltic Sea)**

4. **Metric (the unit of what the indicator is measuring, e.g., BMS discard ratio, number of trips with misrecording, etc.). The unit of the analysis should be defined here as well (e.g., fleet segment, area, temporal scale, etc.)**

5. **Reference values (the verified quantity against which compare the declared data, e.g., Last Haul data BMS discard ratio)**

6. **Compliance criteria (the levels of which compliance is considered, e.g., low, medium, high, very high). A target level can also be defined (e.g., < 5% BMS discard is the target level)**

7. **Detailed description on how to calculate the indicator** (should completed together with MS, based on their experiences)

    a. **Data source and format**

    b. **Quality control** (should be completed together with MS based on their experiences)
        i. **Validation through business rules (e.g., check for duplicates, areas outside the fleet segment definition, etc.)**
        ii. **Verification (e.g., cross-check with other source of information)**
        iii. **Document the quality check process (e.g., description of errors detected, and changes made to the original data)**

    c. **Methodology for the calculation/analysis** (should be completed together with MS based on their experiences)
        i. **Description tool available, if applicable (e.g., Excel template, R script, GIS script, etc.)**

8. **Assumptions of the analysis and ways of verifying (e.g., verify with VMS if the CCTV vessels operates in the same area of the non-reference data)**

9. **Reporting** (when, by whom, to whom)

a. Frequency

b. Definition of output/report

10. **<u>Additional comments with recommendations and caveats of the calculation</u>** (e.g., consideration about Margin or Tolerance when estimating the misrecording of unsorted catches)

11. **<u>Annexes</u>**

Annex 3: Compliance indicators info-sheets

Misrecording indicators

Ratio of trips without a Prior notification (PNO)

1. **Name of indicator:**

   Ratio of trips without a Prior notification (PNO), as indicator of misrecording.

2. **Rationale for the indicator (i.e., why to develop the indicator) and legal basis**

   A missing PNO could indicate that the skipper does not want to report the exact time of landing to avoid an inspection at the landing site because of discrepancies between the reported species and weight in the logbook and the real species and weight to be landed, especially in the case of species which are subject to a multiannual plan.

   The EU Control Regulation 1224/2009, article 17[1], requires vessels with an overall length larger than 12 meters or more, engaged in fisheries on stocks subject to a multiannual plan to submit a pre-notification (PNO) to competent authorities at least four hours before landing, if the vessel have catches of these stocks.

   MS may give permission to an earlier entry at port according to the EU Control Regulation, article 17, point 3 and 6.

[1] **Article 17, Prior notification**
1. Masters of Community fishing vessels of 12 metres' length overall or more engaged in fisheries on stocks subject to a multiannual plan, which are under the obligation to record fishing logbook data electronically in accordance with Article 15, shall notify the competent authorities of their flag Member State at least four hours before the estimated time of arrival at port of the following information:
(a) the external identification number and the name of the fishing vessel;
(b) the name of the port of destination and the purposes of the call, such as landing, transhipment or access to services;
(c) the dates of the fishing trip and the relevant geographical areas in which the catches were taken;
(d) the estimated date and time of arrival at port;
(e) the quantities of each species recorded in the fishing logbook;
(f) the quantities of each species to be landed or transhipped.
2. When a Community fishing vessel intends to enter a port in a Member State other than the flag Member State, the competent authorities of the flag Member State shall immediately upon receipt forward the electronic prior notification to the competent authorities of the coastal Member State.
3. The competent authorities of the coastal Member State may give permission to an earlier entry at port.
4. The electronic fishing logbook data referred to in Article 15 and the electronic prior notification may be sent in a single electronic transmission.
5. The accuracy of the data recorded in the electronic prior notification shall be the responsibility of the master.
6. The Commission, in accordance with the procedure referred to in Article 119, may exempt certain categories of fishing vessels from the obligation set out in paragraph 1 for a limited period, which may be renewed, or make provision for another notification period taking into account, inter alia, the type of fisheries products, the distance between the fishing grounds, landing places and ports where the vessels in question are registered.

According to article 14 in the Control Regulation 1224/2009, all species above 50 kg of live-weight shall be recorded in the logbook. The weight of the fish in a PNO refers to the recording of weight in the logbook.

3. **Scope (spatial and temporal limit of the indicator)**

The indicator is applicable for the evaluation of the likelihood of misreporting of catches. It can be applicable to all fleet segments in all areas, but it could be more relevant for some specific fleets segments and / or specific areas, where misreporting of catches is an issue. It is applicable to vessels with an overall length larger than 12 meters and to all species covered by regional multi-annual plans. The scope could be restricted to only one species, e.g. salmon in the Baltic Sea, or applied more widely to, e.g. demersal species in the North Sea or pelagic species in Western Waters.

A minimum catch limit could be set up when calculating the indicator. This catch limit could be decided based on the species under consideration and the national legislation in place.

The analyses should be carried out with data from a whole year, but it might also be useful to calculate the indicator for a given period, when misrecording of catches is likely higher e.g., period of quota limitations. The seasonality and main peaks of activity of the fisheries should also be considered.

4. **Metric (the unit of what the indicator is measuring, e.g., BMS discard ratio, number of trips with misrecording, etc.). The unit of the analysis should be defined here as well (e.g., fleet segment, area, temporal scale, etc.)**

Ratio (in %) of trips without a PNO is calculated as the number of trips with *No PNO* divided by the total number of trips (i.e., fishing trips with landings activity) in the unit of analysis (see below) and expressed as a percentage.

Unit of analysis: the calculation can be done at fleet segment level, area/fleet segment(s) combination or at species level. If the latter case, an overall value for the fleet segment could be derived from the individual scores of the species considered.

A trip is defined from the logbook as the period from the time of departure to the time of arrival and with one or more of the relevant species recorded in one or more Fishing Activity Report (FAR).

No PNO is defined as a trip for which, having catches of species subject to a multiannual plan recorded in the logbook and no PNO of those catches was received in the Flag State before the time of arrival to the reported port.

No PNO-inspected is the number of landing inspections of trips without a PNO identified through the analyses, were the inspectors have recorded that a PNO was not submitted. The use of these data are explained in point 8, Assumptions of the analysis and ways of verifying.

5. **Reference values (the verified quantity against which compare the declared data)**

There are no reference values in the calculation of this indicator. In principle there should not be any failure in reporting the PNO declarations.

6. **<u>Compliance criteria</u> (the levels of which compliance is considered, e.g., low, medium, high, very high). A target level can also be defined**

The ratio of *No PNO* should be translated into the four different likelihood levels in the SCIP (low, medium, high and very high). The scale should be the same for all fleet segments.

The equivalence from ratio of non-compliance to likelihood could be presented like this:

Level of likelihood	**Ratio of No PNO**
Low	Less than %
Medium	% to %
High	% to %
Very high	More than %

Compliance benchmark:

The ratio of *No PNO* could be used as common compliance benchmark for all MS within a regional scope. If the aggregated ratio of *No PNO* indicates a likelihood value of "high" or "very high" for a given year, MS and EFCA should agree to set the compliance benchmark as a decrease in the ratio of trips without a PNO the following year. Multiannual compliance benchmarks could also be considered.

MS would likely have different levels of ratio of trips without a PNO. The experiences from MS with a higher level of compliance could be shared as best practice to assist other MS to achieve the agreed compliance benchmarks.

The table shows **<u>an example</u>** how multiannual benchmarks could be set, where the estimates obtained by the use of the proposed indicator correspond to a very high level of likelihood:

Year	**Expected ratio (non-compliance benchmark)**
0	XX % = very high (current value)
1	YY % = high (reduction from previous year)
2	ZZ % = medium (reduction from previous year)
3	WW % = low (reduction from previous year)
4	WW % (maintenance benchmark)

7. **<u>Detailed description on how to calculate the indicator</u>** (should be completed together with MS, based on their experiences)

   a. **<u>Data source and format</u>**

The data for the analyses are obtained from electronic and/or paper logbook and associated data from PNO.

The calculation of the indicator requires access to data from landing declarations associated with data from logbooks and PNOs.

The data from logbooks should be available as dataset in all MS. Data from PNO are probably also available in a suitable data format, when originating from electronic logbooks. In the case of logbook data derived from paper logbook, the registration and database available for PNO in MS need to be explored. Segmentation is based on the information from the logbook (gear, mesh size and area).
ERS-data in EFCA will have the data of species and weight (FAR). Information of PNO will also be in ERS in EFCA, but studies of ERS-data show that not all PNO are associated to the correct FAR. Because of this reason, the calculation of the numbers of *No PNO* and the ratio of trips without a PNO per fleet segment per MS could be performed by the MS.
The aggregation of results from MS and the final evaluation and regional risk assessment could be made by EFCA in cooperation with the MS.

b. **Quality control** (should be completed together with MS based on their experiences, including examples)

i. **Validation through business rules**

Trips with relevant species in one or more FAR, but without a departure or an arrival in the logbook should be identified. Other data outside the definition might be found. These data are not included in the analyses according to the definition of a trip (point 4), but their numbers should be counted and evaluated against the trips that are included in the analyses.

PNO not associated to a trip should be identified – these PNOs are not included in the analyses, but their numbers should be counted and evaluated against the number of PNO that are included in the analyses.

ii. **Verification**

iii. **Document the quality check process**

c. **Methodology for the calculation/analysis** (should be completed together with MS based on their experiences)

i. **Description tool available, if applicable**

8. **Assumptions of the analysis and ways of verifying**

An evaluation of the rationale of the ratio of trips without a PNO could be performed by comparing the results from the analyses with information detected through landing inspection. Inspection reports could qualify and verify the findings in the analyses.

If, for example, the majority of inspection reports where inspectors have noted that no PNO was received indicate that misreporting of species and/or weight has taken place, the appropriateness of the indicator to estimate the likelihood of misreporting is confirmed.

If, however, the majority of inspection reports where inspectors have noted that *no PNO* was received indicate other causes different from misreporting, the appropriateness of the indicator to estimate the likelihood of misreporting should be reconsidered.

The evaluation and verification could be carried out by MS as they have access to the whole inspection report. In EFCA only specific sections of the inspection report are registered in JADE.

9. **Reporting** (when, by whom, to whom)

a. Frequency

The analyses could be performed annually by MS during the 1st quarter of the following year. The results of the analyses carried out by MS should be sent to EFCA no later than 15th April to be prepared as an input to the annual Regional Risk Assessment workshop in the 1st semester.

b. Definition of output/report

The output from the analyses from each MS sent to EFCA to be used in the Regional Risk Assessment work should look like this table:

	MS 1			**Total**
Period	**1/1-2018 to 31/12-2018**			
Fleet segment	XX01	XX02	XX03	
Numbers of trips analysed	1.000	200	500	1 700
Numbers of trips with PNO	990	190	480	1.660
Numbers of trips with *No PNO*	10	10	20	40
Ratio of *No PNO*	1.0 %	5.0 %	4.0 %	2.4 %
Number of trips with *No PNO-inspected*	5	2	8	15

The output from the aggregated results from all MS to be used in the Regional Risk Assessment could look like this:

	Segment XX01		Segment XX02		Segment XX03	
Member State	Compliant	No PNO	Compliant	No PNO	Compliant	No PNO
MS-1	990	10	190	10	480	20
MS-2	95	5	98	2	27	3
MS-3	260	40	980	20	470	30
MS-4	2.900	100	290	10	960	40
Total	4.245	155	1.558	42	1.937	93
Ratio of No PNO		3.5 %		2.6 %		4.6 %

10. Additional comments with recommendations and caveats of the calculation

The results of the analyses of *No PNO* could be used in the operational work. When MS have carried out the identification of the landings with *No PNO*, the related vessels are also identified together with the number of trips per vessel with *No PNO*. An analysis of the vessels/trips with *No PNO* could be an element for the target analysis, either through inspections or through a desk based follow up, in addition to provide evidence to determine if an infringement has taken place.

Analyses could be performed to identify PNO that was submitted to the Flag State less than 4 hours before the time of arrival or later than the time MS had permitted according to the derogation in the Control Regulation. The analyses could be performed following the same methodology as for analysing for no PNO.

Ratio of the number of trips exceeding the margin of tolerance (MOT)

1. **Name of indicator:**

Ratio of the number of trips exceeding the margin of tolerance (MOT), as indicator of misrecording.

2. **Rationale for the indicator and legal basis**

Exceeding the margin of tolerance in the logbook is misreporting of catches. The indicator is identifying all trips where the differences between the declared catches in the logbook and the declared catches in the landing declaration exceed the 10 % margin of tolerance for one or several species.

The EU Control Regulation 1224/2009, article 14, no. 3[2], allows the margin of tolerance for estimation of weight per species in the logbook to be a maximum of 10%.

According to the article 14, no. 1[3] all species above 50 kg of live-weight, by trip, shall be recorded in the logbook.

3. **Scope (spatial and temporal limit of the indicator)**

The indicator is applicable for the evaluation of the likelihood of misreporting of catches and as input for the targeting system of national risk assessment and as a compliance based benchmark. It can be applicable to all fleet segments in all areas, but it could be more relevant for some specific fleets segments and / or specific areas, where misreporting of catches is perceived to be an issue. It is applicable to vessels with an overall length larger than 12 meters. The scope could be restricted to only one species/ stock, e.g. cod in the Baltic Sea or applied to a specific fleet segment or fleet segment group e.g. demersal species in the North Sea.
According to the Control Regulation all species for which catch is above 50 kg of live-weight have to be recorded in the logbook. Therefore, trips with registration of species less than 50 kg of live-weight in the logbook and in the landing declaration should be excluded from the analyses.
The analyses should be carried out with data from a whole year, but it might also be useful to calculate the indicator only for a given period, when misrecording of catches is likely higher, e.g., period of quota limitations. The seasonality and main peaks of activity of the fisheries should also be considered.

[2] **Article 14, Completion and submission of the fishing logbook**
3. The permitted margin of tolerance in estimates recorded in the fishing logbook of the quantities in kilograms of fish retained on board shall be 10 % for all species.

[3] Without prejudice to specific provisions contained in multiannual plans, the master of each Union fishing vessel of 10 metres' length overall or more shall keep a fishing logbook of operations, indicating specifically, for each fishing trip, all quantities of each species caught and kept on board above 50 kg of live-weight equivalent. The 50 kg threshold shall apply as soon as catches of a species exceed 50 kg.

4. **Metric (the unit of what the indicator is measuring. The unit of the analysis should be defined here as well.**

Ratio (in %) of the number of trips exceeding the MOT is calculated as the number of trips that have exceeded the margin of tolerance for one or more species divided by the total number of trips of the same species/group of species in the unit of analysis (see below) and expressed as a percentage. The calculation will give the same weight to a trip with all species exceeded the MOT as a trip with only one specie exceeding the MOT.

Trips with registration of species less than 50 kg of live-weight in the logbook and in the landing declaration should be excluded from the analysis.

	Landing declaration > 50 kg	**Landing declaration < 50 kg**
Logbook > 50 kg	Included in the analysis	Included in the analysis?
Logbook < 50 kg	Included in the analysis	Excluded from the analysis

Unit of analysis: the calculation can be done at fleet segment level, area/fleet segments combination or at species level. If the latter is the case, an overall value for the fleet segment could be derived from the individual scores of the species considered.

"*Exceeded MOT*" is defined as a difference higher than the allowed 10 % between the weight of fish recorded in the logbook and the weight of the same species recorded in the landing declaration (both in live weight).

"Exceeded MOT-inspected" is the number of landings where the MOT was exceeded and is identified through land inspections. The use of these data are explained in point 8, Assumptions of the analyses and ways of verifying.

5. **Reference values (the verified quantity against which compare the declared data)**

There are no reference values for this indicator. The differences in declared catches in the logbook and the landing declarations should not exceed the 10% allowed margin of tolerance.

6. **Compliance criteria (the levels of which compliance is considered). A target level can also be defined**

Regional national RA

The ratio of the number of trips exceeding the MOT should be translated into the four different compliance levels (low, medium, high and very high). The scale should be the same for all fleet segments.

The equivalence from ratio of non-compliance to likelihood levels could be presented like this:

Level of likelihood	Ratio of landings exceeding the MOT
Low	Less than %
Medium	% to %
High	% to %
Very high	More than %

Compliance benchmark

The ratio of the number of trips exceeding the MOT could be used as common compliance benchmark for all MS within a regional scope. If the aggregated ratio of the number of trips exceeding the MOT indicates a likelihood value of e.g. “high” or “very high” for a given year, MS and EFCA should agree to set the compliance benchmark as a decrease in the ratio of the number of trips exceeding the MOT the following year or as a multiannual approach (i.e., reaching a target stepwise in a series of years).

MS would likely have different values of the indicator. The experience from MS with a higher level of compliance could be shared as best practice to help other MS to achieve the agreed compliance benchmarks.

The table shows **an example** how multiannual benchmarks could be set, where the estimates obtained by the use of the proposed indicator correspond to a very high level of likelihood:

Year	Expected ratio (non-compliance benchmark)
0	XX % = very high (current value)
1	YY % = high (reduction from previous year)
2	ZZ % = medium (reduction from previous year)
3	WW % = low (reduction from previous year)
4	WW % (maintenance benchmark)

7. Detailed description on how to calculate the indicator (should completed together with MS, based on their experiences)

a. Data source and format

The data for the analyses are obtained from the live weight of the catches by species declared in the logbook and the associated information (live weight by species) from the landing declaration. The differences between both figures for each species should not exceed the 10% of the catches in the landing declaration. This MOT is calculated for each species.

The data from the logbooks and the landing declaration should be available as dataset in all MS. Segmentation is based on the information from the logbook (gear, mesh size and area).

The association between a given logbook and the correspondent landing declaration can be conducted via a unique data identifier or by a set of common criteria. Experiences from MS should be used to

describe a common methodology. The calculation of the ratio of the number of trips exceeding the MOT when comparing the estimates of the catches recorded in the logbook and the catches reported in the landing declaration per fleet segment (or species/group of species) should be performed by the MS.

The aggregation of results from different MS and the final evaluation at regional level could be carried out by EFCA in cooperation with the MS.

b. **Quality control** (should be completed together with MS based on their experiences, including examples)

- **i.** **Validation through business rules**
- **ii.** **Verification**
- **iii.** **Document the quality check process**

c. **Methodology for the calculation/analysis** (should be completed together with MS based on their experiences)

- **i.** **Description tool available, if applicable**

8. **Assumptions of the analysis and ways of verifying**

MS could perform more detailed analysis of the indicator, such as related to specific species or gears. The results could be relevant when proposing risk treatment measures. In addition, an evaluation of the rationale of the ratio of the number of trips exceeding the MOT could be conducted by comparing the results from the analyses with information detected through landing inspections. Inspection reports could qualify and verify the findings in the analyses. If, for example, the majority of inspection reports where inspectors have noted that the allowed MOT was exceeded and misreporting of species and/or weight has taken place, the appropriateness of the indicator to estimate the likelihood of misreporting is confirmed. If, however, the majority of inspection reports where inspectors have noted that the allowed MOT was exceeded indicate other causes different from misreporting, the appropriateness of the indicator to estimate the likelihood of misreporting should be reconsidered.

The evaluation and verification could be carried out by MS as they have access to the whole inspection report. In EFCA only specific sections of the inspection reports are registered in JaDE.

9. **Reporting** (when, by whom, to whom)

a. Frequency

The analyses could be performed annually by MS during the 1st quarter of the following year. The results of the analyses carried out by MS should be sent to EFCA no later than 15th April to be prepared as an input to the annual Regional Risk Assessment workshop in 1. Semester.

b. Definition of output/report

The output from the analyses from each MS sent to EFCA to be used in the Regional Risk Assessment work should look like this table:

	MS 1			**Total**
Period	**1/1-20XX to 31/12-20xx**			
Fleet segment	XX01	XX02	XX03	
Numbers of landings analysed	1.000	200	500	1.700
Numbers of landing exceeding the MOT	10	10	20	40
Ratio of landings exceeding the MOT	1.0 %	5.0 %	4.0 %	2.4 %
Number of landings exceeding the MOT-inspected				

The output from the aggregated results from all MS to be used in the Regional Risk Assessment could look like this:

	Segment XX01		Segment XX02		Segment XX03	
Member State	Compliant	High margin	Compliant	High margin	Compliant	High margin
MS-1	990	10	190	10	480	20
MS-2	95	5	98	2	27	3
MS-3	260	40	980	20	470	30
MS-4	2.900	100	290	10	960	40
Total	4.245	155	1.558	42	1.937	93
Ratio of high margin		3.5 %		2.6 %		4.6 %

10. <u>Additional comments with recommendations and caveats of the calculation</u> (e.g., consideration about Margin or Tolerance when estimating the misrecording of unsorted catches)

The Commission has defined how the margin of tolerance should be calculated for unsorted catches of small pelagic species in the Baltic Sea. For these landings, the margin of tolerance should be calculated on the total catch and not per species, effectively preventing the calculation of this indicator by species, since only when differences in the declared catches of ALL species in the logbook and the catches of ALL species in the landing declaration represent more than 10% will constitute a non-compliance event.

The results of the analyses of the number of trips exceeding the allowed margin of tolerance could be used in the operational work. When MS have carried out the identification of the trips above the 10 % MOT the vessels are also identified together with the number of trips with exceeded the MOT. An analysis of the vessels/trips exceeding MOT could be an element for the target analysis, either through inspections or through a desk based follow up, in addition to provide evidence to determine if an infringement has taken place.

Ratio of no VMS and AIS transmission

1. Name of indicator:

Ratio of no VMS and AIS transmission, as indicator of area misrecording

2. Rationale for the indicator (i.e., why to develop the indicator) and legal basis

Missing VMS- and AIS-signal at sea could indicate that a vessel, not reporting the current position, is trying to avoid an inspection at sea or trying to misreport area of catches.
Missing VMS- and AIS-signals could be caused by technical issues, not directly related to infringements/intentional misreporting activity. By using the data from two independent sources (VMS and AIS), the numbers of intervals caused by technical issues should be reduced.
The Commission Implementation Regulation 404/2011, article 12[4], requires vessels with length overall of 12 meters or more, to transmit VMS-signal to the Flag State at least every two hours.

The EU Control Regulation 1224/2009, article 10[5], requires vessels with length overall 15 meters or more to be fitted with an automatic identification system (AIS).

3. Scope (spatial and temporal limit of the indicator)

This indicator is applicable for the evaluation of the likelihood of misreporting of area and illegal fishing activities in restricted areas. It can be applicable to all fleet segments in all areas, but it will be more relevant for cases where misreporting of area was identified as an issue. It is applicable to vessels of ≥15 meters, as this is the minimum length with mandatory AIS.

Analyses could be performed on all VMS- and AIS-positions at sea or performed only on positions when conducting fishing operations. If the latter is the case, the travel time from and to port should be excluded from the analyses.

Generally, the analyses should be made on data from a whole year, but attention should be given to seasonal variations in the fishery. In periods of quota limitations, the number of hours of VMS-

[4] **Article 22 Frequency of data transmission**
1. Each Member State shall ensure that its FMC receives, at least once every 2 hours, through the VMS the information referred to in Article 19 of this Regulation concerning its fishing vessels. The FMC may require the information at shorter time intervals.

[5] **Article 10 Automatic identification system**
1. In accordance with Annex II Part I point 3 of the Directive 2002/59/EC, a fishing vessel exceeding 15 meters' length overall shall be fitted with and maintain in operation an automatic identification system which meets the performance standards drawn up by the International Maritime Organisation according to chapter V, Regulation 19, section 2.4.5 of the 1974 SOLAS Convention.

failure/AIS-failure might increase. In the case of periodic spatial closures, analyses should be focused on the period of restriction.

4. Metric (the unit of what the indicator is measuring,).

The ratio (in percentage) of no VMS and AIS transmission at sea is calculated as the sum of the number of hours in intervals of more than three hours without sending VMS and AIS messages divided by the total numbers of hours with VMS and AIS signals.

Traveling time could be excluded from the analyses; this will imply extra analyses to differentiate the travelling time and fishing time.

No VMS and AIS is defined as a period of three hours or more at sea without transmitting both VMS and AIS signal.

No VMS and AIS-inspected is defined as the number of trips with intervals > 3 hours without both VMS and AIS transmission, and being inspected at sea. The use of these data are explained in point 8, Assumptions of the analysis and ways of verifying.

5. Reference values (the verified quantity against which compare the declared data)

There are no reference values. In principle there should not be any failure in reporting VMS and AIS positions.

6. Compliance criteria (the levels of which compliance is considered,). A target level can also be defined

VMS- and AIS failure could be caused by technical issues, therefore when a failure is detected, further investigation is needed to determine its cause. The relationship between the indicator and the illegal activity (misreporting of area or fishing in restricted areas) is more likely to be proven true close to restricted area or boundaries.

The ratio of hours in intervals > 3 hours without both VMS and AIS transmission should be translated into the four different compliance levels (low, medium, high and very high). The scale should be the same for all fleet segments.

The equivalence from ratio of compliance levels could be presented like this:

Level of likelihood	**Ratio of hours in intervals > 3 hours without VMS/AIS transmission**
Low	Less than %
Medium	% to %
High	% to %
Very high	More than %

Compliance benchmark

The ratio of hours in intervals > 3 hours without VMS/AIS transmission could be used as common compliance benchmark for all MS within the scope. If the aggregated ratio of hours in intervals > 3 hours without VMS/VMS transmission ends up with a likelihood of “high” or “very high” for a given year, MS and EFCA could agree to set the compliance benchmark as a decrease in the ratio of hours in intervals > 3 hours without VMS/AIS transmission the following year with or without specific targets. Multiannual compliance benchmarks could also be considered.

MS would likely have different levels of ratio hours in intervals > 3 hours without VMS/AIS transmission. The experiences from MS with a higher level of compliance could be shared as best practice to help other MS to achieve the agreed compliance benchmarks.

The table shows **an example** how multiannual benchmarks could be set, where the estimates obtained by the use of the proposed indicator correspond to a very high level of likelihood:

Year	Expected ratio (non-compliance benchmark)
0	XX % = very high (current value)
1	YY % = high (reduction from previous year)
2	ZZ % = medium (reduction from previous year)
3	WW % = low (reduction from previous year)
4	WW % (maintenance benchmark)

7. Detailed description on how to calculate the indicator (should be completed together with MS, based on their experiences)

a. Data source and format

The data for the analyses will be VMS- and AIS messages. Because the analysis needs to be performed at fleet segment level (for the regional application of the indicator), information on gear/mesh size and area of operation would also need to be provided. This information is available in the logbook data.

VMS-data in MS have a field named “STATUS”. In this field different codes are possible, telling the reason of the VMS-failure. Examples could be “Power down” (PWDN) or “Antenna block” (ANTBLKT).

In the VMS-data available in EFCA all data in the field “STATUS” are “POS”. The details from MS are not sent to EFCA.

Because of this difference in data between MS and EFCA, the calculation of the ratio hours in intervals > 3 hours without VMS/AIS transmission per fleet segment could be performed by the MS.

The aggregation of results from MS and the final evaluation and regional risk assessment could be made by EFCA in cooperation with MS.

b. **Quality control** (should be completed together with MS based on their experiences, including examples)

- **i.** **Validation through business rules (e.g., check for duplicates, areas outside the fleet segment definition, etc.)**
- **ii.** **Verification (e.g., cross-check with other source of information)**
- **iii.** **Document the quality check process (e.g., description of errors detected, and changes made to the original data)**

c. **Methodology for the calculation/analysis** (should be completed together with MS based on their experiences)

- **i.** **Description tool available, if applicable (e.g., Excel template, R script, GIS script, etc.)**

8. Assumptions of the analysis and ways of verifying

An evaluation of the rationale of the ratio of hours in intervals > 3 hours without VMS and AIS transmission could be conducted by comparing the results from the analyses with information detected through inspections.

Inspection reports could qualify and verify the findings in the analyses. If, for example, the majority of inspection reports where inspectors have noted that a failure of VMS and AIS was detected and misreporting of area or illegal fishery was indicated, the appropriateness of the indicator to estimate the likelihood of misreporting is confirmed.

If, however, the majority of inspection reports where inspectors have noted that a failure of VMS- and AIS signals indicate other causes (e.g. technical issues) different from misreporting, the appropriateness of the indicator to estimate the likelihood of misreporting should be reconsidered.

The evaluation and verification could be carried out by MS as they have access to the whole inspection report. In EFCA only specific sections of the inspection reports are registered in JADE.

9. Reporting

a. Frequency

The analyses could be performed annually by MS in 1st quarter the following year. The results of the analyses carried out by MS should be sent to EFCA no later than 15th April to be prepared as an input to the annual Regional Risk Assessment workshop in 1st Semester.

b. Definition of output/report

The output from the analyses from each MS sent to EFCA to be used in the Regional Risk Assessment work should look like this table:

	MS 1			**Total**
Period	**1/1-2018 to 31/12-2018**			
Fleet segment	XX01	XX02	XX03	
Numbers of hours at sea with fishing activity	100 000	20 000	50 000	170 000
Numbers of hours in interval >3 hours at sea with *No VMS/AIS* signal	1 000	1 000	2 000	4 000
Ratio of hours in intervals > 3 hours without VMS transmission	1.0 %	5.0 %	4.0 %	2.4 %
Number of trips with *No VMS/AIS*-inspected	10	20	40	70

The output from the aggregated results from all MS to be used in the Regional Risk Assessment could look like this:

	Segment XX01		Segment XX02		Segment XX03	
Member State	Compliant	No VMS	Compliant	No VMS	Compliant	No VMS
MS-1	10.000	100	5.000	200	20.000	100
MS-2	20.000	400	10.000	75	35.000	25
MS-3	50.000	700	30.000	500	60.000	500
Total	80.000	1.200	45.000	775	115.000	625
Ratio of No VMS		1.5 %		1.7 %		0.5 %

10. Additional comments with recommendations and caveats of the calculation

The results of the analyses of the ratio of hours in intervals > 3 hours without VMS and AIS transmission could be used in the operational work. When MS have carried out the identification of the trips with VMS/AIS-failure the vessels are also identified together with the number of hours without transmission. An analysis of the vessels/trips with VMS/AIS-failure could be an element for the target analysis, either through inspections or through a desk based follow up, in addition to provide evidence to determine if an infringement has taken place.

Misreported trips ratio (MTR)

1. Name of the indicator:

Misreported trips ratio (MTR), as indicator of misreporting.

2. Rationale for the indicator (i.e., why to develop the indicator) and legal basis:

Pelagic fisheries in the Baltic Sea mainly target herring and sprat in a mixed fishery operated by trawlers using nets with a range of different mesh sizes. The proportion of herring and sprat in the catches depends on the mesh size but also varies with area and season. This mixed fishery primarily obtains fish for use as animal feed, fish oil and fish meal, although fish for direct human consumption can also be taken. Fish not landed for human consumption are landed unsorted and the species composition of these catches is difficult to estimate accurately. For a number of years, and especially since the late 1990s when the quotas for both species started to limit the fishery (Hentati-Sundberg et al., 2014), it is believed that systematic misreporting of herring and sprat has been taking place both in the logbooks and landing declarations (ICES, 2018).

For catches which are landed unsorted, Article 13 of Regulation (EU) No 2016/1139 establishing a multiannual plan for the stocks of cod, herring and sprat in the Baltic Sea and the fisheries exploiting those stocks, derogates Article 14(3) of Regulation (EU) No 1224/2009 specifying that the permitted margin of tolerance between the catch recorded in the logbook and the catch retained on board *"shall be 10% of the total quantity retained on board*".

Inspectors carry out sampling of the landings at the port following agreed guidelines (see section 11. Annexes) and provide the weight of the different species in the samples taken. The number of samples to be taken depends on the weight of the total catch (see section 11. Annexes).

3. Scope (spatial and temporal limit of the indicator):

The indicator was developed for the evaluation of the level of misreporting of the unsorted catches of pelagic fisheries in the Baltic Sea. Nevertheless, the indicator could be applied to other fisheries where species misreporting is perceived to be an issue and it is possible to obtain reference data.

4. Metric (the unit of what the indicator is measuring, e.g., BMS discard ratio, number of trips with misrecording, etc.). The unit of the analysis should be defined here as well (e.g., fleet segment, area, temporal scale, etc.):

The misreported trips ratio (in %) is calculated by dividing the number of trips considered to be misreporting by the total number of trips in a unit of analysis.

The unit of analysis should be the fleet segment or the fleet segment / subdivision (area).

5. Reference values (the verified quantity against which compare the declared data):

The reference level (expected proportion of herring or sprat) is calculated based on the mean and 95% confidence intervals of the estimates of the proportion of herring or sprat in the catches of vessels subjected

to an inspection. These values are calculated from the weight of the samples taken during the inspections of unsorted landings.

6. <u>Compliance criteria</u> (the levels of which compliance is considered, e.g., low, medium, high, very high). A target level can also be defined:

Possible compliance criteria for this indicator are under discussion and a target level has not been defined.

The compliance criteria levels should be defined as shown in the table below and can be used as likelihood of non-compliance for national and/or regional risk assessment:

Level of likelihood	Value of the indicator
Low	Less than %
Medium	% to %
High	% to %
Very high	More than %

As is the case with other indicators, this indicator could be used at regional level to allow the establishment of regional compliance benchmarks to be attained by MS, one, two or several years down the line. Regional compliance benchmarks could be set at specific levels of reduction in the misreporting, or, since it is likely that different countries will have different misreporting values, the compliance benchmark could refer to an absolute or percentage decrease in the misreporting figures.

The table shows **<u>an example</u>** how multiannual benchmarks could be set, where the estimates obtained by the use of the proposed indicator correspond to a very high level of likelihood:

Year	Expected ratio (non-compliance benchmark)
0	XX % = very high (current value)
1	YY % = high (reduction from previous year)
2	ZZ % = medium (reduction from previous year)
3	WW % = low (reduction from previous year)
4	WW % (maintenance benchmark)

7. <u>Detailed description of how to calculate the indicator</u> (should be completed together with MS, based on their experiences):

a. <u>Data source and format</u>:

Two sources of data are needed for the calculation of this indicator: reference and non-reference data:

- Reference data: the amount of herring and sprat in the samples of the landings taken by inspectors.
- Non reference data: the amount of herring and sprat declared in the logbooks.

Since herring and sprat are the main species in the fisheries, remaining species in the catches are not considered when calculating the proportion of herring and sprat in the catch/samples.

b. <u>Quality control</u>:

As far as possible, samples taken during the inspections should follow the agreed guidelines (see Annex 2) to ensure representative samples are taken.

c. Methodology for the calculation/analysis (should be completed together with MS based on their experiences)

Non-parametric bootstrap methods can be used to estimate the mean and confidence limits for the proportions of herring and sprat in the reference data per unit of analysis (ICES subdivision and fleet segment for example).

Once the mean and confidence intervals are obtained, the indicators can be calculated comparing the proportions of herring and sprat in each non-reference trip with the mean value obtained from the inspections, taking into account the variability in the estimates (provided by the CIs).

For the indicator it is necessary to calculate the ratio between the number of trips outside the acceptable range of values (as calculated from the inspected data) and the total number of trips. The approach assumes that any trip with a proportion of herring/sprat outside the range delimited by the 95% confidence intervals could be considered to represent misreporting. It should be noted that, about 5% of the time, trips outside this range would not be misreporting (or 1% if we have chosen the 99% confidence intervals, 0.1% in case of 99.9% confidence intervals, etc.).

8. Assumptions of the analysis and ways of verifying:

The appropriateness of the indicator to estimate the likelihood of misreporting depends on the existence of sufficient and sufficiently representative reference data (the sampling of the landings taken by the inspectors) to be able to derive meaningful averages and confidence intervals of the expected range of the proportion of herring or sprat (using appropriate statistical techniques such as bootstrapping). Small sample sizes for reference data limit the power of the indicator to detect statistically significant differences between the proportions of herring and sprat obtained by the inspectors and those reported by the vessels.

9. Reporting (when, by whom, to whom):

a. Frequency

Depending on the requirements of the MS and RRA groups.

b. Definition of output/report

10. Additional comments with recommendations and caveats of the calculation:

Article 13 of Regulation (EU) No 2016/1139 states that "*for catches which are landed unsorted the permitted margin of tolerance in estimates recorded in the fishing logbook of the quantitates in kilograms of fish retained on board shall be 10% of the total quantity retained on board*". Furthermore, a letter has been sent by the Commission explaining how to interpret the margin of tolerance (MOT). In this letter it is

indicated that the interpretation of the "*10% of the total quantity retained on board appears to refer to the total quantity retained on board, meaning all entries in the logbook summed together"* and that "*the MOT would not apply to single species*".

This has implications for the consideration of whether species misreporting of unsorted landings in the Baltic Sea would result in an infringement or not, taking into consideration that it will be considered an infringement only if the total stated catch of all species in the logbook is above (or below) 10% of the total landed catch.

The indicator is calculated to provide information on the likelihood of misreporting and on patterns and trends in misreporting over time and across areas. An analysis was carried out on how a 10% increase or decrease in the total catch could be accommodated in the calculations of the indicator, by allowing that 10% to be added to the quantity reported for herring or sprat, respectively. However, although the latter results help us to identify misreporting, they are not indicative of infringements because the MOT is not applied to single species in this fishery in the Baltic.

References

ICES, 2018. Report of the Baltic Fisheries Assessment Working Group (WGBFAS). ICES CM 2018/ACOM:11, 736 pp.

Lassen, H., 2012. Industrial Fisheries in the Baltic Sea. IPOL-PECH_NT(2011)460040_EN.

Hentati-Sundberg, J., Hjelm, J. & Österblom, H., 2014. Does fisheries management incentivize non-compliance? Estimated misreporting in the Swedish Baltic Sea pelagic fishery based on commercial fishing effort. Ices Journal of Marine Science, doi: 10.1093/icesjms/fsu036.

11. Annexes

Guidelines for sampling landings of mixed small pelagic during landing inspections in the Baltic Sea.

Guidelines to be applied when sampling landings of mixed small pelagics (HER / SPR) during landing inspections in the Baltic Sea.

Agreed Guidelines (see footnotes)					
Landing Quantity		Minimum Sample	Further sampling where discrepancies identified[1]	Sub-Sample Size[2]	Distribution
< 20t	→	10kg	100kg	1 x 10kg	Evenly distributed. By weight or timing. Represents stowage.
>20t <100t	→	20kg	100kg	2 x 10kg	
>100t <200t	→	40kg	100kg	4 x 10kg	
>200t	→	40kg	0.5 *Promille*	4 x 10kg	

Briefing Notes for Inspectors

Quantity of the landing: The sampling guidelines are based on four landing tonnage groups as shown in the table. This recognises that the sampling should be relative to the size of the landing. Decide on what sampling guidelines should be followed based on the tonnage reported in the pre-notification (PNO).

Minimum sample: The minimum quantity sampled from the landing should be between 10 kg to 40 kg, depending on the size of the landing.

Sub-sample size: Inspectors may be flexible within the minimum standards in the table. If it is more appropriate in the circumstances to take more sub-samples of a smaller size, this is OK as long as the minimum for the landing quantity is met. For

[1] A guiding principle rather than a rigid requirement; recognising that some Member States may have operational constraints and in some cases the national methodology may be under review.
[2] Minimum standard. Agreed that could be split into more sub-samples (i.e. 2 x 5kg = 1 x 10kg, etc.).

Misreported catch ratio (MCR)

1. Name of the indicator:

Misreported catch ratio (MCR), as indicator of misreporting.

2. Rationale for the indicator (i.e., why to develop the indicator) and legal basis:

Pelagic fisheries in the Baltic Sea mainly target herring and sprat in a mixed fishery operated by trawlers using nets with a range of different mesh sizes. The proportion of herring and sprat in the catches depends on the mesh size but also varies with area and season. This mixed fishery primarily obtains fish for use as animal feed, fish oil and fish meal, although fish for direct human consumption can also be taken. Fish not landed for human consumption are landed unsorted and the species composition of these catches is difficult to estimate accurately. For a number of years, and especially since the late 1990s when the quotas for both species started to limit the fishery (Hentati-Sundberg et al., 2014), it is believed that systematic misreporting of herring and sprat has been taking place both in the logbooks and landing declarations (ICES, 2018).

For catches which are landed unsorted, Article 13 of Regulation (EU) No 2016/1139 establishing a multiannual plan for the stocks of cod, herring and sprat in the Baltic Sea and the fisheries exploiting those stocks, derogates Article 14(3) of Regulation (EU) No 1224/2009 specifying that the permitted margin of tolerance between the catch recorded in the logbook and the catch retained on board *"shall be 10% of the total quantity retained on board*".

Inspectors carry out sampling of the landings at the port following agreed guidelines (see section 11. Annexes) and provide the weight of the different species in the samples taken. The number of samples to be taken depends on the weight of the total catch (see section 11. Annexes).

3. Scope (spatial and temporal limit of the indicator):

The indicator was developed for the evaluation of the level of misreporting of the unsorted catches of pelagic fisheries in the Baltic Sea. Nevertheless, the indicator could be applied to other fisheries where species misreporting is perceived to be an issue and it is possible to obtain reference data.

4. Metric (the unit of what the indicator is measuring). The unit of the analysis should be defined here as well:

The misreported catch ratio (in %) is calculated for each species by adding up the amounts of herring or the amounts of sprat that are considered to be misreported in each trip (derived from the difference in the declared herring or sprat proportion and the reference values obtained from the inspections) and dividing the figure by the total catch of herring or sprat in a unit of analysis.

The unit of analysis should be the fleet segment or the fleet segment / subdivision (area).

5. Reference values (the verified quantity against which compare the declared data):

The reference level (expected proportion of herring or sprat) is calculated based on the mean and 95% confidence intervals of the estimates of the proportion of herring or sprat in the catches of vessels subjected to an inspection. These values are calculated from the weight of the samples taken during the inspections of unsorted landings.

6. <u>Compliance criteria</u> (the levels of which compliance is considered, e.g., low, medium, high, very high). A target level can also be defined:

Possible compliance criteria for this indicator are under discussion and a target level has not been defined.

The compliance criteria levels should be defined as shown in the table below and can be used as likelihood of non-compliance for national and/or regional risk assessment:

Level of likelihood	Value of the indicator
Low	Less than %
Medium	% to %
High	% to %
Very high	More than %

As is the case with other indicators, this indicator could be used at regional level to allow the establishment of regional compliance benchmarks to be attained by MS, one, two or several years down the line. Regional compliance benchmarks could be set at specific levels of reduction in the misreporting, or, since it is likely that different countries will have different misreporting values, the compliance benchmark could refer to an absolute or percentage decrease in the misreporting figures.

The table shows **<u>an example</u>** how multiannual benchmarks could be set, where the estimates obtained by the use of the proposed indicator correspond to a very high level of likelihood:

Year	Expected ratio (non-compliance benchmark)
0	XX % = very high (current value)
1	YY % = high (reduction from previous year)
2	ZZ % = medium (reduction from previous year)
3	WW % = low (reduction from previous year)
4	WW % (maintenance benchmark)

7. <u>Detailed description of how to calculate the indicator</u> (should be completed together with MS, based on their experiences):

d. <u>Data source and format</u>:

Two sources of data are needed for the calculation of this indicator: reference and non-reference data:

- Reference data: the amount of herring and sprat in the samples of the landings taken by inspectors.
- Non reference data: the amount of herring and sprat declared in the logbooks.

Since herring and sprat are the main species in the fisheries, remaining species in the catches are not considered when calculating the proportion of herring and sprat in the catch/samples.

e. Quality control:

As far as possible, samples taken during the inspections should follow the agreed guidelines (see section 11. Annexes) to ensure representative samples are taken.

f. Methodology for the calculation/analysis (should be completed together with MS based on their experiences)

Non-parametric bootstrap methods can be used to estimate the mean and confidence limits for the proportions of herring and sprat in the reference data per unit of analysis (ICES subdivision and fleet segment for example). Once the mean and confidence intervals are obtained, the indicators can be calculated comparing the proportions of herring and sprat in each non-reference trip with the mean value obtained from the inspections, taking into account the variability in the estimates (provided by the CIs).

For the indicator it is necessary to calculate the quantities of herring or sprat that are considered to be misreported, corresponding to fishing trips for which the declared ratio of herring or of sprat for the trip is outside the acceptable range of values calculated from the reference (inspection) data. Once all the quantities of herring (or sprat) are added up, the figure is divided by the total catch of herring or sprat for the fleet segment and area being considered (including the catch of the trips inside the expected values for herring/sprat proportions). The calculation is done separately for each species. As before, the approach considers that any trip with a proportion of herring/sprat outside the range delimited by the 95% confidence intervals of the reference data could be considered to represent misreporting (with a 5% chance of been miss-assigned).

8. Assumptions of the analysis and ways of verifying:

The appropriateness of the indicator to estimate the likelihood of misreporting depends on the existence of sufficient and sufficiently representative reference data (the sampling of the landings taken by the inspectors) to be able to derive meaningful averages and confidence intervals of the expected range of the proportion of herring or sprat (using appropriate statistical techniques such as bootstrapping). Small sample sizes for reference data limit the power of the indicator to detect statistically significant differences between the proportions of herring and sprat obtained by the inspectors and those reported by the vessels.

9. Reporting (when, by whom, to whom):

a. Frequency

Depending on the requirements of the MS and RRA groups.

b. Definition of output/report

10. <u>Additional comments with recommendations and caveats of the calculation</u>:

Article 13 of Regulation (EU) No 2016/1139 states that "*for catches which are landed unsorted the permitted margin of tolerance in estimates recorded in the fishing logbook of the quantitates in kilograms of fish retained on board shall be 10% of the total quantity retained on board*". Furthermore, a letter has been sent by the Commission explaining how to interpret the margin of tolerance (MOT). In this letter it is indicated that the interpretation of the "*10% of the total quantity retained on board appears to refer to the total quantity retained on board, meaning all entries in the logbook summed together"* and that "*the MOT would not apply to single species*".

This has implications for the consideration of whether species misreporting of unsorted landings in the Baltic Sea would result in an infringement or not, taking into consideration that it will be considered an infringement only if the total stated catch of all species in the logbook is above (or below) 10% of the total landed catch.

The indicator is calculated to provide information on the likelihood of misreporting and on patterns and trends in misreporting over time and across areas. An analysis was carried out on how a 10% increase or decrease in the total catch could be accommodated in the calculations of the indicator, by allowing that 10% to be added to the quantity reported for herring or sprat, respectively. However, although the latter results help us to identify misreporting, they are not indicative of infringements because the MOT is not applied to single species in this fishery in the Baltic.

References

ICES, 2018. Report of the Baltic Fisheries Assessment Working Group (WGBFAS). ICES CM 2018/ACOM:11, 736 pp.

Lassen, H., 2012. Industrial Fisheries in the Baltic Sea. IPOL-PECH_NT(2011)460040_EN.

Hentati-Sundberg, J., Hjelm, J. & Österblom, H., 2014. Does fisheries management incentivize non-compliance? Estimated misreporting in the Swedish Baltic Sea pelagic fishery based on commercial fishing effort. Ices Journal of Marine Science, doi: 10.1093/icesjms/fsu036.

11. <u>Annexes</u>

Guidelines for sampling landings of mixed small pelagic during landing inspections in the Baltic Sea.

Guidelines to be applied when sampling landings of mixed small pelagics (HER / SPR) during landing inspections in the Baltic Sea.

Agreed Guidelines (see footnotes)					
Landing Quantity		Minimum Sample	Further sampling where discrepancies identified[1]	Sub-Sample Size[2]	Distribution
< 20t	→	10kg	100kg	1 x 10kg	Evenly distributed. By weight or timing. Represents stowage.
>20t <100t	→	20kg	100kg	2 x 10kg	
>100t <200t	→	40kg	100kg	4 x 10kg	
>200t	→	40kg	0.5 *Promille*	4 x 10kg	

Briefing Notes for Inspectors

Quantity of the landing: The sampling guidelines are based on four landing tonnage groups as shown in the table. This recognises that the sampling should be relative to the size of the landing. Decide on what sampling guidelines should be followed based on the tonnage reported in the pre-notification (PNO).

Minimum sample: The minimum quantity sampled from the landing should be between 10 kg to 40 kg, depending on the size of the landing.

Sub-sample size: Inspectors may be flexible within the minimum standards in the table. If it is more appropriate in the circumstances to take more sub-samples of a smaller size, this is OK as long as the minimum for the landing quantity is met. For

[1] A guiding principle rather than a rigid requirement; recognising that some Member States may have operational constraints and in some cases the national methodology may be under review.
[2] Minimum standard. Agreed that could be split into more sub-samples (i.e. 2 x 5kg = 1 x 10kg, etc.).

Non-compliance with Landing Obligation indicators

BMS discards rate

1. **Name of indicator:**

   BMS discards rate, as indicator of compliance with LO.

2. **Rationale for the indicator (i.e., why to develop the indicator) and legal basis**

   The ratio of catches below the Minimum Conservation Reference Size (MCRS), designated as Below Minimum Size (BMS), derived from reference data (inspections or vessels operating with CCTV, for example) for a species caught by a given fleet segment is assumed to be representative of the BMS ratio of non-reference data of that fleet segment and used to estimate the discard rate.

   Differences between the landed BMS (declared and retained) and the estimate BMS calculated from reference data can be used as an indicator of compliance with the LO.
   Under Article 15[6] of the Common Fisheries Policy (EU regulation 1380/2013), all catches of species which are subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes […] shall be brought and retained on board the fishing vessels, recorded, landed and counted against the quotas where applicable. Some exemptions are detailed in Article 15 of the above referred regulation.

3. **Scope (spatial and temporal limit of the indicator)**

   This indicator is appropriate when the discarded unwanted catch consists only of fish below the MCRS. The discard ratio should be calculated by species and fleet segments. A more disaggregated unit of analysis within a fleet segment, could also be considered. For example, particular areas or time periods could be considering within a fleet segment (e.g., a given area within a fleet segment and a given quarter or month).

   The indicator could be calculated for species subject to the LO but also for species not-subject to the LO. In the latter case, it could be considered as an indicator of misrecording, since discards above 50kg should be recorded in the logbook, according to the Control Regulation.

[6] Article 15 **Landing obligation**

1. All catches of species which are subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes as defined in Annex III to Regulation (EC) No 1967/2006, caught during fishing activities in Union waters or by Union fishing vessels outside Union waters in waters not subject to third countries' sovereignty or jurisdiction, in the fisheries and geographical areas listed below shall be brought and retained on board the fishing vessels, recorded, landed and counted against the quotas where applicable, except when used as live bait.

4. **<u>Metric</u> (the unit of what the indicator is measuring). The unit of the analysis should be defined here as well.**

   The BMS discards rate is calculated as the difference in the ratios of BMS obtained from reference data and from the reported BMS in the logbook of non-reference data. These rates are calculated dividing the BMS quantities in the catch of a given species by the total catch (BMS + Legal Size Catch (LSC)).

   Unit of analysis: The analysis should be conducted by species. The unit should be the fleet segment or a specific area(s) within a fleet segment. A temporal component (month or quarter) could also be considered within a fleet segment.

5. **<u>Reference values</u> (the verified quantity against which compare the declared data))**

   The reference data are the size catch composition of the species split in two components (above and below MCRS) collected during detailed inspections at sea, designated as Last Haul (LH), or from catch data from vessels operating with CCTV.

6. **<u>Compliance criteria</u> (the levels of which compliance is considered). A target level can also be defined.**

The following compliance levels are currently used by EFCA:

Unreported BMS rate	Likelihood of non-compliance	Compliance
<5% for one species	Low	High
≥5% and <15% for one species	Medium	Medium
≥15% for one species	High	Low
≥15% for more than one species	Very high	

As is the case with other indicators, this indicator could be used at regional level to allow the establishment of regional compliance benchmarks to be attained by MS, one, two or several years down the line. Regional compliance benchmarks could be set at specific levels of reduction in the misreporting, or, since it is likely that different countries will have different misreporting values, the compliance benchmark could refer to an absolute or percentage decrease in the misreporting figures.

The table shows **<u>an example</u>** how multiannual benchmarks could be set, where the estimates obtained by the use of the proposed indicator correspond to a very high level of likelihood:

Year	Expected ratio (non-compliance benchmark)
0	XX % = very high (current value)
1	YY % = high (reduction from previous year)

2	ZZ % = medium (reduction from previous year)
3	WW % = low (reduction from previous year)
4	WW % (maintenance benchmark)

7. Detailed description on how to calculate the indicator

a. Data source and format

b. Quality control (should be completed together with MS based on their experiences)

i. Validation through business rules (e.g., check for duplicates, areas outside the fleet segment definition, etc.)

Before conducting the analysis there are several data validations to conduct, both for the reference and non-reference data.

In the case of LH inspections, the provided combination of the categories “discard”/ “retained” (DIS/RET) and “BMS”/ “LSC”, should be checked. For species subject to LO with no exemptions it should not be possible to have records of “discards” (DIS). Also, independently of being subject to LO or not, it is also not correct to have a combination of DIS and LSC.

Records concerning predator damage fish, DIM, should be excluded from the analysis, as they can be both BMS and LSC.

The validation process for reference data of catches from vessels operating with CCTV is similar to the validation of non-reference data and include basic checks like the following:

- identification of duplicates, i.e., same vessel, same dates, same catches quantities. If duplicate records are identified they should be removed.
- Identification of incorrect area-fleet segment combinations (e.g., area 3.a for NS01). These records should if possible be corrected and, in case that is not possible, eliminated from the analysis.

ii. Verification (e.g., cross-check with other source of information)

In case of LH data, the information of fishing areas could be cross-checked with the area recorded in the logbook and recorded in JADE.

If the analysis is conducted at EFCA, the data from EFCA’s ERS could be cross-checked with MS’ERS.

iii. Document the quality check process

All the process of data correction should be duly documented, both in terms of listing the errors detected and of corrections made to the original data.

c. Methodology for the calculation/analysis

i. Description tool available, if applicable (e.g., Excel template, R script, GIS script, etc.)

See Annex.

8. Assumptions of the analysis and ways of verifying

The appropriateness of the indicator to estimate the compliance with the LO depends on the representativeness of the reference data.

If reference data are data from LH, it is assumed that it is representative of the fleet segment under analysis. Several analyses should be conducted / presented to test it representativeness, such as an evaluation of the spatial distribution of the available LH. The data used to calculate the indicators should cover all the area of operation of the fleet segment, to avoid cases where LH data are concentrated in a specific area that thus may not reflect the behaviour of the fleet in the whole area of operation of the fleet segment.

It is also important to check the mesh size during the LH, as it is desirable that the full range of mesh size covered by the fleet segment is represented, or at least, that the most frequently used mesh size (modal mesh size) is represented in the LH data.

Similarly, when using data from vessels operating with CCTV, the spatial information of their fishing activity should also be checked against the spatial activity of the rest of the fleet. This could be done by comparing the VMS data of vessels operating with and without CCTV.

9. Reporting

a. Frequency

The indicator could be calculated annually or more frequently if needed. It could be calculated by EFCA at regional level and also by the MS at national level. The quality of the analysis depends greatly of the representativeness of the reference data (e.g. number of LHs conducted in the fleet segment being analysed). Therefore, when the indicator is calculated at national level, reference data obtained at regional level could be used to increase reference data availability.

b. Definition of output/report

The report should provide the estimates of the (unreported) BMS ratio by species and unit of analysis (usually the fleet segment), including the sample sizes.

10. Additional comments with recommendations and caveats of the calculation

It is likely that vessels operating with CCTV have a different fishing behaviour than vessels operating without CCTV, as they will avoid areas with high concentration of juveniles. Therefore, when conducting the analysis using logbook data of vessels operating with CCTV as reference, the BMS ratio estimated should be considered as a minimum estimate.

11. Annexes

The generic calculations are presented below, where *f* denotes reference data and *n* denotes non-reference. Considering the BMS ratio, $bmsR_f$, of the reference data as:

Equation 1 $$\mathbf{bmsR_f = \frac{BMS_f}{BMS_f + LSC_f}}$$

the catch categories ratios (the BMS ratio and the LSC) of the reference data are assumed to be representative of the fleet segment. The ratio of LSC on non-reference data ($lscR_n$), is assumed to be equal to the LSC ratio of the reference data ($lscR_f$).

Equation 2 $$lscR_f = lscR_n = \frac{LSC_n}{LSC_n + BMS_n}$$

Considering that:

Equation 3 $$lscR_f = 1 - bmsR_f$$

Expanding the right term of **Error! Reference source not found.** and using also **Error! Reference source not found.**:

Equation 4 $$1 - bmsR_f = \frac{LSC_n}{LSC_n + BMS_n}$$

Note that the BMS_n in the denominator of the second term of Equation 4 has two components: i) the BMS that is declared (i.e., retained, landed and reported, $rBMS_n$) and ii) the BMS that is not declared (unreported and not landed, $uBMS_n$). The latter is unknown. Equation 4 can be re-written so that BMS_n, is split in the two components mentioned above, as:

Equation 5 $$1 - bmsR_f = \frac{LSC_n}{LSC_n + (rBMS_n + uBMS_n)}$$

which corresponds to:

Equation 6 $$uBMS_n = \frac{bmsR_f \cdot LSC_n}{(1 - bmsR_f)} - rBMS_u$$

Having an estimate of the discarded component, the discard ratio, uDR_n, is then calculated as:

Equation 7 $$uDR_n = \frac{uBMS_n}{uBMS_n + rBMS_n + LSC_n}$$

Equation 7 can be written directly as a function of the BMS discard ratio of reference data as:

Equation 8 $$uDR_n = \left(\frac{DR_f \cdot LSC_n}{1-DR_f} - rBMS\right) \cdot \left(\frac{1-DR_f}{LSC_n}\right)$$

Discard rate of fish above MCRS, high-grading (HG)

1. **Name of indicator:**

   Discard rate of fish above MCRS, high-grading (HG), as indicator of compliance with the LO.

2. **Rationale for the indicator (i.e., why to develop the indicator) and legal basis**

   The proportion of the grade of fish above the Minimum Conservation Reference Size (MCRS), derived from reference data (inspections or vessels operating with CCTV, for example) for a species caught by a given fleet segment is assumed to be representative of the proportion of the grade of fish of non-reference data of that fleet segment and used to estimate the high grading rate.

   Differences between the proportion of the grade size of fish declared and landed and the estimated proportion of grade size of fish calculated from reference data can be used as an indicator of compliance with the LO.

   Under Article 15[7] of the Common Fisheries Policy (EU regulation 1380/2013), all catches of species which are subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes […] shall be brought and retained on board the fishing vessels, recorded, landed and counted against the quotas where applicable. Some exemptions are detailed in Article 15 of the above referred regulation.

   Under Article 19a of the (EC) No 850/98[8] the discarding, during fishing operations, of species subject to quota, which can be legally landed, is prohibited.

3. **Scope (spatial and temporal limit of the indicator)**

   This indicator is appropriate when illegal discard of fish above MCRS is taking place. The discard rate should be calculated by species and fleet segments. A more disaggregated unit of analysis could also

[7] Article 15 **Landing obligation**

1. All catches of species which are subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes as defined in Annex III to Regulation (EC) No 1967/2006, caught during fishing activities in Union waters or by Union fishing vessels outside Union waters in waters not subject to third countries' sovereignty or jurisdiction, in the fisheries and geographical areas listed below shall be brought and retained on board the fishing vessels, recorded, landed and counted against the quotas where applicable, except when used as live bait.

[8] TITLE IIIa. Measures to reduce discarding
Article 19a. Prohibition of high-grading
1. Within Regions 1, 2, 3 and 4 the discarding, during fishing operations, of species subject to quota which can be legally landed shall be prohibited.
2. The provisions referred to in paragraph 1 are without prejudice to the obligations set out in this Regulation or in any other Union legal acts in the field of fisheries.
3. Paragraphs 1 and 2 shall not apply to catches or species, which are exempted from the application of the landing obligation in accordance with Article 15(4) of Regulation (EU) No 1380/2013.

be considered within a fleet segment. For example, particular areas or time periods could be considered within a fleet segment (e.g., a given area within a fleet segment and/or a given quarter or month).

The indicator is only calculated for species, which have defined grade sizes.

4. **Metric (the unit of what the indicator is measuring, including its definition).**

The HG discards rate is the estimated quantity of discarded fish above the MCRS divided by the total catch of fish above the MCRS (landings and estimated discards). The estimates of discards of fish above MCRS are calculated as the difference between the proportions of the grade sizes obtained from reference data and the proportions of grade sizes reported in the sales notes of non-reference data.

Unit of analysis: The analysis should be conducted by species. The unit should be the fleet segment or a specific area(s) within a fleet segment. A temporal component (month or quarter) could also be considered within a fleet segment, or any other disaggregation level that could show different discard practices of fish above MCRS

5. **Reference values (the verified quantity against which compare the declared data))**

The reference data are the grade size catch composition of the species above MCRS collected during detailed inspections at sea, designated as Last Haul (LH), or from catch data from vessels operating with CCTV declared in the sale notes.

6. **Compliance criteria (the levels of which compliance is considered). A target level can also be defined.**

The compliance criteria levels should be defined as shown in the table below and can be used as likelihood of non-compliance for national and/or regional risk assessment. In addition, these values could be used as targets for the compliance based benchmarks described as part of the SCIP requirements:

Unreported HG rate	Likelihood of non-compliance criteria	Compliance
< % for one species	Low	High
≥ % and < % for one species	Medium	Medium
≥ % for one species	High	Low
≥ % for more than one species	Very high	

Compliance benchmark

The HG ratio could be used as common compliance benchmark for all MS within a regional scope. If the value indicates “low” compliance for a given year, MS and EFCA should agree to set the compliance benchmark as a lower value for the following year or consider a progressive increase in compliance

(i.e., reaching the defined target at the end of a number of years with an agreed (or not) reduction in the value of the indicator each year).

When calculating the indicator, it is likely that different MS would obtain different values reflecting different discarding practices. The experience from MS with a higher level of compliance could be shared as best practice to help other MS achieve the agreed compliance benchmarks.

The table shows **an example** of how multiannual benchmarks could be set, where the estimates obtained by the use of the proposed indicator correspond to a very high likelihood of non-compliance:

Year	Expected ratio (non-compliance benchmark)
0	XX % = very high (current value)
1	YY % = high (reduction from previous year)
2	ZZ % = medium (reduction from previous year)
3	WW % = low (reduction from previous year)
4	WW % (maintenance benchmark)

7. Detailed description on how to calculate the indicator

a. Data source and format

The non-reference data are reported grades by species from sales notes.

The reference data could be either data (in grades) from inspection at sea (LH), or reported grades from sales notes of vessel operating with CCTV. In case of the latter, the non-reference data should exclude vessels operating with CCTV.

To carry out the analysis needed to derive the indicator, the catch data should have information on gear, mesh size and area to allow their allocation to the appropriate fleet segment.

b. Quality control (should be completed together with MS based on their experiences)

i. Validation through business rules (e.g., check for duplicates, areas outside the fleet segment definition, etc.)

Before carrying out the analysis, there are several data validations to conduct, both for the reference and non-reference data.

In the case of LH inspections, the provided combination of the grade size per species, should be checked. Grades outside the legal grades (either 1-4 or 1-5, depending on the species), should be excluded.

The validation process for reference data of catches from vessels operating with CCTV is similar to the validation of non-reference data and include basic checks like the following:

- Identification of duplicates, i.e., same vessel, same dates, same catches quantities. If duplicate records are identified, they should be removed.
-
- Identification of incorrect area-fleet segment combinations (e.g., area 3.a for NS01). These records should if possible be corrected and, in case this is not possible, eliminated from the analysis.

ii. Verification (e.g., cross-check with other source of information)

In case of LH data, the information of fishing areas could be crosschecked with the area recorded in the logbook and recorded in the inspection database, either JaDE at regional level or national inspection activities databases at MS level.

If the analysis is conducted at EFCA, the data from EFCA's ERS could be crosschecked with MS'ERS.

iii. Document the quality check process

All the process of data correction should be duly documented, both in terms of listing the errors detected and of corrections made to the original data.

c. Methodology for the calculation/analysis

i. Description tool available, if applicable (e.g., Excel template, R script, GIS script, etc.)

8. Assumptions of the analysis and ways of verifying

The appropriateness of the indicator to estimate the likelihood of non-compliance with the LO depends on the representativeness of the reference data.

If reference data are data from LH, it is assumed that it is representative of the fleet segment under analysis. Several analyses should be conducted / presented to test its representativeness, such as an evaluation of the spatial distribution of the available LH. The data used to calculate the indicators should cover all the area of operation of the fleet segment, to avoid cases where LH data are concentrated in a specific area that thus may not reflect the behaviour of the fleet in the whole area of operation of the fleet segment.

It is also important to check the mesh size during the LH, as it is desirable that the full range of mesh size covered by the fleet segment is represented, or at least, that the most frequently used mesh size (modal mesh size) is represented in the LH data.

Similarly, when using data from vessels operating with CCTV, the spatial information of their fishing activity should also be checked against the spatial activity of the rest of the fleet. This could be done by comparing the VMS data of vessels operating with and without CCTV.

9. Reporting

a. Frequency

The indicator could be calculated annually or more frequently if needed. It could be calculated by EFCA at regional level and by the MS at national level. The quality of the analysis depends greatly of the representativeness of the reference data (i.e. number of LHs conducted in the fleet segment being analysed, or proportion of vessels (or landings quantities) operating with CCTV)). Therefore, when the indicator is calculated at national level, reference data obtained at regional level could be used to increase reference data availability.

b. Definition of output/report

The report should provide the estimates of the (unreported) HG ratio by species and unit of analysis (usually the fleet segment), including the sample sizes.

10. Additional comments with recommendations and caveats of the calculation

It is likely that vessels operating with CCTV have a different fishing behaviour than vessels operating without CCTV, as they will avoid areas with high concentration of less valuable fish in smaller grade sizes. Therefore, when conducting the analysis using sale notes of vessels operating with CCTV as reference, the HG ratio estimated should be considered as a minimum estimate. This could be taken into account when using the indicator and the values should preferably be presented as "≥ xx%".

11. Annexes (available by EFCA in FISHNET)

a. Annex 1, Composition of grade-size as an indicator of high grading. Analyses on high grading of cod in sales notes in the North Sea in 2016. EFCA, 2016

b. Annex 2, Composition of grade-size as an indicator of high grading. Analyses on grade-size of cod, haddock, hake, saithe, and whiting in sales notes in the North Sea in 2016. EFCA 2017

c. Annex 3, Analysis of the grade-size of cod in sales notes in the North Sea in 2016 and 2017. Abascal, F. 2018

Difference in species rate

1. **Name of indicator:**

   Difference in species rate, as indicator of compliance with LO.

2. **Rationale for the indicator (i.e., why to develop the indicator) and legal basis**

   The ratio in the catch of two species derived from reference data (inspections or vessels operating with CCTV, for example) of a given fleet segment is assumed to be representative of the ratio (of the same species) of non-reference data of that fleet segment and is used to estimate the discard rate of one of the species. For this, the total catch of the second species needs to be known.

   Differences between the landed species ratio and the estimated species ratio calculated from reference data can be used as an indicator of compliance with the LO.

   Under Article 15[9] of the Common Fisheries Policy (EU regulation 1380/2013), all catches of species which are subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes […] shall be brought and retained on board the fishing vessels, recorded, landed and counted against the quotas where applicable. Some exemptions are detailed in Article 15 of the above referred regulation.

3. **Scope (spatial and temporal limit of the indicator)**

   This indicator is appropriate when the discarded unwanted catch of a species consists of both fish below and above the MCRS. In this case the estimates based on BMS rate do not provide the full picture of the level of discards taking place.

   The discard ratio should be calculated by species and fleet segments. A more disaggregated unit of analysis within a fleet segment, could also be considered. For example, particular areas or time periods could be considering within a fleet segment (e.g., a given area within a fleet segment and a given quarter or month).

4. **Metric (the unit of what the indicator is measuring). The unit of the analysis should be defined here as well.**

[9] Article 15 **Landing obligation**

1. All catches of species which are subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes as defined in Annex III to Regulation (EC) No 1967/2006, caught during fishing activities in Union waters or by Union fishing vessels outside Union waters in waters not subject to third countries' sovereignty or jurisdiction, in the fisheries and geographical areas listed below shall be brought and retained on board the fishing vessels, recorded, landed and counted against the quotas where applicable, except when used as live bait.

The discard rate of *Species A* is calculated dividing the discarded (un-reported) component of species *A* (uA_n) by the total catch of *Species A* ($A_{n,TOTAL}$). To estimate the total catch of *Species A* ($A_{n,TOTAL}$) the known catches of species B is used and also the ratio between *Species A* and *Species B* (derived from the reference data). Once the total catch of *Species A* is obtained, the discarded component (uA_n) is calculated as the difference between the total catches ($A_{n,TOTAL}$), and the reported catch in the logbook (see Annex).

Unit of analysis: the analysis should be conducted by species. The unit should be the fleet segment or a specific area(s) within a fleet segment. A temporal component (month or quarter) could also be considered within a fleet segment.

5. <u>Reference values</u> (the verified quantity against which compare the declared data))

The reference data are the catch quantities of the two species considered (*Species A* and *Species B)*, collected during inspections at sea, designated as Last Haul (LH), or from catch data from vessels operating with CCTV.

6. <u>Compliance criteria</u>. A target level can also be defined.

The following compliance levels are currently used by EFCA:

Discards rate	Likelihood of non-compliance	Compliance
<5% for one species	Low	High
≥5% and <15% for one species	Medium	Medium
≥15% for one species	High	Low
≥15% for more than one species	Very high	

As is the case with other indicators, this indicator could be used at regional level to allow the establishment of regional compliance benchmarks to be attained by MS, one, two or several years down the line. Regional compliance benchmarks could be set at specific levels of reduction in the misreporting, or, since it is likely that different countries will have different misreporting values, the compliance benchmark could refer to an absolute or percentage decrease in the misreporting figures.

The table shows **<u>an example</u>** how multiannual benchmarks could be set, where the estimates obtained by the use of the proposed indicator correspond to a very high level of likelihood:

Year	Expected ratio (non-compliance benchmark)
0	XX % = very high (current value)
1	YY % = high (reduction from previous year)
2	ZZ % = medium (reduction from previous year)
3	WW % = low (reduction from previous year)
4	WW % (maintenance benchmark)

7. Detailed description on how to calculate the indicator

a. Data source and format

b. Quality control

i. Validation through business rules (e.g., check for duplicates, areas outside the fleet segment definition, etc.)

Before conducting the analysis there are several data validations to conduct, both for the reference and non-reference data.

The validation process for reference data of catches from vessels operating with CCTV is similar to the validation of non-reference data and include basic checks like the following:

- identification of duplicates, i.e., same vessel, same dates, same catches quantities. If duplicate records are identified they should be removed.
- Identification of incorrect area-fleet segment combinations (e.g., area 3.a for NS01). These records should if possible be corrected and, in case that is not possible, eliminated from the analysis.

ii. Verification (e.g., cross-check with other source of information)

In case of LH data, the information of fishing areas could be cross-checked with the area recorded in the logbook and recorded in JADE.

If the analysis is conducted at EFCA, the data from EFCA's ERS could be cross-checked with MS'ERS.

iii. Document the quality check process

All the process of data correction should be duly documented, both in terms of listing the errors detected and of corrections made to the original data.

c. Methodology for the calculation/analysis

i. **Description tool available, if applicable (e.g., Excel template, R script, GIS script, etc.)**

8. Assumptions of the analysis and ways of verifying

The method assumes a uniform species composition of the catch within a given fleet segment, or within any other unit considered to calculate the compliance indicator. To apply the method, reference data of two species (let's say *species A* and *species B*) need to be available. The indicator is based on the discards ratio of one species (*species A*) if for the other species (*species B*) the catch is known. *Species B* could have a discard component but needs to be known (e.g., quantified using other discard estimation methods). The indicator assumes that the proportion of catches of the two species is similar within a fleet segment, i.e., the proportion of *species A* in the catch (indicated as RA) in relation to the total catches of *species A* and *B*, is the same in reference (f) and non-reference (n) data.

The appropriateness of the indicator to estimate the compliance with the LO depends on the representativeness of the reference data.

If reference data are data from LH, it is assumed that it is representative of the fleet segment under analysis. Several analyses should be conducted / presented to test it representativeness, such as an evaluation of the spatial distribution of the available LH. The data used to calculate the indicators should cover all the area of operation of the fleet segment, to avoid cases where LH data are concentrated in a specific area that thus may not reflect the behaviour of the fleet in the whole area of operation of the fleet segment.

It is also important to check the mesh size during the LH, as it is desirable that the full range of mesh size covered by the fleet segment is represented, or at least, that the most frequently used mesh size (modal mesh size) is represented in the LH data.

Similarly, when using data from vessels operating with CCTV, the spatial information of their fishing activity should also be checked against the spatial activity of the rest of the fleet. This could be done by comparing the VMS data of vessels operating with and without CCTV.

9. Reporting

a. Frequency

The indicator could be calculated annually or more frequently if needed. It could be calculated by EFCA at regional level and also by the MS at national level. The quality of the analysis depends greatly of the representativeness of the reference data (e.g. number of LHs conducted in the fleet segment being analysed). Therefore, when the indicator is calculated at national level, reference data obtained at regional level could be used to increase reference data availability.

b. Definition of output/report

The report should provide the estimates of the discards rate of the species being analysed by unit of analysis (usually the fleet segment), including the sample sizes.

10. Additional comments with recommendations and caveats of the calculation

It is likely that vessels operating with CCTV have a different fishing behaviour than vessels operating without CCTV, as they will avoid areas with high concentration of juveniles. Therefore, when conducting the analysis using logbook data of vessels operating with CCTV as reference, the discard ratio estimated should be considered as a minimum estimate.

11. Annexes

This method is appropriate for species subjected to the LO for which discards occur both for fish above and below the MCRS.

Considering four components of the catch: i) legal size catches landed (*rLSC*); ii) legal size catches discarded (*uLSC*); iii) catches below the MCRS landed (*rBMS*): and iv) catches below the MCRS discarded (*uBMS*), the indicators is appropriate when discarding occurs in the BMS component (*uBMS*)and in the legal size component of the catches (*uLSC*).

This indicator could be used if the reference data available do not have size composition information beyond the distinction of catches above and below the MCRS.

The method assumes a uniform species composition of the catch within a given fleet segment, or within any other unit considered to calculate the compliance indicator. Therefore:

Equation 9 $R_{A,f} = R_{A,n}$

Equation 9 ca be rewritten as Equation where *A* and *B* denotes the total catch (retained and discarded) of *species A* and *B*, respectively. Note that the total catch of *species B* ($B_{n,TOTAL}$) is a known value.

Equation 2 $R_{A,f} = \frac{A_{n,TOTAL}}{A_{n,TOTAL}+B_{n,TOTAL}}$

Equation could be re-written to obtain the total catch (retained and discarded) of *species A*, as:

Equation 10 $A_{n,TOTAL} = \frac{B_{n,TOTAL} \cdot R_{A,f}}{1 - R_{A,f}}$

The discarded (un-reported) component of species *A*, uA_n, is calculated as shown in Equation 11 based on the total catches calculated in Equation 10, $A_{n,TOTAL}$, and the retained (and reported) catch (above and below the MCRS), rA_n, which is a known value from logbook data.

Equation 11 $$uA_n = A_{n,TOTAL} - rA_n$$

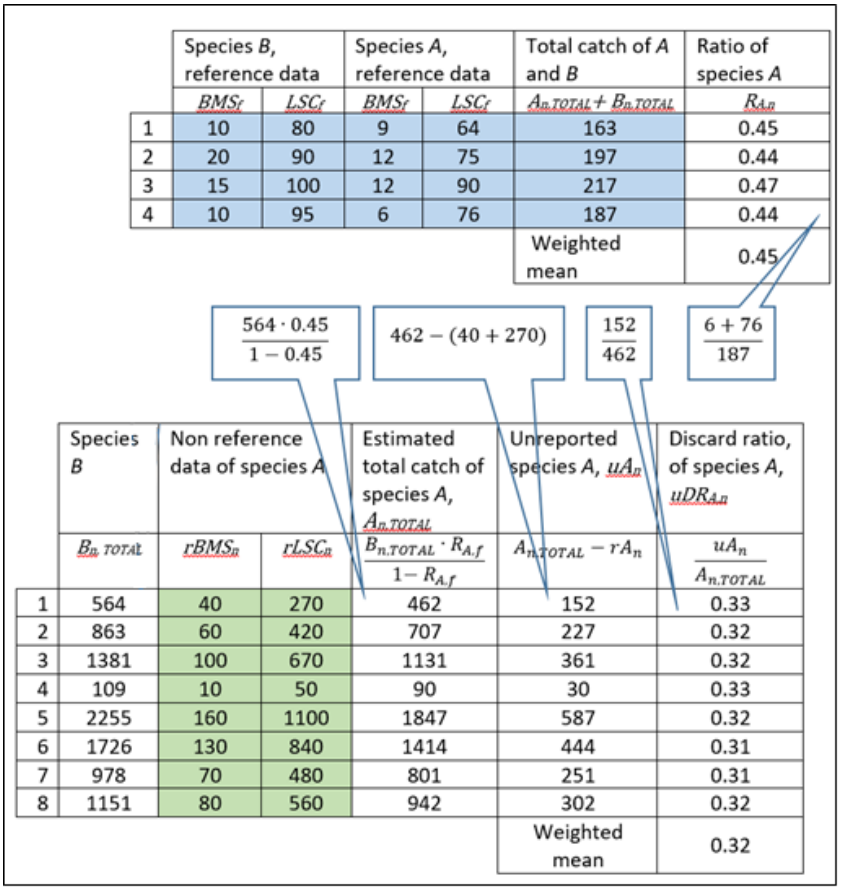
The discard ratio of *species A* is then calculated as:

Equation 5 $$DR_{A,n} = \frac{uA_n}{A_{n,TOTAL}}$$

If there is indication that the discarding pattern is not the same within the fleet segment but on only one (identifiable) component of the segment (e.g., in a given area) then the indicators should only be calculated to that part and other appropriate methodologies should be used to estimate the discard of the remaining fleet segments.

It should also be noted that, although it is assumed that discarding is independent of fish size, it is likely that larger sizes will be retained more than smaller sizes. This aspect is not reflected in the calculations since there is no size composition information in the reference data.

Figure 1 shows an example of the calculation of the discards ratio based on the species ratio, where the ratio of species *A* in relation to the sum of species *A* and *B* is obtained from reference data and equal to 45%.



	Species *B*, reference data		Species *A*, reference data		Total catch of *A* and *B*	Ratio of species *A*
	BMS_f	LSC_f	BMS_f	LSC_f	$A_{n.TOTAL} + B_{n.TOTAL}$	$R_{A.n}$
1	10	80	9	64	163	0.45
2	20	90	12	75	197	0.44
3	15	100	12	90	217	0.47
4	10	95	6	76	187	0.44
					Weighted mean	0.45

$\frac{564 \cdot 0.45}{1 - 0.45}$ $462 - (40 + 270)$ $\frac{152}{462}$ $\frac{6 + 76}{187}$

	Species *B*	Non reference data of species *A*		Estimated total catch of species *A*, $A_{n.TOTAL}$	Unreported species *A*, uA_n	Discard ratio, of species *A*, $uDR_{A.n}$
	$B_{n.TOTAL}$	$rBMS_n$	$rLSC_n$	$\frac{B_{n.TOTAL} \cdot R_{A.f}}{1 - R_{A.f}}$	$A_{n.TOTAL} - rA_n$	$\frac{uA_n}{A_{n.TOTAL}}$
1	564	40	270	462	152	0.33
2	863	60	420	707	227	0.32
3	1381	100	670	1131	361	0.32
4	109	10	50	90	30	0.33
5	2255	160	1100	1847	587	0.32
6	1726	130	840	1414	444	0.31
7	978	70	480	801	251	0.31
8	1151	80	560	942	302	0.32
					Weighted mean	0.32

Figure 1. Unreported discard quantities and discards ratio calculation based on the species ratio. Cells with light blue background correspond to reference data (subscript *f*). Cells with green background correspond to non-reference data (subscript *n*). Cells with no background colour show the calculations. Species composition and discard ratio are calculated as a weighted mean, corresponding to the mean of all observations weighted by their contribution to the total catch.