EFCA
European Fisheries Control Agency

Scheveningen and North Western Waters Control Experts Groups (CEG)

Evaluation of Compliance with the Landing Obligation

Mackerel Fisheries

2018 - 2020

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Contents

List of Acronyms

ALB	Albacore (*Thunnus alalunga*)
ARU	Greater silver smelt (*Argentina silus*)
BMS	Below Minimum Size
CCTV	Closed Circuit Television
CDR	Commission Delegated Regulation
CEG	Control Expert Group
CFP	Common Fisheries Policy
DCF	Data Collection Framework
DIM	*De minimis*
DIS	Discards
FDI	Fisheries Dependent Information
FS	Fleet Segment
HER	Herring (*Clupea harengus*)
ICES	International Council for the Exploration of the Sea
JAX / HOM	Horse mackerel / scad (*Trachurus* spp.)
LH	Last haul inspection
LO	Landing obligation
LSC	Legal size catches
MAC	Mackerel (*Scomber scombrus*)
MAP	Multiannual Plan
MCRS	Minimum Conservation Reference Size
MCS	Monitoring, Control and Surveillance
MS	Member States
NOP	Norway pout (*Trisopterus esmarkii*)
NS	North Sea
NWW	North Western Waters
REM	Remote Electronic Monitoring
RSW	Refrigerated Sea Water
SAN	Sandeel (*Ammodytes* spp.)
SPR	Sprat (*Sprattus sprattus*)
STECF	Scientific, Technical and Economic Committee for Fisheries
WHB	Blue whiting (*Micromesistius poutassou*)
WHG	Whiting (*Merlangius merlangus*)

Executive summary

The current report presents the results of an analysis of discards in the North Sea and North Western Waters for fisheries targeting mackerel (*Scomber scombrus*) during the period 2018-2020 with the aim to evaluate fishers compliance with the provisions of the Landing Obligation (LO). This analysis was carried out following the request for assistance from members of the Scheveningen and North Western Waters Control Expert Groups (CEG). The methodology applied in the present analysis intended to a) replicate the previous evaluation of compliance carried out for the mackerel fisheries for the period 2015 – 2017 and b) provide results on: (i) estimates of illegal discards based on the comparison of logbook and inspection information from the Last Haul (LH) (Method 1), (ii) discard estimates provided by scientific bodies (STECF and ICES) (Method 2) and (iii) the typology of the suspected infringements related to the non-compliance with the LO (Method 3). The description of the results, in relation to their usefulness to evaluate compliance with the provisions of the LO, are discussed. In addition to the three methods applied in the previous evaluation, the data available have been complemented with the opinion of control experts (Method 4). Overall, the results from these four methods have been used to provide an assessment of compliance within the analysed period. In the future, when repeated, results could be used to provide compliance trends over time. The analysis followed the segmentation of the fleet currently used by EFCA as agreed with the MS within the framework of the SCIPs.

An important aspect of compliance evaluation with the LO is an assessment of the amount of discarding occurring. The discard estimates presented in this report are largely based on the scientific data (mainly on the STECF data) (Method 2) due to the limited number of LH available for the period of this evaluation (three in 2019 and only one in 2020), and the lack of reported suspected infringements (Method 3). The few LH available are a consequence of the difficulties in carrying out these types of inspections, that requires measuring and weighing catches in pelagic hauls that include typically large quantities of fish, up to several hundred tonnes.

For Method 2, there were not enough discard data available to calculate discard estimates for all FS/areas. In addition, it was not possible to differentiate the discard data available in the STECF database between PEL01 (freezer trawlers using midwater trawl and midwater pair trawl) and PEL02 (RSW tank vessels and polyvalent vessels using midwater trawl and midwater pair trawl) data and therefore the same discard levels are assigned to both fleet segments, acknowledging the fact that the same fishing gear is used by these vessels. For the three years under consideration, low discard estimates for MAC were obtained for subareas 4, 6 and 7 for fleet segments PEL01/PEL02 (midwater trawlers) while high discard estimates were obtained in subarea 7 in 2018 and 2019 but low in 2020 for fleet segment PEL03 (polyvalent vessels using bottom trawl and bottom pair trawl). Lack of

discard information in the STECF database made estimating discard levels with Method 3 for the remaining areas (divisions 2.a and 3.a of PEL01/PEL02) and fleet segments (PEL04-PEL06) not possible.

Regarding Method 4, the view of the Member States' (MS) risk assessment and control experts was that compliance with the provisions of the LO in some of the MAC fisheries was lower than suggested by the compliance level that might be inferred from the discard estimates obtained from the scientific data. In their view, compliance was low for PEL01, PEL02 and PEL03 for most areas where vessels from these fleet segments operate.

It is worth noting that scientific data are collected with a different objective, not related with compliance evaluation and that sampling levels are low. The views of the control experts provide a picture of the likelihood of non-compliance based on their experience and are also gathered for a different purpose of risk assessment.

This analysis attempted to evaluate compliance using four separate methods. Of these four methods, only two provided information on compliance, either directly as the opinion of the control experts, or indirectly via the assessment of the differences between the discards reported in the logbooks and the discard estimates obtained for scientific purposes (with low sampling coverage in some of the analysed fleets). There is a discrepancy between the scientific estimates and the opinion of control experts for some of the areas and fleet segments analysed, for which additional sources of data are needed to assess compliance in MAC fisheries. Lack of appropriate data, on which to base the evaluation of compliance, was a problem already identified in the previous evaluation. The introduction of remote electronic monitoring (REM) systems and/or control observers could facilitate the collection of reliable discard data and it has proven to be an effective control tool likely to improve compliance.

1 Introduction

Regulation (EU) No. 1380/2013 of the European Parliament and of the Council on the Common Fisheries Policy (CFP) introduced a phased obligation to land all catches of species subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes, the Landing Obligation (LO). From the perspective of the North Sea (NS) and the North Western Waters (NWW) regions, the phasing introduced the obligation to land almost all catches of small pelagic species including MAC from 1 January 2015.

The Member State Control Expert Groups (CEG) for the North Sea region (the Scheveningen CEG) and for the NWW region formally requested the assistance of EFCA to facilitate a compliance evaluation with the provisions of the LO in the NS and NWW regions for mackerel (MAC) fisheries for the period 2018-2020 following a previous request for the same fisheries for the period 2015-2017 under the same cooperation agreement between EFCA and the Scheveningen and NWW CEGs. Pelagic fisheries were the first ones to be subject to the LO and MAC fisheries were selected due to their economic importance. This report presents the findings of this evaluation based on the fisheries segments (fleet segments, FS) used by EFCA currently (see Annex 1). To allow the comparison with the results from the previous evaluation, this report includes the comparison of the results of both evaluations taking into account the changes in FS definitions.

The precise details of the implementation of the LO in the North Sea and NWW regions since 2015 were laid down in so-called '*discard plans*' adopted as delegated regulations by the European Commission for a period of no more than three years acting upon joint recommendations made by those Member States (MS) with interests in the fisheries and following a scientific appraisal by STECF. The discard plans applicable to MAC fisheries and other relevant legislation are briefly summarised below.

2015-2017

For fisheries for small pelagic fish in the NS, the discard plan specifying the details for the implementation of the LO applying from 1 January 2015 to 31 December 2017 was adopted as Commission Delegated Regulation (CDR) (EU) No. 1395/2014. This regulation covered certain fisheries for the following NS pelagic species: mackerel (MAC), herring (HER), horse mackerel (JAX / HOM), blue whiting (WHB), greater silver smelt (ARU), and sprat (SPR). In addition, the regulation also covered fisheries for non-human consumption for Norway pout (NOP), sprat and sandeel (SAN). A survivability exemption was granted for MAC and HER caught by purse seine complying with

certain technical and sampling requirements. A d*e minimis* exemptions for certain pelagic trawl fisheries was provided for MAC, JAX/HOM, HER and WHG for 2015 and 2016.

In NWW, the discard plan adopted as CDR (EU) No. 1393/2014, laid down the provisions for the application of the LO to certain pelagic fisheries in NWW waters from 1 January 2015 to 31 December 2017. This regulation listed a survivability exemption for MAC and HER caught by purse seine complying with certain technical and sampling requirements and *de minimis* exemptions for: certain pelagic trawl fisheries for MAC, JAX/HOM, HER and WHG and pelagic freezer trawlers for BOR for 2015 and 2016; and pelagic trawl fishery for non-human consumption for WHB and directed fisheries for ALB for 2015, 2016 and 2017.

2018-2020

CDR (EU) No. 2018/189 amended CDR EU 1395/2014 and extended the survivability and *de minimis* exemptions with minor changes to 31 December 2020.

CDR (EU) No. 2018/190 amended CDR EU 1393/2014. As it was the case for the NS, the survivability and *de minimis* exemptions were extended to 31 December 2020 with some modifications.

A list of the available exemptions from the LO (allowing for continued discarding) for the MAC fisheries and the correspondence with the current NS and WW pelagic fleet segmentation (see Annex 1) is provided in Annex 2. No appreciable differences existed for MAC fisheries between the two regions during the study period. Table 1 summarises the provisions of the discard plans and CDRs for MAC for each FS. These exemptions are difficult to take under consideration for the evaluation of compliance since in some cases they are calculated based on a percentage of the total annual catch of a number of species by each vessel. It should be noted that the provisions for the exemptions to the LO require that the amounts discarded are reported, and therefore although fishers may legally discard the fish, quantities need to be recorded in the logbooks.

*Table 1. Codification of the fleet segments (FS) subject to the Landing Obligation (LO) fishing for MAC. The code "X" and the light grey background represents the availability of exemptions (*de minimis *or survivability). For details on the available exemptions see Annex 2.*

Fleet segmentation	Discard plans	MAC	Old FS denomination	Current FS denomination
Before - 2019	2015-2018		*PEL01*	PEL01
			PEL02	
		X	*PEL03*	PEL02
		X	*PEL04*	
			PEL05	PEL04
			PEL06	PEL02
			PEL07	
		X	*PEL08*	PEL05
			PEL09	PEL03
			PEL10	
			PEL11	PEL08
			PEL12	PEL09
After 2019	2019-2020			PEL01
		X		PEL02
				PEL03
				PEL04
		X		PEL05
				PEL06
				PEL07
				PEL08
				PEL09

2 Evaluation Methodology

EFCA's Administrative Board agreed in 2014 on a standard methodology for compliance evaluation with the LO. This original methodology included the analyses of information gathered from control and industry stakeholders via questionnaires and a market study. Due to the low return from these questionnaires, in agreement with the Scheveningen and NWW CEGs, this evaluation has not repeated these exercises. The approach initially focused on the methods listed in Table 2. Additionally, in an attempt to apply the regional methodology and to incorporate the views of risk assessment and control experts, their assessment of the probability of non-compliance with the provisions of the LO have been included, based on the results of the annual regional risk assessment workshops organised by EFCA together with MS for the pelagic fisheries in the North Sea and North Western Waters.

Table 2. Methods for evaluating compliance with the Landing Obligation (LO).

	Evaluation Method	Applied to the LO
1	Inspection data compared with official catch or landings statistics	Specifically, to attempt to estimate the ratio of unreported (illegal) discards using last haul data
2	Considering the evaluation of scientific bodies (STECF, etc.)	Estimates of the catches that are discarded

3	Trends of infringements	Suspected infringements (or lack of) issued for non-compliance with the LO

Both Methods 1 and 2 involve the estimation of discards, in sample-based but relatively objective manner, which are used as a quantitative approach to arrive at an assessment of compliance, following the benchmarking criteria endorsed by the Scheveningen and NWW CEGs (see Table 3). These same criteria were used for the compliance evaluation carried out in other areas.

Table 3. Compliance benchmarking criteria endorsed by the Scheveningen and North Western Waters Control Expert Groups. The estimates of illegal discards are expressed as the percentage of the amount discarded of a species in relation to the total catch of that species in an area of a fleet segment in a year.

Compliance Level	Estimates of the ratio of illegal discards to catches	Benchmark Icon
High	< 5%	
Medium	≥5% and < 15%	
Low	≥ 15%	

Although there are 16 FS identified for the NS and WW pelagic fisheries, the evaluation was carried out only for FS PEL01-PEL06 and for those areas of these FS where the fisheries targeting MAC operate. Those FS dealing with the trammel nets (PEL07), lines (PEL08), traps (PEL09), industrial fisheries (PEL10-PEL12) and those FS for the albacore fisheries (PEL13-PEL15) were not included in this evaluation that focuses on those FS fishing for MAC. In addition, the last FS, PEL16 (see Table 4), was also not included in the evaluation since it includes those gears/mesh sizes not considered under PEL01-PEL15. Due to the variety of gears/mesh sizes it represents, the heterogeneous pattern of activity represented and the lack of data, no evaluation of compliance with the LO was conducted.

Furthermore, available opportunity (fishing quota) is a significant factor in the likelihood of discarding, both illegal and LO-exempt legal discarding. Within a FS of a region, different vessels may have very different quotas, either in terms of quantity or species mix, arising from different availability or uptake within their Flag State. The current assessment considers FS at regional level, therefore it attempts an homogenous assessment within the heterogenous risks amongst different participants of that FS.

Method 1: "Inspection data compared with official catch or landings statistics"

This is a quantitative method consisting of the estimation of an unreported discard ratio based on the comparison between the quantities of catches below the minimum conservation reference size (B-MCRS) observed from last haul (LH) inspections carried out by fisheries control authorities and the quantities reported in the logbooks or declared at landing (see Figure 1 and further detailed

method description in Annex 3). Information from the inspections is sent by MS to EFCA while the catch data by species and category (BMS, legal size catches LSC, *de minimis* DIM, discards DIS) reported in the logbooks are provided by the MS in reply to an annual data call sent by EFCA. Differences between the BMS detected in the LH and the reported (and landed) BMS and other reporting categories related with exemptions (e.g., DIM) may indicate illegal discarding practices and/or misreporting of legal discards. This analysis has been conducted by area for each FS and was undertaken by an external expert contracted by EFCA applying the methodology developed by EFCA[1] in collaboration with MS.

Because the catch composition in the LH is split generally only between B-MCRS and A-MCRS for each species, and no length/size data are routinely available, this method assumes that illegal discarding takes place only in the BMS portion of the catches. Therefore, illegal discarding in the LSC portion of the catches (either because of high-grading or due to quota limitation), which has been suggested to take place for MAC fisheries, at least in some areas, since larger fish obtain a higher price (ICES 2019, 2020, 2021[2]), is not taken into account. Discard estimates obtained using Method 1 would therefore underestimations of the true discard ratios if discarding of LSC fish is taking place.

Figure 1. Estimation of BMS discards for Method 1.

For FS and areas where catches within MAC fisheries was subject to survivability or *de minimis* exemptions, Method 1 was based on calculating the difference between the BMS in the LH and the

[1]www.efca.europa.eu/sites/default/files/Guidelines%20on%20indicators%20to%20measure%20compliance%20in%20fisheries_1.pdf

[2] ICES. 2019. Working Group on Widely Distributed Stocks (WGWIDE). ICES Scientific Reports. 1:36. 948 pp. http://doi.org/10.17895/ices.pub.5574
ICES. 2020. Working Group on Widely Distributed Stocks (WGWIDE). ICES Scientific Reports. 2:82. 1019 pp. http://doi.org/10.17895/ices.pub.7475
ICES. 2021. Working Group on Widely Distributed Stocks (WGWIDE). ICES Scientific Reports. 3:95. 874 pp. http://doi.org/10.17895/ices.pub.8298

sum of the reported BMS and all reported legal discards in the logbooks, either as DIM and or DIS, by all vessels belonging to a FS operating in the same area in a year.

Method 2: "Considering the evaluation of scientific bodies"

This method consists of the analysis of the estimates of discards based on data made available by the Scientific, Technical and Economic Committee for Fisheries (STECF) of the European Commission and other scientific bodies such as the International Council for the Exploration of the Sea (ICES). The amounts of discards estimated by these organisations are presented in Tables 5 and 6. Where possible, the estimates are linked to the respective FS and area to allow comparison with the results of *Method 1*.

Discard ratio estimates from STECF

Annually, an Expert Working Group of the Scientific, Technical and Economic Committee for Fisheries (STECF) revises the data on landings and discards by area, gear and species made available by Member States in response to the official call by the EU for Fisheries Dependent Information (FDI) in the framework of the EU-MAP (EC No 2017/1004). The data for 2018, 2019 and 2020 were downloaded from the STECF portal[3] in February 2022.

Data from the three years, 2018, 2019 and 2020, have been used to obtain estimates of discard ratios for MAC fisheries, using the total live weight landed (tonnes) and the total discard (tonnes) provided in the FDI database. Discards are generally based on scientific estimations carried out at national level, that follow the requirements established under the EU Multi-Annual Programme for collection, management and use of data in the fisheries sector and support for scientific advice regarding the CFP, the Data Collection Framework (DCF) and include legal and illegal discards, as the focus of the sampling is not compliance but estimates of removals due to fishing. These estimates may also include discards of catches above MCRS (for example due to high-grading and/or when quota is exhausted). These data are aggregated at MS level and the information provided on sub-region, mesh size range and *métier* have been used to allocate the catch and discards to the FS that EFCA uses (Annex 4). It has not been possible to discriminate the STECF data between PEL01 and PEL02 FS and therefore the same discard ratios are given to both FS. Also, for PEL06, due to the fact that most data in subarea 7 were not provided at division level (e.g., 7.a, 7.d, 7.e.), the discard ratio is provided at subarea level only.

[3] https://stecf.jrc.ec.europa.eu/dd/fdi

The estimation of the level of discards based on the FDI data was carried out by an external expert contracted by EFCA. In those cases for which MAC discard information available in the FDI database is associated to MAC landings that represent < 1% of the MAC landing data declared in that fleet segment/area combination, a discard ratio is not provided in this report. This is done to avoid generating discard estimates with very limited data.

It should be noted that several factors affect the data presented in this report:

- because the FDI call requested data at a detailed level, MS are obliged by Eurostat statistical disclosure procedures to mark some data as confidential, when the risk of personal information disclosure is high, e.g., small number of vessels involved. In these cases, MS do not provide the values of the variables (i.e., catches, discards, etc.). The STECF Expert Working Group on Fisheries Dependent Information (STECF 19-11) reviewed the data submitted by MS and reported that "a substantial part of the data submitted have been marked as confidential"[4]. The same conclusion was reached by STECF 21-12.

- as previously mentioned, discards are generally based on scientific estimations carried out at national level. These estimates of discards are then partitioned across the reporting categories (i.e., quarter, gear type, *métier*, etc.) by each MS, following different criteria. No information on the number of samples used to derived discard estimates is available and therefore it is not possible to determine the representativeness of the data. STECF, in its website, emphasises the risk of biases arising from this process with the following text, "*discards amounts in the catches data are scientific discards estimates based on national sampling programmes that do not support the level of disaggregation requested by the FDI data call. The quality of discards estimates cannot be assured and should be used with caution, as these estimates might be uncertain and biased*".

- STECF 21-12 noted that for 2020 "*the data submitted in response to the data call, excluding UK data, amounted to 3,974,393 tonnes of landings, where of 21% (827,214 tonnes) had associated discard estimates. 366,007 tonnes (9%) had a discard estimate of zero*". It is worth noting that values with 0 discards may not actually reflect the observation of no discards but be an artefact of data input in some cases. These figures highlight the low proportion of landings that have associated discard estimates.

Discard ratio estimates from ICES

[4] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC119066/kj-ax-19-019-en-n.pdf

Data used in this analysis are obtained from the published *ICES Advice* for the stock of MAC[5] in subareas 1 to 8, division 9.a and 14 for the years 2019, 2020 and 2021[6], which presents data on catches, landings and discards taken in 2018, 2019 and 2020, respectively. Generally, the discard estimates provided in the ICES Advice are derived from the data collection programmes conducted by fisheries research institutes that, in the case of EU Member States, are based on the DCF. sampling. These data collection programmes also provide the data for the discard estimations from STECF. It should be noted that ICES and STECF use the same data, derived from observer programmes but also self-sampling programmes, but arrive at different discard estimates at fleet level due to different raising methodologies.

The information provided by ICES is on a stock basis, therefore it was necessary to make the corresponding association of these estimates to the FS and areas used by EFCA. Because the stock is exploited by several gears corresponding to more than one FS the discard ratios calculated from ICES figures are difficult to associate to particular FS and areas.

As it was the case with the STECF discard data, ICES estimates of discards include legal and illegal discards, with those catches landed due to the LO included in the estimates. ICES notes in its advice (WGWIDE 2021) that discards have been provided by MS for subareas and divisions 6, 7/8.a,b,d,e and 3/4 since 1978. This discard information arises from pelagic discard monitoring programmes but also include data from the sampling of demersal fleets. It is therefore not possible to associate the discard rate estimated for MAC in subareas 1-8, 14 and division 9.a (<1% for the 2018, 2019 and 2020) to a particular FS, since several FS are exploiting the stock. ICES highlights in its advice that discards are only estimated for part of the fisheries and that the proportion of the landings covered by the calculated discard estimates cannot be calculated.

Method 3 "Trends of infringements" involves an analysis of the quantities and nature of any suspected infringement issued for non-compliance with the LO in the framework of the NS and WW Joint Deployment Plans (JDP) for the applicable fisheries over the reported time series. The analysis uses those suspected infringements related with the LO which have been reported to EFCA by the MS through their inspection Activity Reports (ACTREPs). It should be noted that this method relies exclusively on the ability to detect infringements for non-compliance with the LO. In the absence of continuous monitoring, any discarding behaviour could take place unobserved at sea, and this explains the lack of infringements observed over the reference period as a result of sea inspections.

[5] Mac.27.nea
[6] http://www.ices.dk/publications/library/Pages/default.aspx

Method 4 as applied in this study: Opinion of the control experts

Annually, risk assessment and control experts from MS meet at dedicated regional risk analysis (RRA) workshops organised by EFCA. During these meetings, where representatives of each concerned MS are present, the risk of non-compliance with the fisheries regulations is evaluated and its two components, the likelihood (the probability of a non-compliant event taking place) and the impact (its consequences) are quantified following the risk assessment methodology developed by EFCA in collaboration with MS[7]. When available, evaluation of the likelihood is based on the information provided by compliance indicators and/or expert knowledge from the previous year (i.e., the most recent year for which complete data are available). The compliance indicators used generally to assess compliance with the LO at the RRA workshops are based on the same data that are considered in this report (i.e., LH, STECF and ICES discard estimates). As it has been the case in this report, the lack of robust data to estimate discards resulted in the likelihood assessment of compliance with the LO for MAC fisheries being based essentially on expert knowledge.

3 Results[8]

3.1 Estimation of a discard ratio using last haul data (Method 1)

During the period analysed, only a limited number of LH where MAC was reported were available in either NS or NWW: 3 LH in 2019 in PEL02 (RSW tank vessels and polyvalent - midwater trawl and midwater pair trawl) and 1 LH in 2020 for PEL03 (polyvalent - bottom trawl and bottom pair trawl) all in subarea 7. No LH with the species were available in 2018 and no LH were available for the other FS and areas for any of the years considered.

Because of the low number of LH available, and the fact that Method 1 would not account for the illegal discarding in the part of the catch above MCRS (unless grade sizes are taken when performing the LH), method 1 is not used to evaluate compliance in the current report.

3.2 Discards estimates provided by scientific organisations (Method 2)

[7] Guidelines on Risk Assessment Methodology on Fisheries Compliance | EFCA (europa.eu)

[8] For ease of reading, results are described using the ICES subarea and division denomination, e.g., subarea 7. This corresponds to FAO area 27.7 as shown in Figure 2 and in the tables throughout the report.

3.2.1 Discard ratio estimates from STECF

The discard ratios calculated from the catches and discards data of the FDI database are presented in Table 4 by area of each FS. The table also presents the percentage of the total catch represented by the DIM and/or DIS catch category in the logbooks since for some of the FS and areas, exemptions to the LO, in the form of *de minimis* and survivability, exist.

Table 4. MAC discard ratio (DR, estimated by dividing the MAC total discards by the MAC total catch) per area within each fleet segment (FS) in 2018, 2019 and 2020 based on the Fisheries Dependent Information data downloaded from the STECF portal on February 2022, percentage of the total MAC catch represented by the DIM and DIS categories reported in the logbooks (DR_{DIM}, DR_{DIS}) in 2018 - 2020 (data sent in reply to EFCA data calls). Dash (-) in the DR_{DIM} and DR_{DIS} columns corresponds to areas/FS with no information. A '-' in the DR column indicates that there are no estimates of discard ratios because no discard information was available. indicates that a discard ratio is not provided because data available on discards were too limited (see the methods section on the main text).*

		2018			2019			2020		
FS	**Area**	**DR**	**DR_{DIM}**	**DR_{DIS}**	**DR**	**DR_{DI}**	**DR_{DIS}**	**DR**	**DR_{DIM}**	**DR_{DIS}**
PEL01 Freezer Trawlers - Midwater trawl and midwater pair trawl	27.2.a	**-**	**0.0**	**0.0**	**-**	**0.0**	**0.0**	-	**0.0**	**0.0**
	27.3.a	**-**	**-**	**-**	**-**	**-**	**-**	-	**-**	**-**
PEL02 RSW tank vessels and Polyvalents - Midwater trawl and midwater pair trawl	27.4	**0.2**	**0.0**	**0.0**	**0.5**	**0.0**	**0.0**	**0.5**	**0.0**	**0.0**
	27.6	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	27.7	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
PEL03 Polyvalents - Bottom trawl and bottom pair trawl	27.7	**17.1**	**0.0**	**0.0**	**32.2**	**0.1**	**0.0**	**1.4**	**2.5**	**0.0**
PEL04 RSW tank vessels - Purse seine	27.2.a	**-**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**
	27.4	**-**	**0.0**	**0.0**	**-**	**0.0**	**0.0**	**-**	**0.0**	**0.0**
	27.7	**-**	**0.0**	**0.0**	**-**	**0.0**	**0.0**	**-**	**-**	**-**
PEL05 Polyvalents - Purse seine	27.7	**-**	**-**	**-**	**-**	**0.0**	**0.0**	**-**	**0.0**	**0.0**
PEL06 Gillnets anchored (set), and Gillnets (drift)	27.3.a	*****	**0.0**	**0.0**	*****	**0.0**	**0.0**	*****	**0.0**	**1.0**
	27.7	*****	**0.0**	**0.0**	**84.2**	**0.0**	**0.0**	**-**	**-**	**-**

In 2018 and 2019 discard ratios above 15% were estimated for MAC for PEL03 in subarea 7 while discard ratios below 5% were obtained in this subarea in 2020.

Discard ratios above 15% were also calculated in subarea 7 for PEL06 (gillnets) in 2019. No comparison with the other years of the study is possible for this area since no discard data from STECF were available for 2020 and the discard data available in 2018 were too limited. Discards ratios below 5% were obtained for the remaining areas and FS for which STECF data were available (PEL01/PEL02). No discard information from the FDI database is available for the remaining areas and FS.

As it can be seen from the numbers in Table 4, discard reporting in the logbooks is very low in almost all cases, below 2.5% of the total catch of MAC, even when LO exemptions are in place. As an example, for PEL02, a *de minimis* exemption was available for the whole period studied for those vessels operating in division 7.d. The analysis of the logbooks (see Annex 5) indicates that fishers recorded very limited amounts of MAC under the DIM or DIS categories in subarea 7 (none in 2018 or 2019 and <0.01% of the total reported catch of MAC in 2020 which was recorded as DIM). In the case of PEL03 in subarea 7, no *de minimis* or survivability exemptions were available for this subarea for this FS but small percentages of DIM MAC in relation to the total catch of MAC were reported in the logbooks in 2019 and 2020.

3.2.2 Discard ratio estimates from ICES

Table 5 presents the estimated discard ratios in 2018, 2019 and 2020 for the MAC stock provided in the ICES advice [9]. The overview of the information provided by ICES is presented in Annex 6.

Table 6. 2018, 2019 and 2020 discard ratio (DR) as estimated by ICES for the MAC stock (Method 2) and the correspondence to fleet segments. FS = fleet segment. FS listed are those reporting the main catches of the stock obtained from the information provided by MS in reply to the 2020 and 2019 EFCA data call on 2019 and 2018 catches and landings, respectively in the North Sea and North Western Waters.

Stock	Fleets sampled	2018	2019	2020
		DR	DR	DR
MAC in subareas 1-8, 14 and division 9.a	Pelagic fleets (3, 4, 6,7.8)	0.3%	0.9%	0.9%

As mentioned above, the estimates provided by ICES are on a stock basis and not by FS. It is stated in the latest advice (2021) for the stock that the "*overall discarding in recent years is assumed negligible*". ICES defines '*negligible discards*' as those with a discard ratio less than 5% (in relation to the total catches).

3.3 Infringement Trends (Method 3)

Between 2018 and 2020 only one suspected infringement related to the LO of MAC was detected in the North Sea, out of the only inspection with LH reporting MAC conducted in 2019 (no inspections reporting MAC were available for 2018 and 2020), within the scope of the North Sea JDP. This suspected infringement was detected during the fishing operation by inspectors at sea in 2019 when

[9] Mac.27.nea

a vessel belonging to FS PEL01 was suspected of a slipping event. Slipping is a form of discarding whereby an entire haul of pelagic fish is discarded if catch is undesirable due to size or species. The slipping event did not occur within the parameters described in the discard plan for the opening of the gear in the case of survivability exemption and therefore is considered an illegal slipping event. In the Western Waters, 79, 42 and 34 inspections reporting MAC were performed in 2018, 2019 and 2020, respectively. None of the reported suspected infringements related to the LO.

3.4 Opinion of the control experts

Results of the likelihood evaluations, for the threat of non-compliance with the LO, obtained at the last three annual regional risk assessment exercises, are shown in Table 6. MS are obliged by the regional SCIP decision to conduct risk assessment and they nominate relevant experts to the EFCA-coordinated regional risk assessment workshops.

Experts from MS considered there was a very high or high likelihood of non-compliance with the provisions of the LO in MAC fisheries in division 2.a and of rest of 7 and in subareas 4 and 6 in the case of FS PEL01 and PEL02 (Table 6). Very high or high likelihood was also considered for division 7.d and of rest of 7 of FS PEL03. Lower likelihoods were considered for the remaining FS and areas. The experts based their likelihood assessment on their experience about the behaviour of the fleets and the examination of the information provided in the logbooks noticing the very low reporting of BMS and, in the past, the economic incentive to high-grade MAC. The experts also highlighted the difficulties present to monitor the initial part of the pumping operation routinely carried out in some MAC fisheries that facilitates that smaller MAC are pumped directly into the sea and in addition, the sometimes different catch profiles of vessel operating with the same gear at the same time and same area (with some vessels reporting clean catches of one species and others reporting mixed catches or clean catches of other species).

Table 6. Likelihood scores obtained at the 2019, 2020 and 2021 pelagic regional risk assessment workshops organised by EFCA and with the participation of risk assessment and control experts from the MS involved in the fisheries. Colours indicate the four different levels of the likelihood expressed as a percentage of illegal discards over the total catches or accounting for other qualitative factors: red – very high probability of non-compliance with the LO (≥15% for at least one TAC species and additional factors such as very low deterrence, high market incentive, etc.), orange – high probability (≥15% for at least one TAC species and additional factors such as low deterrence, high market incentive, etc.), yellow – medium probability (≥5% < 15% for at least one TAC species) and green – low probability (<5% for all TAC species). NA = not applicable. Grey cells indicate those

areas where in 2021 the likelihood was not evaluated because the fishery for MAC takes place mainly in areas now under UK jurisdiction.

	Likelihood scored for MAC				
			Non-compliance with the LO		
Fleet segment	**Gear**	**Area**	**2019**	**2020**	**2021**
PEL01	Freezer Trawls - Mid water and mid water pair trawl	2.a, 4			
		6			
		7.d			
		rest of 7			
PEL02	RSW tank vessel and Polyvalent - Mid water and mid water pair trawl	2.a, 4			
		3.a			
		6			
		7.d			
		rest of 7			
PEL03	Polyvalent - Bottom trawl and pair trawl	3.a			
		7.d			
		rest of 7			
PEL04	RSW tank vessel - Purse seine	2.a, 4			
		rest of 7			
PEL05	Polyvalent - Purse seine	rest of 7			
PEL06	Gillnets anchored (set), and Gillnets (drift)	3.a			
		7.d			
		7 a, e			

4 Compliance outcome

Noting the caveats regarding the correspondence between assessing discards at area and FS level and doing so at stock level, table 7 presents a summary of the information available to determine compliance for each area of each FS.

For MAC, data from only a few LH inspections were available (for PEL02 and PEL03, all in subarea 7) and therefore this information was too limited to assess the discard ratios. In addition, and as explained in the Method section, the discards would be underestimated if high-grading takes place. STECF discard data indicated low discard ratios in subareas 4, 6 and 7 for all years considered for PEL01/PEL02 (it was not possible to differentiate between both FS using the STECF data). The ICES discard ratios for the stock of MAC are within the range of values estimated using the STECF data for these FS in subareas 4, 6 and 7, which were the main FS/area reporting catches of the stock based on the data received in answer to the EFCA data calls (see Annex 7). Discard ratio estimates from STECF were available for PEL03 in subarea 7 indicating important differences

between those reported logbook discards in 2018 and 2019. For the remaining areas and FS under consideration no data are available to determine discard rates.

There were insufficient infringements identified (Method 3) to make a conclusive assessment of compliance using this information in the context of the poor sensitivity of traditional control tools for detecting infringements of LO.

As it can be seen from table 7, the results of the likelihood of non-compliance with the LO obtained as part of the annual RRA workshops provides a different picture from the results of the discard estimates based on the scientific data. The likelihood represents the opinion of the risk assessment and control experts from EFCA and MS based on their knowledge of the compliance situation together with the use of compliance indicators if available. In the case of the MAC likelihood evaluation, even if the same information from the STECF and ICES discard rates were available, experts considered that the probability of illegal discarding was higher than the information from the scientific estimates would indicate. In their view, compliance is lower than these data indicate for PEL01, PEL02 and PEL03 for most areas.

Table 8. Summary of the information analysed in this study to evaluate compliance in the provisions of the LO for MAC in the North Sea and North Western waters pelagic fleet segments (FS) per area in 2018, 2019 and 2020. indicates that a discard ratio is not provided because data available on discards were too limited (see the methods section on the main text). LH: last haul inspections (Method 1). STECF, ICES: discard ratios obtained by scientific data (Method 2). Likelihood: MS' risk assessment and control expert evaluation of probability of non-compliance with the provisions of the LO, from EFCA Regional Risk Assessment workshops. Grey cells indicate those areas where in 2021 the likelihood was not evaluated because the fishery for MAC takes place mainly in areas now under UK jurisdiction.*

		2018				2019				2020			
FS	**Area**	**1-LHN**	**2a-STECF**	**2b-ICES**	**Likelihood**	**1-LHN**	**2a-STECF**	**2b-ICES**	**Likelihood**	**1-LHN**	**2a-STECF**	**2b-ICES**	**Likelihood**
PEL01 Freezer Trawlers - Midwater trawl and midwater pair trawl	27.2.a				✗				✗				
	27.3.a				✓				✓				✓
PEL02 RSW tank vessels and Polyvalents - Midwater trawl and midwater pair trawl	27.4		**0.2**	**0.3**	✗		**0.5**	**0.9**	✗		**0.5**	**0.9**	✗
	27.6		**0.3**		✗		**0.0**		✗		**0.0**		✗
	27.7		**0.4**		✗	*	**0.0**		✗		**0.0**		✗
PEL03 Polyvalents - Bottom trawl and bottom pair trawl	27.7		**17.1**		✗		**32.2**		✗	*	**1.4**		✗
PEL04 RSW tank vessels - Purse seine	27.2.a				!				!				
	27.4				!				!				
	27.7				✓				✓				✓
PEL05 Polyvalents - Purse seine	27.7				✓				✓				!
PEL06 Gillnets anchored (set), and Gillnets (drift)	27.3.a		*		✓		*		✓		*		✓
	27.7		*		✓		**84.2**		✓				✓

Comparison with the previous evaluation

The previous evaluation of compliance, carried out for the years 2015, 2016 and 2017, faced the same issues as this one. There was again an insufficient number of LH available, and the evaluation highlighted that the high discard rates obtained when analysing the STECF data (only available for 2015 and 2016 at the time the evaluation was completed) suggested a high level of non-compliance with the provisions of the LO for pelagic trawlers. Although it is important to note that in the previous evaluation it was not possible to discriminate the STECF data between the old FS from PEL01 to PEL04 (current FS PEL01, PEL02). Therefore, the same discard ratio value was given to these groups of FS. The previous evaluation highlighted that the results of the interviews with control experts and industry stakeholders indicated that compliance with the LO was low. In addition, results from the market analysis indicate from the response obtained to the questionnaires that the average size of the lowest commercial grade was too low which could act as an incentive to high-grade. Neither industry stakeholders nor market analysis were included in the present study.

5 Conclusions and recommendations

Four different sources of data were originally used in the evaluations of compliance, with the original aim of giving priority to the information from the LH (Method 1) over that obtained from Method 2. However, in the current evaluation, the number of LH have been too limited to base compliance of the results from Method 1. In addition, as noted in the Methods section, there could be a potential underestimation of the discards if high-grading is taking place with Method 1. In relation to Method 3, only one suspected infringement related with compliance with LO was detected to base compliance on this method. Method 2 has been used to obtain an estimate of the ratios of discards in the different FS. Before using these estimates of discards to determine compliance based on, several issues should be considered:

a) as already discussed in the previous evaluation of compliance for MAC in the NS and NWW, it is difficult to incorporate the provisions of the different exemptions available for the species since these exemptions, in the form of *de minimis* or survivability exemptions allow that some proportion of the fish caught can be legally discarded. In the present report, the reported discards in the logbooks (as DIM or DIS) have been considered and compared with the discard estimates obtained using method 2, since it is required to report legal discards when exemptions are available,

b) the lack of information on the number of samples used to infer discards, and on the raising procedures used by MS when submitting the data to the FDI data call does not allow to infer the precision of the discard estimates obtained using these data and

c) the main aim of the scientific sampling of discards is the gathering of information on the species and length composition of the catches and not on compliance. Following the implementation of the LO, the at-sea scientific sampling programme of discards has become the sampling of an activity that might be considered illegal. In addition, in 2020, due to the Covid-19 pandemic, some sampling programmes were based on self-sampling by the industry while the existing sampling plans were reduced, and this could have affected the data quality for that year. Because of this, determining compliance using solely the scientific estimates is problematic.

The likelihood estimates, which represent the opinion of risk assessment and control experts from MS indicate that compliance with the provisions of the LO is low for PEL01 and PEL02 in division 2.a and subareas 4, 6 and 7 and for PEL03 in subarea 7. It should be noted that the opinion of control experts, obtained via a questionnaire, was one of the methods used during the previous evaluation of compliance and this study uses a different method of extrapolating form risk assessment based on informed professional opinion of a particular cohort of experts.

Final remarks

- Of the four methods used in this evaluation, Method 1, which uses discard data derived from direct observations in the form of LH inspections, could not be used to determine compliance due to the very few last haul inspections carried out in the fleet segments under consideration and the potential underestimation of the discards if high-grading is taking place. This was also the case in the previous evaluation and reflects the difficulty of performing inspections at sea in some of these fleet segments and measuring the catch in the hauls of the large-scale MAC fisheries.
- Method 2, the use of scientific discard estimates, has been used in both evaluations but estimating discard rates using this information to determine compliance is problematic and debatable since the scientific estimates are not collected to determine compliance.
- Method 3 provided very little/no additional information on compliance which, given the known intrinsic difficulties in detecting illegal discarding through inspections at sea, is not surprising.
- Method 4, the view of the MS' risk assessment and control experts, as obtained at the regional risk assessment process, is that compliance with the LO in some of the MAC fisheries is low, especially in the pelagic trawlers, as highlighted in the previous evaluation of compliance, but also in bottom trawlers.

Recommendations

1. Lack of appropriate verified data has been a recurrent problem when evaluating compliance. To solve this lack of information, the introduction of REM systems and/or control observers in some of these fleet segments could facilitate the collection of reliable reference data. REM systems have proven to act also as a control tool for effective enforcing of the LO, especially since traditional control tools have been inefficient in verifying or enforcing compliance and detecting or deterring non-compliance.

Until more reliable reference data become available other sources of information could be explored:

a) In the short term, a more detailed look into the STECF data could offer additional insights into discarding patterns, for example by comparing the sampled length frequencies and the data collected as part of the control procedures (i.e., the length categories in sale notes) to determine if discarding of some length classes could be taking place.

b) Another possible source of valuable information would be obtaining the catch data based on haul-by-haul recording in the logbooks. This would facilitate the gathering of discard and other catch data. In addition, it could have a deterrence effect on the illegal discarding. It should be noted that some MS already have this requirement at national level (e.g., DK).

Annex 1. 2022 North Sea and Western Waters Pelagic Fleet Segmentation

Fleet segment definition and equivalence with segment codes used in previous years

Main group	Segment Code	Segment Name	Gears	Areas	Code before 2019
Active	**PEL01**	Freezer Trawlers - Midwater trawl and midwater pair trawl	OTM, PTM	2.a, 3.a, 4, 5.b, 6, 7, 8	PEL01, PEL02
	PEL02	RSW tank vessels and Polyvalents - Midwater trawl and midwater pair trawl	OTM, PTM	2.a, 3.a, 4, 5.b, 6, 7, 8	PEL03, PEL04, PEL06, PEL07
	PEL03	Polyvalents - Bottom trawl and bottom pair trawl	OTB, PTB	7, 8, 9	PEL09, PEL10
	PEL04	RSW tank vessels - Purse seine	PS	2.a, 3.a, 4, 5.b, 6, 7	PEL05
	PEL05	Polyvalents - Purse seine	PS	7, 8, 9, 10, 34.1.1, 34.1.2, 34.2.0	PEL08
Passive	**PEL06**	Gillnets anchored (set), and Gillnets (drift)	GNS, GND	3.a, 4, 7.a, 7.d, 7.e, 8, 9	PEL13
	PEL07	Trammel nets	GTR	4	PEL14
	PEL08	Polyvalents - Lines	LHM, LLS, LHP	3.a, 4, 8, 9	PEL11
	PEL09	Traps, pots and pound nets	MIS	4	PEL12
Industrial	**PEL10**	Industrial trawlers 16-31 mm	OTM, PTM, OTB, PTB	3.a, 4, 6, 7	PEL16
	PEL11	Industrial trawlers < 16mm	OTM, PTM, OTB, PTB	3.a, 4	PEL15
	PEL12	Industrial purse seiners	PS	3.a, 4	PEL17
Albacore	**PEL13**	Midwater trawls targeting albacore	OTM, PTM	7, 8	NWW11, NWW12, SWW07
	PEL14	Pelagic Trolling and poles-and-lines targeting albacore	LTL, LHM, LHP	7, 8, 9, 10, 34.1.1, 34.1.2, 34.2.0	NWW10
	PEL15	Pelagic longlines targeting albacore	LL, LLD, LLS	8, 9, 10, 34.1.1, 34.1.2, 34.2.0	SWW09
PEL16		Any other gear/mesh size not included in segments 1-15		2.a, 3.a, 4, 5.b, 6, 7, 8, 9, 10, 34.1.1, 34.1.2, 34.2.0	-

Annex 2. Survivability and *de minimis* exemptions for MAC in the North Sea and NWW from 2015-2020

Species	Year	Exemption Conditions			
		Survivability	**Corresponding fleet segments**	***De Minimis***	**Corresponding fleet segments**
MAC	2015-17	NORTH SEA MAC caught by PS in subarea 4 if all the following conditions are met: - the catch is released before a certain % (set out in paragraphs 2 and 3 below) of the PS is closed ('the point of retrieval'), - the PS gear is fitted with a visible buoy clearly marking the limit for the point of retrieval, - the vessel and the PS gear are equipped with an electronic recording and documenting system when, where and extent to which the PS has been hauled for all fishing operations. 2. The point of retrieval shall be 80% closure of the PS in fisheries for MAC. 3. If the surrounded school consists of a mixture of MAC and HER the point of retrieval shall be 80% closure of the PS. 4. It shall be prohibited to release catches of MAC after the point of retrieval. 5. The surrounded school of fish shall be sampled before its release to estimate the species composition, the fish size composition and the quantity	PEL05	NORTH SEA ICES Division 4.b and c south of 54 degrees north: gear OTM up to 25 m in length overall *"up to a maximum of 3% in 2015 and 2% for 2016 of the total annual catches of mackerel, horse mackerel, herring and whiting in the pelagic fishery targeting mackerel, horse mackerel and herring"*	PEL02
		WW MAC caught by PS in subarea 6 if all the following conditions are met: the catch is released before a certain percentage (set out in paragraphs 2 and 3 below) of the PS is closed ('the point of retrieval'). − the PS gear is fitted with visible buoys clearly marking the limit for the point of retrieval, − the vessel and the PS gear are equipped with an electronic recording and documenting system when, where and extent to which the PS has been hauled for all fishing operations. 2. The point of retrieval shall be 80% closure of the PS. 3. If the surrounded school consists of a mixture of MAC and HER the point of retrieval shall be 80% closure of the PS. 4. It shall be prohibited to release catches of MAC after the point of retrieval. 5. The surrounded school of fish shall be sampled before its release to estimate the species composition, the fish size composition and the quantity.	PEL05	WW ICES Division 7.d: gear OTM up to 25 m in length overall *"up to a maximum of 3% in 2015 and 2% for 2016 of the total annual catches of mackerel, horse mackerel, herring and whiting in the pelagic fishery targeting mackerel, horse mackerel and herring"*	PEL02

	2018-20	NORTH SEA MAC caught by PS in subarea 4 if all the following conditions are met: - the catch is released before a certain percentage (set out in paragraphs 2 and 3 below) of the PS is closed ('the point of retrieval'), - the PS gear is fitted with a visible buoy clearly marking the limit for the point of retrieval, - the vessel and the PS gear are equipped with an electronic recording and documenting system when, where and extent to which the PS has been hauled for all fishing operations. 2. The point of retrieval shall be 80% closure of the PS in fisheries for MAC. 3. If the surrounded school consists of a mixture of MAC and HER the point of retrieval shall be 80% closure of the PS. 4. It shall be prohibited to release catches of MAC after the point of retrieval. 5. The surrounded school of fish shall be sampled before its release to estimate the species composition, the fish size composition and the quantity.		NORTH SEA ICES Division 4.b and c south of 54 degrees north: gear OTM, PTM up to 25 m in length overall *"up to a maximum of 1% of the total annual catches of mackerel, horse mackerel, herring and whiting in the pelagic fishery targeting mackerel, horse mackerel and herring"*	PEL02
		WW MAC caught by PS in subarea 6 if all the following conditions are met: the catch is released before a certain percentage (set out in paragraphs 2 and 3 below) of the PS is closed ('the point of retrieval'). − the PS gear is fitted with visible buoys clearly marking the limit for the point of retrieval, − the vessel and the PS gear are equipped with an electronic recording and documenting system when, where and extent to which the purse seine has been hauled for all fishing operations. 2. The point of retrieval shall be 80% closure of the PS. 3. If the surrounded school consists of a mixture of MAC and HER the point of retrieval shall be 80 % closure of the purse seine. 4. It shall be prohibited to release catches of MAC after the point of retrieval. 5. The surrounded school of fish shall be sampled before its release to estimate the species composition, the fish size composition and the quantity.	PEL05	WW ICES Division 7.d: gear OTM, PTM up to 25 m in length overall *"up to a maximum of 1% in 2018, 2019 and 2020 of the total annual catches of mackerel, horse mackerel, herring and whiting in the pelagic fishery targeting mackerel, horse mackerel and herring"*	PEL02

Annex 3. Detailed description of the methodology used to estimate the discard ratio

BMS discards ratio

The generic calculations are presented below, where *f* denotes reference data (in this case, inspections with last haul) and *n* denotes non-reference. Considering the BMS ratio, $bmsR_f$, of the reference data as:

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

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 ($lscR_n$) obtained from the information on catch categories in the logbook, is assumed to be equal to the LSC ratio of the reference data ($lscR_f$).

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

Considering that:

Equation 3 $$\boldsymbol{lscR_f = 1 - bmsR_f}$$

Expanding the right term of Equation 3 and using also Equation 2:

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

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

which corresponds to:

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

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

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

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

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

Annex 4. North Sea and North Western Waters pelagics fleet segments correspondence with area/ gear type/ mesh size range in FDI database

NK = Not known mesh size range.

Combination of gear code “Gear” (Table A), area “Area” (Table B) and mesh size range “Mesh size” and assignation to EFCA fleet segments (FS).

Gear	Area	Mesh size	FS
GN	2a	250DXX	PEL16
GN	2a	50D90	PEL16
GN	3a	100D120	PEL06
GN	3a	10D31	PEL06
GN	3a	120D220	PEL06
GN	3a	220D250	PEL06
GN	3a	250DXX	PEL06
GN	3a	31D50	PEL06
GN	3a	50D71	PEL06
GN	3a	71D1000	PEL06
GN	3a	-	PEL06
GN	4	00D10	PEL06
GN	4	100D120	PEL06
GN	4	10D31	PEL06
GN	4	120D220	PEL06
GN	4	220D250	PEL06
GN	4	250DXX	PEL06
GN	4	31D50	PEL06
GN	4	50D71	PEL06
GN	4	71D1000	PEL06
GN	4	-	PEL06
GN	5b	120DXX	PEL16
GN	6	100D120	PEL16
GN	6	120D130	PEL16
GN	6	120DXX	PEL16
GN	6	150D220	PEL16
GN	6	250DXX	PEL16
GN	6	32D70	PEL16
GN	6	50D90	PEL16
GN	6	90D100	PEL16
GN	7	00D50	PEL06
GN	7	100D120	PEL06
GN	7	110D120	PEL06
GN	7	120D130	PEL06
GN	7	120DXX	PEL06
GN	7	130D150	PEL06
GN	7	150D220	PEL06
GN	7	16D32	PEL06
GN	7	220D250	PEL06
GN	7	250DXX	PEL06
GN	7	32D70	PEL06
GN	7	50D90	PEL06
GN	7	90D100	PEL06
GN	7	-	PEL06
GN	7a	00D50	PEL06

Gear	Area	Mesh size	FS
GN	7a	100D120	PEL06
GN	7a	120D130	PEL06
GN	7a	120DXX	PEL06
GN	7a	130D150	PEL06
GN	7a	150D220	PEL06
GN	7a	220D250	PEL06
GN	7a	250DXX	PEL06
GN	7a	32D70	PEL06
GN	7a	50D90	PEL06
GN	7a	90D100	PEL06
GN	7d	00D50	PEL06
GN	7d	100D120	PEL06
GN	7d	120D130	PEL06
GN	7d	130D150	PEL06
GN	7d	150D220	PEL06
GN	7d	220D250	PEL06
GN	7d	250DXX	PEL06
GN	7d	50D90	PEL06
GN	7d	90D100	PEL06
GN	7d	-	PEL06
GN	7e	00D50	PEL06
GN	7e	100D120	PEL06
GN	7e	120D130	PEL06
GN	7e	130D150	PEL06
GN	7e	150D220	PEL06
GN	7e	220D250	PEL06
GN	7e	250DXX	PEL06
GN	7e	50D90	PEL06
GN	7e	90D100	PEL06
GN	7e	-	PEL06
GT	2a	100D120	PEL16
GT	3a	100D120	PEL16
GT	3a	10D31	PEL16
GT	3a	120D220	PEL16
GT	3a	220D250	PEL16
GT	3a	250DXX	PEL16
GT	3a	50D71	PEL16
GT	3a	71D100	PEL16
GT	4	100D120	PEL07
GT	4	120D220	PEL07
GT	4	220D250	PEL07
GT	4	250DXX	PEL07
GT	4	50D71	PEL07
GT	4	71D100	PEL07
GT	4	-	PEL07

Gear	Area	Mesh size	FS
GT	6	150D220	PEL16
GT	6	90D100	PEL16
GT	7	00D50	PEL16
GT	7	100D120	PEL16
GT	7	120D130	PEL16
GT	7	120DXX	PEL16
GT	7	130D150	PEL16
GT	7	150D220	PEL16
GT	7	220D250	PEL16
GT	7	250DXX	PEL16
GT	7	50D90	PEL16
GT	7	90D100	PEL16
GT	7	-	PEL16
GT	7a	100D120	PEL16
GT	7a	120D130	PEL16
GT	7a	150D220	PEL16
GT	7a	250DXX	PEL16
GT	7d	00D50	PEL16
GT	7d	100D120	PEL16
GT	7d	120D130	PEL16
GT	7d	130D150	PEL16
GT	7d	150D220	PEL16
GT	7d	220D250	PEL16
GT	7d	250DXX	PEL16
GT	7d	50D90	PEL16
GT	7d	90D100	PEL16
GT	7d	-	PEL16
GT	7e	00D50	PEL16
GT	7e	100D120	PEL16
GT	7e	120D130	PEL16
GT	7e	130D150	PEL16
GT	7e	150D220	PEL16
GT	7e	220D250	PEL16
GT	7e	250DXX	PEL16
GT	7e	50D90	PEL16
GT	7e	90D100	PEL16
GT	7e	-	PEL16
LL	2a	-	PEL16
LL	3a	-	PEL08
LL	4	-	PEL08
LL	5b	-	PEL16
LL	6	-	PEL16
LL	7	-	PEL14
LL	7a	-	PEL14
LL	7d	-	PEL14
LL	7e	-	PEL14
MIS	2a	-	PEL16
MIS	3a	100D120	PEL09
MIS	3a	10D31	PEL09
MIS	3a	-	PEL09
MIS	4	00D10	PEL09
MIS	4	100D120	PEL09
MIS	4	10D31	PEL09
MIS	4	120D220	PEL09
MIS	4	250DXX	PEL09
MIS	4	31D50	PEL09

Gear	Area	Mesh size	FS
MIS	4	50D71	PEL09
MIS	4	71D100	PEL09
MIS	4	-	PEL09
MIS	5b	-	PEL16
MIS	6	-	PEL16
MIS	7	-	PEL16
MIS	7a	-	PEL16
MIS	7d	-	PEL16
MIS	7e	-	PEL16
OTB	2a	110D120	PEL16
OTB	2a	120DXX	PEL16
OTB	2a	32D80	PEL16
OTB	2a	80D100	PEL16
OTB	2a	-	PEL16
OTB	3a	00D16	PEL11
OTB	3a	100D110	PEL03
OTB	3a	100D120	PEL03
OTB	3a	110D120	PEL03
OTB	3a	120DXX	PEL03
OTB	3a	16D32	PEL10
OTB	3a	32D80	PEL03
OTB	3a	70S90	PEL03
OTB	3a	80D100	PEL03
OTB	3a	-	PEL03
OTB	4	00D16	PEL11
OTB	4	100D110	PEL16
OTB	4	100D120	PEL16
OTB	4	110D120	PEL16
OTB	4	120DXX	PEL16
OTB	4	16D32	PEL10
OTB	4	32D80	PEL16
OTB	4	80D100	PEL16
OTB	4	-	PEL16
OTB	5b	120DXX	PEL16
OTB	5b	80D100	PEL16
OTB	6	00D16	PEL16
OTB	6	100D110	PEL16
OTB	6	100D120	PEL16
OTB	6	110D120	PEL16
OTB	6	120D130	PEL16
OTB	6	120DXX	PEL16
OTB	6	16D32	PEL16
OTB	6	32D70	PEL16
OTB	6	50D90	PEL16
OTB	6	70D80	PEL16
OTB	6	80D100	PEL16
OTB	6	-	PEL16
OTB	7	00D16	PEL03
OTB	7	100D110	PEL03
OTB	7	100D120	PEL03
OTB	7	110D120	PEL03
OTB	7	120D130	PEL03
OTB	7	120DXX	PEL03
OTB	7	16D32	PEL03
OTB	7	32D70	PEL03
OTB	7	50D90	PEL03

Gear	Area	Mesh size	FS
OTB	7	70D80	PEL03
OTB	7	80D100	PEL03
OTB	7	90D100	PEL03
OTB	7	-	PEL03
OTB	7a	00D16	PEL03
OTB	7a	100D110	PEL03
OTB	7a	110D120	PEL03
OTB	7a	120D130	PEL03
OTB	7a	120DXX	PEL03
OTB	7a	16D32	PEL03
OTB	7a	32D70	PEL03
OTB	7a	70D80	PEL03
OTB	7a	80D100	PEL03
OTB	7d	00D16	PEL03
OTB	7d	100D110	PEL03
OTB	7d	110D120	PEL03
OTB	7d	120DXX	PEL03
OTB	7d	16D32	PEL03
OTB	7d	32D70	PEL03
OTB	7d	70D80	PEL03
OTB	7d	80D100	PEL03
OTB	7d	-	PEL03
OTB	7e	00D16	PEL03
OTB	7e	100D110	PEL03
OTB	7e	110D120	PEL03
OTB	7e	120DXX	PEL03
OTB	7e	16D32	PEL03
OTB	7e	32D70	PEL03
OTB	7e	70D80	PEL03
OTB	7e	80D100	PEL03
OTB	7e	-	PEL03
OTM	2a	100D110	PEL01,2
OTM	2a	100D120	PEL01,2
OTM	2a	100DXX	PEL01,2
OTM	2a	110D120	PEL01,2
OTM	2a	120DXX	PEL01,2
OTM	2a	32D70	PEL01,2
OTM	2a	32D80	PEL01,2
OTM	2a	-	PEL01,2
OTM	3a	00D16	PEL11
OTM	3a	120DXX	PEL01,2
OTM	3a	16D32	PEL10
OTM	3a	32D80	PEL01,2
OTM	4	00D16	PEL11
OTM	4	100D110	PEL01,2
OTM	4	100D120	PEL01,2
OTM	4	120DXX	PEL01,2
OTM	4	16D32	PEL10
OTM	4	32D80	PEL01,2
OTM	4	80D100	PEL01,2
OTM	4	-	PEL01,2
OTM	5b	120DXX	PEL01,2
OTM	5b	32D70	PEL01,2
OTM	5b	-	PEL01,2

Gear	Area	Mesh size	FS
OTM	6	100D110	PEL01,2
OTM	6	100D120	PEL01,2
OTM	6	110D120	PEL01,2
OTM	6	120DXX	PEL01,2
OTM	6	16D32	PEL01,2
OTM	6	32D70	PEL01,2
OTM	6	32D80	PEL01,2
OTM	6	50D90	PEL01,2
OTM	6	80D100	PEL01,2
OTM	6	-	PEL01,2
OTM	7	100D110	PEL01,2
OTM	7	110D120	PEL01,2
OTM	7	120DXX	PEL01,2
OTM	7	16D32	PEL01,2
OTM	7	32D70	PEL01,2
OTM	7	50D90	PEL01,2
OTM	7	70D80	PEL01,2
OTM	7	80D100	PEL01,2
OTM	7	-	PEL01,2
OTM	7a	100D110	PEL01,2
OTM	7a	120DXX	PEL01,2
OTM	7a	16D32	PEL01,2
OTM	7a	32D70	PEL01,2
OTM	7a	70D80	PEL01,2
OTM	7d	00D16	PEL01,2
OTM	7d	100D110	PEL01,2
OTM	7d	110D120	PEL01,2
OTM	7d	120DXX	PEL01,2
OTM	7d	16D32	PEL01,2
OTM	7d	32D70	PEL01,2
OTM	7d	70D80	PEL01,2
OTM	7d	80D100	PEL01,2
OTM	7d	-	PEL01,2
OTM	7e	00D16	PEL01,2
OTM	7e	100D110	PEL01,2
OTM	7e	110D120	PEL01,2
OTM	7e	120DXX	PEL01,2
OTM	7e	16D32	PEL01,2
OTM	7e	32D70	PEL01,2
OTM	7e	70D80	PEL01,2
OTM	7e	80D100	PEL01,2
OTM	7e	-	PEL01,2
PS	2a	32D80	PEL04
PS	3a	16D32	PEL04
PS	3a	32D80	PEL04
PS	4	00D16	PEL04
PS	4	120DXX	PEL04
PS	4	32D80	PEL04
PS	7	00D16	PEL04,5
PS	7	16D32	PEL04,5
PS	7	-	PEL04,5
PS	7d	100D110	PEL04,5
PS	7d	32D70	PEL04,5
PS	7d	80D100	PEL04,5

Gear	Area	Mesh size	FS
PS	7e	00D16	PEL04,5
PS	7e	100D110	PEL04,5
PS	7e	120DXX	PEL04,5

Gear	Area	Mesh size	FS
PS	7e	16D32	PEL04,5
PS	7e	80D100	PEL04,5
PS	7e	-	PEL04,5

Annex 5. Logbook information (2018-2020)

Percentage of MAC total catch represented by each discard category (BMS, DIS, DIM) in relation to the total catch of MAC reported in the logbooks by fleet segment (FS) and area, for each year under this evaluation.

rBMS=BMS reported divided by the total catch and expressed as a %; rDIM and rDIS were similarly calculated; rTot= sum of reported BMS+DIM+DIS divided by the total catch of MAC and expressed as a %.

		2018				2019				2020			
FS	**Area**	**rBMS**	**rDIM**	**rDIS**	**rTot**	**rBMS**	**rDIM**	**rDIS**	**rTot**	**rBMS**	**rDIM**	**rDIS**	**rTot**
PEL01	**27.2.a**	**1.2**	**0.0**	**0.0**	**1.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	27.4	**2.0**	**0.0**	**0.0**	**2.0**	**0.6**	**0.0**	**0.0**	**0.6**	**0.8**	**0.0**	**0.0**	**0.8**
	27.6	**0.6**	**0.0**	**0.0**	**0.6**	**0.4**	**0.0**	**0.0**	**0.4**	**0.5**	**0.0**	**0.0**	**0.5**
	27.7	**0.4**	**0.0**	**0.0**	**0.4**	**0.8**	**0.0**	**0.0**	**0.8**	**0.1**	**0.0**	**0.0**	**0.1**
PEL02	**27.2.a**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	27.3.a	**1.5**	**0.0**	**0.0**	**1.5**	**12.5**	**0.0**	**0.0**	**12.5**	**0.0**	**0.0**	**0.0**	**0.0**
	27.4	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**0.0**	**0.0**	**1.8**	**0.0**	**0.0**	**0.0**	**0.0**
	27.6	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	27.7	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
PEL03	**27.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.1**	**0.0**	**2.5**	**0.0**	**2.6**
PEL04	**27.2.a**	**0.0**	**0.0**	**0.0**	**0.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	27.4	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	27.7	**0.0**	**0.0**	**0.0**	**0.0**	**12.4**	**0.0**	**0.0**	**12.4**	**-**	**-**	**-**	**-**
PEL05	**27.7**	**-**	**-**	**-**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
PEL06	**27.3.a**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.0**	**1.0**
	27.7.a	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	27.7.d	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-**	**-**	**-**	**-**
	27.7.e	**0.2**	**0.0**	**0.0**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**-**	**-**	**-**	**-**

Annex 6. ICES discard estimates

Stock	Source	Comments	2018			2019			2020		
			Total catch (t)	Discards (t)	Discard ratio (%)	Total catch (t)	Discards and slipping (t)	Discard ratio (%)	Total catch (t)	Discards (t)	Discard ratio (%)
Mackerel in subareas 1–8 and 14 and in division 9.a (the NE Atlantic and adjacent waters)	mac.27.nea	*Proportion of landings: 79-83% (pelagic trawls), 17-20.5% purse seine and 0.2-1% (others)*	1 026 437	2 890*	0.3	840 021	7 807**	0.9	1 039 513	9 280*	0.9

* Only quantified for part of the fleet

** Data on discards and slipping from only two fleets

Annex 7. Reported catches of MAC by fleet segments/area

Data obtained from the logbook information submitted by MS in reply to the EFCA data calls.

Amount of MAC reported caught (Catch, tons) by fleet segment (FS) and area and percentage of the total catch reported that year for the species (% of TC).

		2018		2019		2020	
FS	Area	Catch (tons)	% of TC	Catch (tons)	% of TC	Catch (tons)	% of TC
PEL01 Freezer Trawlers - Midwater trawl and midwater pair trawl	27.2.a	3030	1.1	183	0.1	<1	0.0
	27.4	53728	19.1	108911	39.9	37442	20.3
	27.6	32792	11.7	67899	24.9	13392	7.3
	27.7	8293	2.9	9400	3.4	12870	7.0
PEL02 RSW tank vessels and Polyvalents - Midwater trawl and midwater pair trawl	27.2.a	520	0.2	<1	0.0	220	0.1
	27.3.a	10	0.0	8	0.0	6	0.0
	27.4	54850	19.5	19342	7.1	51719	28.1
	27.6	99607	35.4	43599	16.0	47373	25.7
	27.7	11194	4.0	12420	4.5	17559	9.5
PEL03 Polyvalents - Bottom trawl and bottom pair trawl	27.7	1548	0.6	3051	1.1	2680	1.5
PEL04 RSW tank vessels - Purse seine	27.2.a	660	0.2	**-**	-	**-**	-
	27.4	14931	5.3	8069	3.0	800	0.4
	27.7	31	0.0	28	0.0	**-**	-
PEL05 Polyvalents - Purse seine	27.7	14	0.0	177	0.1	8	0.0
PEL06 Gillnets anchored (set), and Gillnets (drift)	27.3.a	88	0.0	107	0.0	101	0.1
	27.7.a	**-**	-	**-**	-	10	0.0
	27.7.d	2	0.0	3	0.0	**-**	-
	27.7.e	8	0.0	13	0.0	**-**	-
Total catch under evaluation		**281307**		**273211**		**184181**	