Pelagic pilot project discard ban, 2013-2014

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Report number C071/14

IMARES Wageningen UR

(IMARES - Institute for Marine Resources & Ecosystem Studies)

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Publication date:	29 April 2014

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A_4_3_2-V13.3

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Summary

The new EU obligation to land all catches of regulated species will apply to the pelagic fisheries from 1 January 2015 onwards. Although the pelagic fisheries are generally described as single species fisheries with relatively low discard rates, the new regulation still poses a number of specific challenges that need to be addressed prior to the implementation of the regulation.

In the first half of 2013, the Pelagic Freezer-trawler Association (PFA) already recognized the need to prepare well for the new regulation even though the regulation had not been formally agreed at that stage. The PFA initiated a pilot project to explore possible mitigation strategies to avoid unwanted bycatch, to handle and use unwanted bycatch and to find feasible strategies to document and control the catches. The results of the pilot project would also inform discussions on the future technical measures regulations that impact on discards. The project started in August 2013 and finished in February 2014. IMARES was commissioned to lead the project with inputs from a consortium consisting of the fishing companies that are members to the PFA, the Dutch ministry of Economic Affairs, the Dutch inspection agency NVWA, Maritiem BV and Archipelago Marine Research. The project was funded by the PFA, who received a compensation in the form of a limited scientific quota.

The pilot project addressed four main objectives:

1. How to **avoid** catching unwanted fish?
2. How to **handle and use** the unwanted catch that is caught despite measures to avoid?
3. How to **document and control** the composition of the catches?
4. How does the current **technical measures** regulation affect discarding in PFA fisheries and how could new approaches to avoid, handle and use unwanted catches be accommodated in future technical measures regulations.

Although not a formal objective, the project also facilitated the collaboration between industry, research, regulators, control and service suppliers on the implementation of the landing obligation.

How to avoid catching unwanted fish?

Avoiding the catch of unwanted fish in pelagic fisheries is determined by a number of factors (e.g. area, season, gear, mesh size, depth). The catching operations of pelagic vessels are strongly informed by the acoustic information on fish schools. Acoustic technologies that allow for characterizations of the composition of fish schools (species, sizes) are under development in several research projects but have not yet reached the stage of routine application yet.

In this pilot project, the focus has been on release panels in the net that should allow unwanted small fish to escape from the net. Two types of release panels have been tested: release panels with a grid made of semi-rigid bars and release panels on the basis of a flexible grid, made of Dyneema rope. The release panels were tested in the herring fishery (August to October 2013) and the horse mackerel/mackerel fishery (October to December 2013). Trials were conducted on board two vessels (Carolien SCH81 and Afrika SCH24). Comparable vessels fishing in the vicinity of the trials were used as reference vessels.

To assess the effects of the different sorting grids on the catch of a test vessel, information on length distribution per species per haul were compared with a reference vessel. Trial vessels were monitored by an observer who sampled catch and discards. Reference vessels were monitored by the vessel's own quality manager according to the IMARES sampling protocols. There were no clearly distinct differences in length compositions between the test vessel and the reference vessel for any of the trials or species. Inspection of underwater camera footage during various tows for herring suggested that the opening between the bars may have been too small for the size of herring caught. This is further supported by

the fact that during a tow from a school with relative small herring, a larger number of escapes could be seen. During the last trip (for mackerel), an indication of a possible positive effect of the gear modifications could be derived from the higher average weight of the mackerel compared to the reference vessel (meaning that the smaller individuals were released from the net). In general, the discard percentages encountered during the gear trials, did not differ from the range that was found in the regular discard sampling programme of the pelagic fishery that is carried out by IMARES. There were not sufficient comparative samples to allow for statistically significant results.

How to handle and use the unwanted bycatch that is caught despite mitigation measures?

A discard-collection and mincing device was placed on board of the Carolien (SCH81). It consisted of a discard stream from the sorting device, a separate conveyor belt that transported the discards into a water-cooled hold, from which they were transported into the mincing device. The mincing device, in combination with the available freezing capacity for minced products, could operate up to a discard percentage of around 4%. When larger bycatches were taken of small mackerel, unwanted bycatches were frozen in whole to target a specific bait market.

The chemical analyses of discard samples showed that they are suitable for production of higher quality fish oil with protein as a by-product. Fish oil extraction could be considered as a first step in material processing, combined with further processing of the solid and dissolved protein fractions. The most economic valuable product valorisation should be analysed in a broader perspective.

During pelagic fishing trips incidental bycatches of sharks and sea-mammals may occur. Incidental bycatches were registered by the scientific observer. During one trip on the Carolien (SCH81), the IMARES observer noted substantial bycatches of sharks. Bycatches of sharks were treated in three different ways: 1) Large sharks were removed from the "shark-catcher", a device in the net that allows removing before they reach the fish-pump. 2) Medium sized sharks which were able to pass the fish pump were removed from the fish-water separator on deck. 3) Small-sized sharks were handled in the factory. Because the sharks could not be fed through the mincing machine, they were manually transported to the rear deck to be discarded. All sharks were counted and weight estimated by the scientific observer.

Bycatches of sharks, rays and marine mammals will need to be treated in different ways because of the different rules that apply to these species. In order to document these bycatches, clear guidelines would need to be developed on which approach is applicable to which species. A visual chart of species and handling categories would be very useful.

How to document and control the composition of the catches?

A major challenge for the landing obligation will be to assess the composition of the retained bycatch of regulated species. The current project focussed on monitoring of the species and length compositions of the retained bycatch. The trial vessel that kept discards on board (Carolien SCH81) was monitored using three different techniques.

- Scientific observer on board. A total of 73 days were observed with the routine discard sampling protocol of IMARES.
- Analysis of random samples taken from the discard fraction. A total of 4 frozen blocks of unsorted discards were analysed at IMARES for species composition and length composition.
- Electronic Monitoring of the bycatch handling procedures. Here the bycatches were quantified by analysing a subsample from the video footage.

For only two hauls a comparison could be made between all three sampling techniques. In those hauls the resulting species compositions were generally in line. For another two hauls, a comparison could be made between only two sampling techniques (random frozen samples and observing on board). For one of those hauls, the species composition of the discard samples differed considerably between two techniques. The difference was between the proportion of mackerel in the sample which could be due to the timing of when samples were taken. Mackerel is known to sink to the bottom of the fish tanks, so taking a sample from the beginning of a fish tank discharge could give a different species composition compared to at the end of a tank discharge.

Electronic Monitoring of a no-discard policy

To verify that no discarding took place on the trial vessel (Carolien SCH81), a Remote Electronic Monitoring (REM) equipment was installed by Archipelago Marine Research. The REM system consisted of 8 cameras and a recording device. One of the cameras was specifically aimed at monitoring the species and length composition of the retained bycatch (see above).
The other seven cameras were aimed to verify the no-discard policy.

Overall, the camera system worked satisfactory after the initial technical hurdles were overcome. The use of digital camera's (in the fish processing deck) proved to give a clearer picture than the analogue cameras used on the upper deck. Attention needs to be given to the positioning of the camera's, so that all processes can be registered. The alignment of the camera aimed off the stern of the vessel could have been improved. In the current setup it was difficult to observe the process of coupling and uncoupling of the fish pump on the camera footage.
A dedicated video analysis session was held with the Dutch inspection agency (NVWA), representatives of Cornelis Vrolijk BV and IMARES researchers. From this session, specific recommendations were made for inspection agencies on the potential requirements and application of camera systems in pelagic freezer trawler fisheries.

How does the current technical measures regulation affect discarding in PFA fisheries and how could new approaches to avoid, handle and use unwanted catches be accommodated in future technical measures regulations?

The landing obligation constitutes a 180 degree change of the CFP: where previously catches of undersized fish and fish for which no quota was available had to be discarded, now these fish will need to be landed. This means that the current set of technical measures legislation will have to be changed to allow for landing the catches that are now still obligatory to discard (e.g. Reg. 850/98, Reg. 1224/2009, Reg. 39/2013, Reg. 227/2013). One of the objectives of this pilot project was to establish which parts of the existing technical measures legislation should be adapted or removed in relation to implementation of the landing obligation in the PFA fisheries. The most important technical measures that should be amended are the following:

- Article 4 (1) Reg. 850/98 and Annexes I to V: specification of combinations of mesh size and percentage target species. Combinations of mesh sizes and percentage of target species may lead to substantial unwanted bycatches. **Recommendation:** The industry argues that selectivity in the fishery is the result of using the most appropriate gears or nets. Under a landing obligation this should be at the discretion of the skipper. Application of larger mesh sizes and different mesh types (e.g. hexagonal, rectangular, different types of grids) should be allowed (also in hake and cod boxes).
- Article 4 (2a) Reg. 850/98: one-net rule. The one net rule may lead to substantial unwanted bycatches in fishing trips where multiple target species are fished in different areas. **Recommendation:** under a landing obligation the choice of appropriate gear should be under the responsibility of the skipper.

- Article 19 (1) Reg. 850/98: obligation to discard undersized marine organisms. **Recommendation:** this article should be deleted since it will not be allowed to discard regulated species.
- Art. 19a (1) Reg. 227/2013: prohibition of high-grading. **Recommendation:** this article can be withdrawn as a landing obligation will be in place.
- Article 42 Reg. 850/98: Processing operations. The current Technical Measures regulation prohibits the on-board production of fish oil, fish meal or similar products. However, the same article allows for the handling and processing of fish on board pelagic vessels into fish pulp. The production of fish pulp under the condition of full documentation of the amount, size and species type, was integral part of this pelagic pilot project. **Recommendation:** explorations of other on-board handling and processing of fish into different intermediate products should be allowed under the condition that the composition of the unwanted bycatch can be reliably and verifiably determined.

Reflections on the process

The pilot project on the landing obligation for pelagic fisheries resulted in an interactive process between fishing industry, research, fishery management, control authorities and technical suppliers. The interaction meant that there was a joint learning process on what the landing obligation could mean in the practice of this fishery. The translation from the political agreement on the landing obligation to the operational aspects in a specific fishery, provided an environment for exploration and experimentation, like:

- exploring technical aspects of gears and how they could be made more selective
- the need for sufficient replicates in order to allow conclusions to be drawn from catch comparisons
- the operation of mincing machines on board the vessels and how they work for different species
- the future roles and responsibilities for documenting and verifying the catches under a landing obligation
- the many different situations in which the vessels operate and may need to handle catches in different ways in order to comply with the landing obligation.

Joint learning is very important because of the many uncertainties surrounding the implementation of the landing obligation and the need to develop buy-in for the regulation at the vessel level.

Samenvatting

De nieuwe EU aanlandplicht voor gereguleerde soorten zal voor de pelagische visserijen gaan gelden vanaf 1 januari 2015. Hoewel de pelagische visserijen vaak worden beschreven als visserijen op individuele soorten met relatief lage discard percentages, zal de nieuwe regelgeving toch een aantal specifieke uitdagingen opwerpen die geadresseerd moeten worden voorafgaand aan de implementatie van de regels.

In de eerste helft van 2013 heeft de Pelagic Freezer-trawlers Association (PFA) de noodzaak onderkent om goed voorbereid te anticiperen op de nieuwe regelgeving hoewel die toen nog niet formeel aanvaard was. De PFA heeft een pilot project opgestart om strategieën te verkennen waarmee bijvangst zou kunnen worden voorkomen, waarmee bijvangst zou kunnen worden verwerkt en gebruikt en waarmee vangsten kunnen worden gedocumenteerd en gecontroleerd. De resultaten van het pilot project zouden ook informatie op moeten leveren voor de herzieningen van de technische maatregelen in het visserijbeheer voor zover ze invloed hebben op discards. Het project is gestart in augustus 2013 en liep af in februari 2014. IMARES werd gevraagd om het project te leiden met inbreng van een consortium bestaande uit visserijbedrijven die lid zijn van de PFA, het ministerie van Economische Zaken, de Nederlandse Voedsel en Waren Autoriteit (NVWA), Maritiem BV en Archipelago Marine Research (Canada). Het project werd gefinancierd door de PFA die een tegemoetkoming ontving in de vorm van een beperkt wetenschappelijk quota.

Het pilot project richtte zich op vier hoofddoelen:

1. Hoe kan het vangen van ongewenste vis worden **voorkomen**?
2. Hoe kan ongewenste vis worden **verwerkt en gebruikt**?
3. Hoe kunnen vangsten worden **gedocumenteerd en gecontroleerd**?
4. Hoe beïnvloed de huidige **technische maatregelen** regelgeving discards in de PFA visserijen en hoe kunnen nieuwe benaderingen om bijvangst te voorkomen, verwerken en documenteren worden ondergebracht in de nieuwe technische maatregelen regelgeving?

Hoewel geen formeel doel, heeft het project ook de samenwerking verbeterd tussen sector, onderzoek, beheerders, controleurs en technische ondersteuning.

Hoe kan het vangen van ongewenste vis worden voorkomen?

Het vermijden van ongewenste vis in pelagische visserijen wordt bepaald door een aantal factoren, zoals gebied, seizoen, vistuig, maaswijdte en diepte. Het vangstproces wordt in sterke mate gestuurd door de akoestische informatie over visscholen. Akoestische technieken de het mogelijk maken om visscholen nauwkeurig te karakteriseren (soort, groottes) zijn in ontwikkeling in verschillende onderzoeksprojecten maar hebben nog niet het niveau bereikt van routinematige toepassing.

In dit pilot project lag de nadruk op het ontwikkelen van ontsnappingspanelen in het net die ervoor zouden moeten zorgen dat ongewenste kleine vis kan ontsnappen uit het net. Twee soorten ontsnappingspanelen zijn getest: ontsnappingspanelen met semi-stijve buizen en ontsnappingspanelen met flexibel Dyneema. De ontsnappingspanelen zijn getest in de haring visserij (augustus tot oktober 2013) en in de horsmakreel en makreelvisserij (oktober tot december 2013). De proeven werden uitgevoerd aan boord van twee testschepen (Carolien SCH81 en Afrika SCH24). Vergelijkbare schepen die visten in de buurt van de testschepen werden gebruikt als referentieschepen.

Om het effect van de ontsnappingspanelen op de vangstsamenstelling van de testschepen te bepalen, werd informatie van de lengteverdeling per soort en per trek vergeleken met een referentieschip. De testschepen werden bemonsterd door een wetenschappelijke waarnemer die de vangst en discards bemonsterde. De referentieschepen werden bemonsterd door de Quality Managers van de schepen die

waren geïnstrueerd op bases van het IMARES bemonsteringsprotocol. Er was geen algemeen duidelijk verschil in lengtesamenstelling waarneembaar tussen de testschepen en referentieschepen. Beelden van onderwater camera's lieten zien dat de openingen van het ontsnappingspaneel mogelijk te klein waren voor de haring die werd gevangen. Dit werd ook bevestigd door de beelden van een trek met relatief kleine haring waarin een groter aantal ontsnappende vis kon worden gezien. Gedurende de laatste reis waarin op makreel werd gevist, kon een mogelijk positief effect van het ontsnappingspaneel worden afgeleid uit het relatief hogere gemiddelde gewicht van makreel in de het test schip vergeleken met het referentieschip. Dit zou kunnen betekenen dat de kleinere makreel uit het net was ontsnapt. In het algemeen waren de discard percentages in the testvisserijen vergelijkbaar met de discard percentages die worden waargenomen in de standaard bemonstering zoals die wordt uitgevoerd door IMARES. Er waren helaas te weinig vergelijkbare monsters voor statistisch significante resultaten.

Hoe kan ongewenste vis worden verwerkt en gebruikt?

Een discard verzamelbak en maalapparaat was geplaatst aan boord van de Carolien (SCH81). Het bestond uit een speciaal discard spoor op de sorteermachine, een speciale lopende band die de discards naar de watergekoelde verzamelbak transporteerde en van daaruit weer naar het maalapparaat. Deze verwerkingsprocedure in combinatie met de beschikbare vriescapaciteit voor het vermalen product, werkte goed tot een discard percentage van ongeveer 4%. Bij hogere bijvangsten van bijvoorbeeld kleine makreel, werden de ongewenste bijvangsten ook geheel ingevroren (voor een specifieke aas-markt).

Chemische analyses van een drietal discard monsters liet zien dat ze geschikt zijn voor het maken van hoogwaardige visolie met eiwit als bijproduct. Extractie van visolie kan gezien worden als een eerste stap in het verwerken van de ongewenste vis. Verder verwerking zou dan kunnen leiden tot vaste en opgeloste eiwit fracties. Een volledige economische product valorisatie zou nog kunnen worden uitgevoerd.

Tijdens pelagische visreizen worden soms incidentele bijvangsten gemeld van haaien, roggen en zeezoogdieren. Incidentele bijvangsten werden geregistreerd door de wetenschappelijke waarnemer aan boord van de testschepen. Tijdens een van de reizen van de Carolien (SCH81) heeft de waarnemer behoorlijke bijvangsten van haaien gerapporteerd. Bijvangsten van haaien werden op drie verschillende manieren verwerkt: 1) grote haaien werden verwijderd via de "haaienvanger", een aanpassing in het net waarmee haaien kunnen worden verwijderd voordat ze de vispomp bereiken. 2) middelgrote haaien werden verwijderd bij de vis-water separator voordat de vis de vistank in wordt gepompt. 3) Kleine haaien werden verwerkt in de fabriek. Omdat de haaien niet door de vermaler konden worden verwerkt (te grove huid) werden deze kleine haaien handmatig naar boven gedragen en gediscard. Alle haaien werden geteld en geschat op gewicht door de waarnemer.

Bijvangsten van haaien, roggen en zeezoogdieren zullen onder een aanlandplicht op verschillende wijze moeten worden behandeld omdat er verschillende regels op van toepassing zijn. Om die bijvangsten te documenteren zijn hele richtlijnen nodig om te bepalen welke regel geldt voor welke soort. Een visuele kaart van soorten en verwerkingscategorieën zou hierbij zeer welkom zijn.

Hoe kunnen vangsten worden gedocumenteerd en gecontroleerd?

Een belangrijke uitdaging voor de aanlandplicht zal zijn om de samenstelling te bepalen van de aan boord gehouden bijvangsten van gereguleerde soorten. Dit pilot project richtte zich op de soorten en lengtesamenstelling van de aan boord gehouden bijvangsten. Het testschip dat discards aan boord hield (Carolien SCH81) werd bemonsterd met drie verschillende methodes:

- Wetenschappelijk waarnemer aan boord. In totaal 73 waarnemersdagen met routinematige discard sampling volgens het IMARES protocol

- Analyse van willekeurige monsters genomen van de discard fractie door de Quality Master van het schip. In totaal 4 bevroren blokken van 25 kg zijn geanalyseerd op soort en lengtesamenstelling.
- Elektronische Monitoring (CCTV, EM) van de bijvangst verwerking. De bijvangsten werden gekwantificeerd door een deelmonster van de videobeelden te analyseren.

Slechts voor 2 trekken kon een vergelijking worden gemaakt met alle drie de bemonsteringsmethodes. In deze trekken waren de soorten samenstellingen overeenkomstig. Voor twee andere trekken kon een vergelijking worden gemaakt tussen twee technieken (willekeurige monsters en wetenschappelijk waarnemer). Voor een van deze trekken was de soortensamenstelling overeenkomstig, voor de andere was er een behoorlijk verschil. Het verschil had te maken met de verhouding makreel in het monster. Dit verschil zou veroorzaakt kunnen zijn door het moment waarop de monsters werden genomen. Makreel zakt naar de bodem in een vistank (omdat makreel geen zwemblaas heeft). Daarom kan het moment van bemonsteren een verschillende soortensamenstelling geven.

Elektronische Monitoring van een geen-discard beleid

Om vast te stellen dat geen discarding plaats vond aan boord van het testschip (Carolien SCH81) werd een Remote Electronic Monitoring (REM, CCTV) systeem geïnstalleerd door Archipelago marine Research. Het systeem bestond uit 8 camera's en een opname apparaat. Een van de camera's was specifiek gericht op de discard verwerkingsband. De andere 7 camera's waren voor het vaststellen dat geen discards overboord werden gezet.

Het camera systeem werkte naar behoren nadat eerst een aantal technische problemen werden overwonnen. Het gebruik van digitale camera's op het visprocessing dek gaf een veel duidelijker beeld dan de analoge camera's op het achterdek. Aandacht moet worden gegeven aan het positioneren van de camera's zodat alle relevante processen kunnen worden gevolgd. De richting van de camera op het achtersteven van het schip zou beter hebben kunnen zijn. In de huidige opzet was het moeilijk om het koppelen en ontkoppelen van de vispomp waar te nemen.

Een video-analyse workshop werd gehouden met de NVWA, vertegenwoordigers van het visserijbedrijf Vrolijk BV en met IMARES onderzoekers. Vanuit deze workshop zijn specifieke aanbevelingen gegeven voor de controle instanties over hoe om te gaan met camera controle in pelagische vriesschepen.

Hoe beïnvloed de huidige technische maatregelen regelgeving discards in de PFA visserijen en hoe kunnen nieuwe benaderingen om bijvangst te voorkomen, verwerken en documenteren worden ondergebracht in de nieuwe technische maatregelen regelgeving?

De aanlandplicht is een 180 graden verandering in het Gemeenschappelijk Visserijbeleid: waar eerder vangsten van ondermaatse vis en vis waar geen quota voor was, overboord moest worden gezet, zal die in de nieuwe situatie juist aan boord moeten worden gehouden. Dat betekent dat de technische maatregelen regelgeving aangepast zal moeten worden om het mogelijk te maken om vangsten aan boord te houden die nu nog gediscard moeten worden (Reg. 850/98, Reg. 1224/2009, Reg. 39/2013, Reg. 227/2013). Een van de doelen van dit pilot project was om vast te stellen welke deze van de technische maatregelen aangepast of verwijderd zouden moeten worden om implementatie van de aanlandplicht in de PFA visserijen mogelijk te maken. De belangrijkste technische maatregelen die aangepast zouden moeten worden zijn:

- Artikel 4 (1) Reg. 850/98 en Annexen I tot V: regels de combinatie van maaswijdte en percentage doelsoort. Dergelijke combinaties van maaswijdte en percentage doelsoort kunnen leiden tot omvangrijke ongewenste bijvangsten. **Aanbeveling:** de sector redeneert dat selectiviteit in de visserij het resultaat is van het gebruik van de het beste vistuig op de beste plek. Onder een aanlandplicht zou de keuze van het net aan de schipper moeten zijn. Toepassing van grotere maaswijdtes of andere vormen van maaswijdte (bijv. hexagonaal, rechthoekig, verschillende soorten ontsnappingspanelen) zouden toegestaan moeten worden (ook in de heek en kabeljauw gebieden).

- Artikel 4 (2a) Reg. 850/98: Een-net regel. De een-net regel kan leiden tot omvangrijke ongewenste bijvangsten in visreizen waar meerdere doelsoorten in verschillende gebieden worden bevist. **Aanbeveling:** Onder een aanlandplicht zou de keuze van het net aan de schipper moeten zijn.
- Artikel 19 (1) Reg. 850/98: verplichting om ondermaatse vis te discarden. **Aanbeveling:** artikel zou verwijderd moeten worden; het is niet meer toegestaan om te discarden.
- Artikel 19a (1) Reg. 227/2013: verbod op high-grading. **Aanbeveling:** artikel kan verwijderd worden als een aanlandplicht in werking is.
- Artikel 42 Reg. 850/98: Bewerkingen aan boord. De huidige Technische Maatregelen regelgeving verbiedt het aan boord produceren van visolie, vismeel of vergelijkbare producten. In hetzelfde artikel wordt wel toegestaan om aan boord van pelagische schepen vispulp te maken. Het maken van vispulp onder de voorwaarden van volledige documentatie van hoeveelheid, grootte en soort was een integraal onderdeel van het pilot project. **Aanbeveling:** onderzoek naar verwerking van vis aan boord tot verschillende tussenproducten zou toegestaan moeten worden onder de voorwaarde van betrouwbare en controleerbare documentatie van bijvangst.

Reflecties op het proces

Het pilot project over de aanlandplicht voor pelagische visserijen heeft geleid tot een interactief proces met de visserijsector, onderzoek, visserijbeheer, controle agentschappen en technische bedrijven. Door dit proces is een gemeenschappelijk leren op gang gekomen over wat de aanlandplicht zou kunnen betekenen in de praktijk van de visserij en het beheer. De vertaling van de politieke overeenkomst van de aanlandplicht naar de operationele aspecten in een specifieke visserij, hebben een omgeving voor onderzoek en testen gemaakt, voor onder andere:

- Verkennen van technische aspecten van vistuigen en hoe die selectiever kunnen worden gemaakt.
- De noodzaak om genoeg vergelijksmateriaal te hebben zodat robuuste conclusies kunnen worden getrokken.
- Het hanteren van vermalers aan boord van de schepen en hoe die werken voor verschillende vissoorten.
- De toekomstige rollen en verantwoordelijkheden in het documenteren en controleren van vangsten onder een aanlandplicht
- De vele verschillende situaties die een schip kan tegenkomen en waar de verwerking van de vangst op een manier zou moeten uitgevoerd die past bij de aanlandplicht.

Gezamenlijk leren is erg belangrijk gelet op de vele onzekerheden die nog rond de implementatie van de aanlandplicht bestaan en de noodzaak om draagvlak te krijgen op het niveau van de schepen.

1 Introduction

The new EU obligation to land all catches of regulated species will apply to the pelagic fisheries from 1 January 2015 onwards. Although pelagic fisheries are generally described as single species fisheries with relatively low bycatch rates, the new regulation still poses a number of specific challenges that need to be addressed prior to the implementation of the regulation.

In the first half of 2013, the Pelagic Freezer-trawler Association (PFA) already recognized the need to prepare well for the new regulation even though the regulation had not been formally agreed at that stage. The PFA initiated a pilot project to explore possible mitigation strategies to avoid unwanted bycatch, to handle and use unwanted bycatch and to find feasible strategies to document and control the catches. The results of the pilot project would also inform discussions on the future technical measures regulations that impact on discards.

The project started in August 2013 and finished in February 2014 (Offerte 13.43.095). IMARES was commissioned to lead the project with inputs from a consortium consisting of the fishing companies that are members to the PFA, the Dutch ministry of Economic Affairs, the Dutch inspection agency NVWA, Maritiem BV and Archipelago Marine Research. Throughout the project, five consortium meetings were held to plan and discuss the ongoing work in the project (see annex 1 for a list of participants at each of the meetings). The project was funded by the PFA, who received a compensation in the form of a limited scientific quota.

This report documents the findings of the pilot project.

2 Assignment

The pilot project consisted of four main objectives:

1. How to avoid catching unwanted fish?
2. How to handle and use the unwanted catch that is caught despite measures to avoid?
3. How to document and control the composition of the catches?
4. How does the current technical measures regulation affect discarding in PFA fisheries and how could new approaches to avoid, handle and use unwanted catches be accommodated in future technical measures regulations.

3 Materials and Methods

3.1 Avoid

Literature study into escape behaviour of pelagic fish

A short literature study was conducted to provide insight into the escapement behaviour of a range of pelagic fish species.

Testing of gear modifications in trial fisheries

Several gear modifications were tested on two trial vessels. The two main gear modifications were sorting panels (also called flexible or flexi-grids) and sorting grids made of Dyneema twine. The grid is formed by longitudinal and transverse Dyneema ropes. PVC or POM-C spacers are used to secure the width of the grid, and in the initial grids PVC and POM-C hollow tubes were put over the longitudinal Dyneema ropes, to assure size-integrity. In all cases, the pales or grids were positioned in the aft part of the net before the cod end, straight below the intermediate section, which connects the cod end to the trawl, and in front of the more or less straight section of the cod end, often referred to as the tunnel section (figure 3.1)

All of the grids were 15.00m long, and either 1.20 or 1.50m wide. The purpose of the grids was to have a series of slots of variable dimensions (bar spacing between 15mm and 36mm, bar length between 300mm and 500mm), through which the fish would be able to escape. All but one of the various grids used focussed on escape of fish through the top panel. Only one section was produced with escape grids on all four sides of the trawl. Grids were initially produced of semi-rigid material, in order to assure size-integrity, but in the course of the project, more flexible materials such as Dyneema twines were used in the longitudinal direction, in combination with semi-rigid spacers in transverse direction (figure 3.2). The tension in the bars during fishing assured a certain level of rigidity. In addition, flaps or guiding panels were inserted inside the escape sections, in order to stimulate the fish up to the openings and look for an escape opportunity.

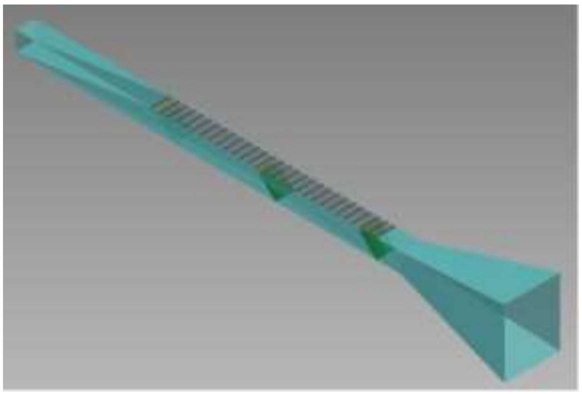

Figure 3.1 Schematic representation of the escape grids in the intermediate section of the net

Figure 3.2 Two release panels tested during the pilot project.

Grids were tested on two trial vessels: Carolien (SCH81, LoA 126m, 7053 GT, 7690 Hp) and Afrika (LoA 126m, 7005 GT, 7210 Hp)(Figure 3.3) . The trial vessels each carried out four trips between August and December 2013. In total 95 hauls were made by the trial vessels using one of the gear modifications.

Figure 3.3 Two trial vessels in the pilot project. The Carolien (SCH81) operated the release panels and a full catch retention scheme with Electronic Monitoring. The Afrika (SCH24) operated the release panels only.

Catch composition was analysed on board of the vessels either by a scientific observer from IMARES or the Quality Manager (QM) of the fishing company who had received instructions on the protocol for data collection.

Catch comparisons between trial vessels and reference vessels

In addition to the two trial vessels (Carolien SCH81 and Afrika SCH24), a reference vessels were identified who would fish with comparable pelagic trawls (without gear modifications) in the neighbourhood of the trial vessels. The Quality Managers on board of the designated reference vessels were instructed how to collect information that would be useable for the comparisons. The catch comparison between the trial vessels and the reference vessels were analysed on species and length compositions on a haul-by-haul basis.

Unfortunately it turned out to be difficult to get a substantial number of paired observations between the trial vessels and the reference vessels partly due to fishing strategies that resulted in vessels fishing at longer distances away from the trials than foreseen and partly due to a lack of sampling on board of reference vessels. In total, 31 hauls could be paired.

Catch comparisons between trial vessels and observations from the standard discard monitoring under the DCF.

IMARES[1] has conducted a discard sampling programme for pelagic trawlers, which started in 2003 and consists of around 10 trips per year that are monitored by a scientific observer. From the available trips in this monitoring programme, those trips that were in areas and seasons comparable with the trial vessels were selected for comparison.

3.2 Handle and use

Testing of a fish mincing device in trial fisheries

The discard collection and mincing device was placed on board of the Carolien (SCH81). It consisted of a discard stream from the sorting device, a separate conveyor belt that transported the discards into a water-cooled hold, from which it was transported into the mincing device (figure 3.4).

Figure 3.4 Discard handling on board of the Carolien (SCH81). From left to right: discard path on the sorting conveyor, conveyor belt for discards into the discard hold, conveyor belt out of the discard hold and the mincing device.

Assessment of bio-chemical composition of mince products

The bio-chemical composition of a limited number (3) of minced discard products was analysed by Nutrilab BV on 29 October 2013 with the aim to assess the potential valuable fats and proteins. Three samples of 25 kg each were provided of which 1 kg was prepared for analysis.

[1] IMARES is commissioned to do this by the Centre of Fisheries Research (CVO), which coordinates all obligatory data collection under the Data Collection Framework of the EU for the Dutch ministry of Economic Affairs.

3.3 Document & control

Assessment of the composition of landed bycatch through observations, random sampling and electronic monitoring.

A major challenge for the landing obligation will be to assess the composition of the retained bycatch of regulated species. The current project focussed on monitoring of the species composition and length compositions of the retained bycatch. The trial vessel that kept all discards on board (Carolien SCH81) was monitored using three different techniques.

- Observers on board of trial vessels. A total of 73 days were observed with the routine discard sampling protocol of IMARES (Van Helmond et al. 2011). As part of the routine sampling protocol, the catch composition of the unsorted catch and of the discarded (minced) catch were taken for each haul. For each sample weights per species were estimated with length-weight relationships.
- Analysis of random samples taken from the discard fraction. A total of 4 frozen blocks of unsorted discards were analysed at IMARES and weight fractions per species were registered.
- Electronic Monitoring of the bycatch handling procedures. Here the bycatches were quantified by analysing a fixed amount of time from the video footage: per haul 3 periods of 10 minutes video footages from discards was analysed. Species were identified and lengths were estimated with the conveyer belt width (40 cm) as the reference length. Weights per species were estimated with length-weight relationships derived from the IMARES DCF sampling.

Electronic Monitoring of a no-discard policy

To implement the no-discard policy, the discard gutters on-board the Carolien (SCH81) were completely closed by welding the former gutters. To verify that no discarding took place on the trial vessel, Electronic Monitoring (EM) equipment was installed by Archipelago Marine Research, Victoria BC, Canada. The EM system installation included:

- EM Control Centre, placed in the factory deck
- Hydraulic pressure: initially video recording was triggered at the first fishing event and then run on for 20 minutes after the end of haulback pressure levels; After the second trip this was changed to a 24/7 recording mode to provide adequate confidence for enforcement.
- Rotation sensor: to sense the operation of the conveyor in the factory and trigger the cameras to run on for 20 minutes after the conveyor stopped running;
- GPS: time, location, speed, heading to be recorded every ten seconds;
- Satellite modem: hourly Health Statements sent to Archipelago for EM system and vessel monitoring; and
- Eight cameras: to capture catch handling both on the trawl deck and on the factory floor. One of the cameras was aimed at the escalator to the mincer holding tank to enable monitoring the species (and length) composition of the retained bycatch (see section 3.2). The other seven cameras were aimed to verify the no-discard policy.

An Archipelago EM data technician reviewed the data using the EM InterpretTM Pro software that integrates video, sensor, and GPS records into a single synchronized timeline. Key events, comments and observations can be saved as annotations, created by the reviewer and saved along with the data for later exporting into databases or reports.

The EM reviewer reviewed imagery from the eight cameras on-board using two different methodologies: one for the trawl deck cameras and one for the factory floor cameras. This review was done to identify:

- Catch stowage (from start to end) after each tow and at opportunistic times in between tows,
- Catch discarding above and below deck, and

- Crew activities and behaviours related to catch handling (e.g., fish removed from camera view, fish put into the mincer etc.).

Archipelago Marine Research submitted a report to the owner of the vessel on setup and findings of the EM system during the pilot project (Bryan 2014).

In addition, the lessons from the EM system on board of a pelagic trawler were compared to the general lessons derived from other EM projects in the Netherlands. A dedicated session was held between IMARES, the PFA partners and the NVWA (inspection agency) to determine the best practices for EM that could be used from a control perspective.

4 Results

4.1 Avoid

Literature study into escape behaviour of pelagic fish

A short literature study was conducted to provide insight into the escapement behaviour of a range of pelagic fish species to inform the development of selectivity grids.

The pelagic fishery carried out by the freezer-trawlers of the PFA, takes place with a midwater or pelagic trawl towed between the seafloor and the surface. The vertical position is determined by the towing speed, the length of the trawl warps and the bridles, the types of otter boards and the size of the trawl weights (Figure 4.1). The tow duration is very variable and mostly dependent on the catch rate. Fish can survive in the net for a substantial amount of time by swimming along with the towed net . The fishery in European waters is targeted to pelagic species like herring (*Clupea harengus*), mackerel (*Scomber scombrus*), horse mackerel (*Trachurus trachurus*) and blue whiting (*Micromesistius poutassou*). Sometimes there is a substantial bycatch of boarfish (*Capros aper*). After being brought on board, the fish are first kept in tanks with cooled seawater. After sorting, they are frozen (without having been gutted) in carton boxes of around 25 kg and these are stored in a refrigerated fish hold.

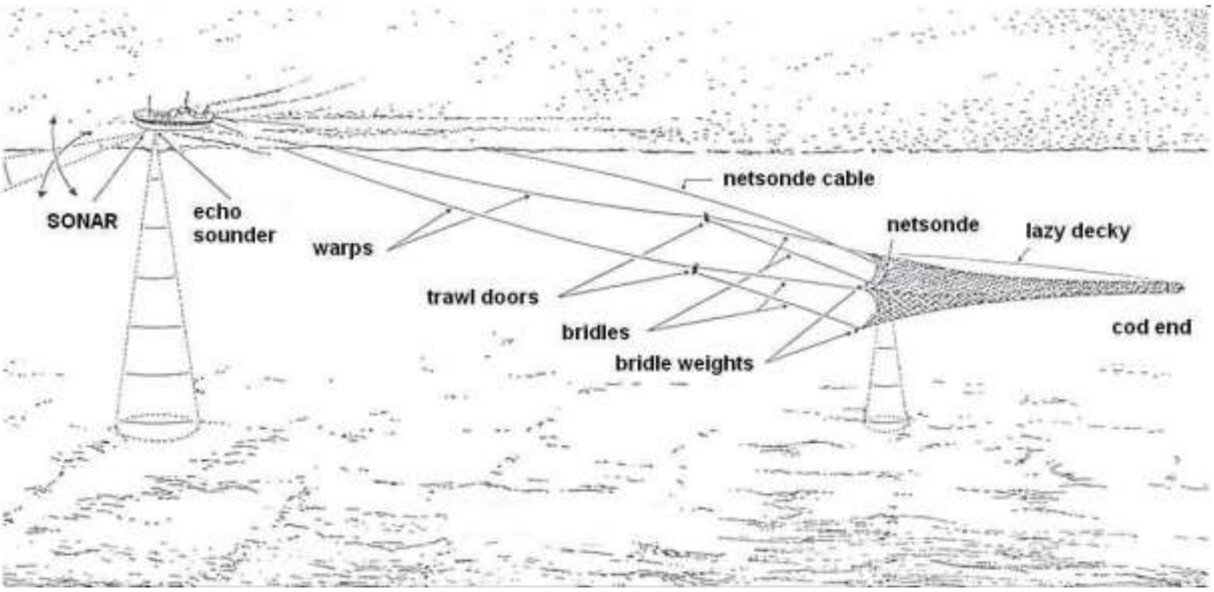

Figure 4.1. Working principle and major components of a pelagic trawl (From: de Boer and Van der Meulen 1976).

Observations with divers and underwater cameras have yielded substantial insights into behavioural responses of fish towards fishing gears (Graham et al. 2004; Main and Sangster 1978; Main and Sangster 1981; Main and Sangster 1983). A comprehensive description of fish behaviour is presented by Wardle (Wardle 1993). The behaviour of fish is triggered by a combination of acoustic, visual and vibration stimuli that are generated by the gear and the vessel. Research has shown that many fish species can perceive sounds well and respond to an approaching vessel (Anonymous 2012; Hastings and Popper 2005; Popper and Hastings 2009). This has also been recognized as an issue for acoustic surveys for pelagic fish like herring (Vabø et al. 2002) and it also received attention in the design of fishing vessels. Nevertheless, the responses to fishing gears seem to be dominated by visual stimuli. Observation at extreme darkness (no lights on the deck, no moonlight on northerly fishing grounds) showed that fish in these conditions were surprised by physical contacts with parts of the gear and were not forewarned with respect to the approaching gear. The light level in these experiments was less than 10-6 lux (Glass and Wardle 1989). In most case the light level appears to be sufficient for fish to detect approaching fishing gear. Acoustic stimuli increased the alertness, but visual stimuli were needed to trigger a response in the fish.

The first part of the trawl that is experienced by the fish are the otter boards. Depending on the visibility of the boards, fish will behave as if confronted by a predator and will try to swim around the board (Figure 4.2).

Figure 4.2 Fish behaviour relative to an otter board

Between the otter boards, the fish are guided by the visual stimuli of the boards and the guiding lines to the net opening. Here we usually find the **'optomotor response**' which means that the fish swims along with the towed net. We can also find the **'erratic response**' which means a very irregular and unpredictable behavioural response with high variation in speed, acceleration and direction (Kim and Wardle 2003).

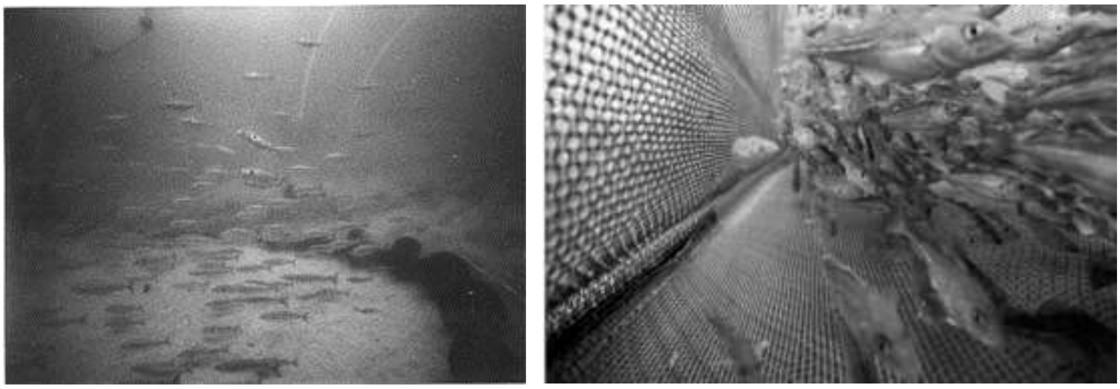

Figure 4.3 Optomotor response: swimming along the direction of the trawl

The optomotor response (swimming along within the net) can last until the fish gets too exhausted. This depends on the cruising velocity of the fish and the towing speed of the gear. The cruising velocity of the fish is dependent on the species, the length of the fish and the water temperature (Kim and Wardle, 2003; Wardle, 1989; Wardle, 1993). The maximum swimming speed is around 10 times the body length per second. The maximum speed is reduced to 50% if the temperature drops by 10 °C. There have been recordings of pelagic fish swimming just in front of a large escape window of the gear without any attempts to escape from the gear. There are also observations of fish that have escaped from the net, but subsequently swim back into the net to re-join with the school (van Marlen et al. 1994; van Marlen 1995).

Before the fish reaches the codend, behavioural responses can arise from the narrowing of the net. This can result in escape behaviour and fish sticking out of the codend ('stekers'). Suuronen observed that Baltic Sea herring swim up at the approach of a trawl, especially during daylight. The smaller herring also had the inclination to escape up in dark situations (Suuronen et al. 1997).

In the pelagic fishery, large quantities of fish may be caught in a short period of time. This may make it difficult to allow unwanted or undersized fish to escape from the gear through sorting grids or escape windows (O'Neill et al. 2008).

Sorting grids have previously been tried in the Norwegian mackerel fishery in 1997-1999 with the aim to avoid catching undersized mackerel. Because of the length-selectivity, the revenue from these hauls could be increased by 8 to 18% (Kvalsvik et al., 2002).

Recent research around the Faroe Islands has shown that blue whiting and herring can escape from the rear end of a Vónin 640m pelagic survey trawl with a 60m horizontal and 40m vertical opening and with large 16m meshes in the front of the net and 40 mm in the codend. Escape proportions were respectively 0.6–12% and 2–21%. Blue whiting escaped predominantly from a part of the net with 200 mm meshes (at 400 m depth), herring escaped from 80mm, 200mm en 400mm sections at 200 m depth (Skúvadal et al. 2011).

The mortality of pelagic species that escape through the meshes or that are retained in the net was found to be relatively high in some studies. In the study of Suuronen et al, the mortality of herring of smaller than 12 cm after 7 days was 72% and for herring between 12 and 17 cm it was 30%. The mortality is likely to be caused by exhaustion and loss of scales. (Suuronen et al. 1996; Suuronen et al. 1997). However, almost opposite results have also been reported with the same species (Treschev et al. 1975; Efanov 1981).

This literature review summarized some insights into the escapement behaviour of a range of pelagic fish species that could be used in the development of selectivity grids.

Testing of gear modifications in trial fisheries

Various grids have been tested. The flexi-grids with tubes offered a smooth surface, which were helpful in minimizing the possible damage to escaping fish. However, because of the increased diameter, fewer slots were available in the width of the net. The semi-rigid materials were vulnerable to damage in the process of hauling and shooting, in particular when coming over the stern, as well as when taken on the net drum. Irregularities in the trawl (e.g. individual fish or lengths of relative oversized rope) on the layer beneath the grid contributed to these parts bending or breaking when taken onto the net drum. The use of shorter sections of tube did improve this, but at the same time this would decrease the efficiency of the grid, since the chance to escape was diminished.

Subsequent efforts were made with grids using only Dyneema twines instead. Due to the strain on the cod end and by making the grid slightly shorter than the corresponding tunnel section, these ropes tightened when the net was towed and offered a reasonable amount of rigidity to the grid. However, more meshed fish was noticeable with the use of the Dyneema-only grids.

In one case, a section was used consisting of 4 escape grids, top, bottom and both sides. It soon became apparent that this version could not handle large quantity of fish entering the section. Tests with the 4 grid version were discontinued.

Various widths have been tried for the escape grids. Initial trials started with 15mm and 18mm openings. With these openings, escape was minimal as shown by the video footage. During one tow, when relatively small herring was caught, a significant escape was observed on the underwater cameras. Later trials made use of openings between 21mm and 25mm for the herring fishery. For the mackerel fishery, an opening of 36mm was used.

Catch comparisons between trial vessels and reference vessels

An overview of trips per test vessel and corresponding reference vessel and the number of comparable hauls is given in Table 4.1 below. The catch compositions of the trial vessels are presented in Appendix 3 (commercial species) and 4 (sharks, rays and others)

Table 4.1 Overview of trial vessels and paired reference vessels

Trip/ Trials	**Test vessel**	**Departure**	**Arrival**	**Reference vessel**	**Target species**	**Comparable hauls (n)**
1	SCH81	23-08-2013	08-09-2013	SCH118	herring	20
2	SCH81	14-09-2013	26-09-2013	SCH123	herring	5
3	SCH81	09-10-2013	18-11-2013	-	mixed	-
4	SCH24	29-10-2013	08-11-2013	SCH118	mackerel	6
5	SCH81	25-11-2013	20-12-2013	-	mixed	-

Average length and weight are compared by haul. Hauls of test vessel and reference vessel were matched based on location and hauling time. Both length and weight are indicators for the size of the individual fish. The grids are expected to avoid catching smaller fish, so that the average length and weight of fish in the catch of test vessel is expected to be larger than in the catch of the reference vessel. Results of the comparisons between test and reference vessel, trials 1,2 and 4, are presented in figures 4.4-4.6. Unfortunately the different grid/gear combinations were not fully recorded so that a formal gear-test could not be carried out. As an alternative to the gear-test, we compared the length compostions based on the location of the net-collars relative to the positoning of the grid.

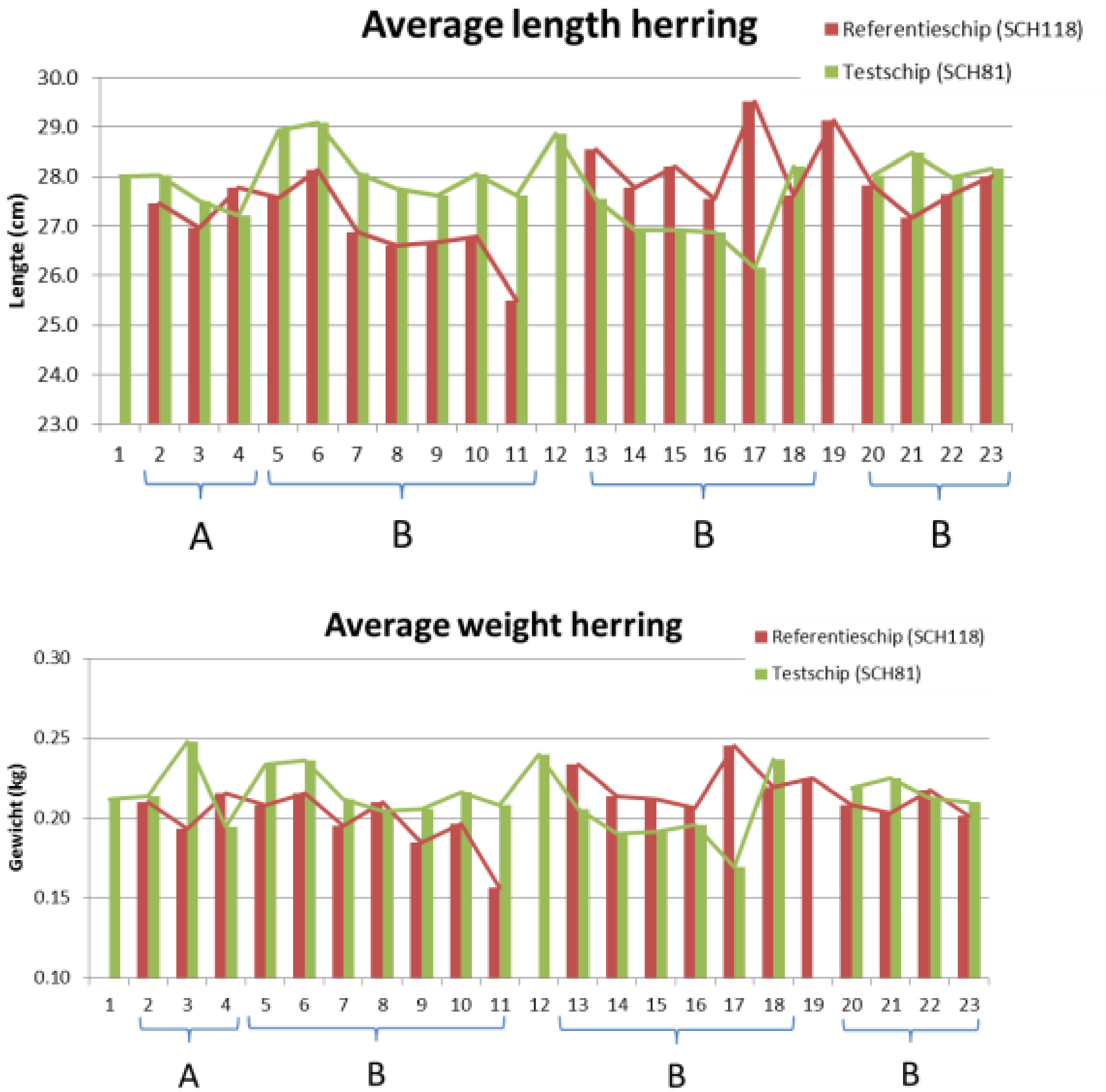

Figure 4.4. Trip 1: Comparison of average herring length (top panel) and weight (bottom panel) by haul for test vessel Carolien (SCH81) and reference vessel Johanna Maria (SCH118). On vertical axis weight in kg. On the horizontal axis haul number and grid modification:
A) Net-type 4800; grid before rear net; first collar 50 m before grid; second collar on grid (2 and 5 m).
B) Net-type 4800; grid before rear net; first collars on grid (2 and 5 m); second collars on grid (8 and 12 m).

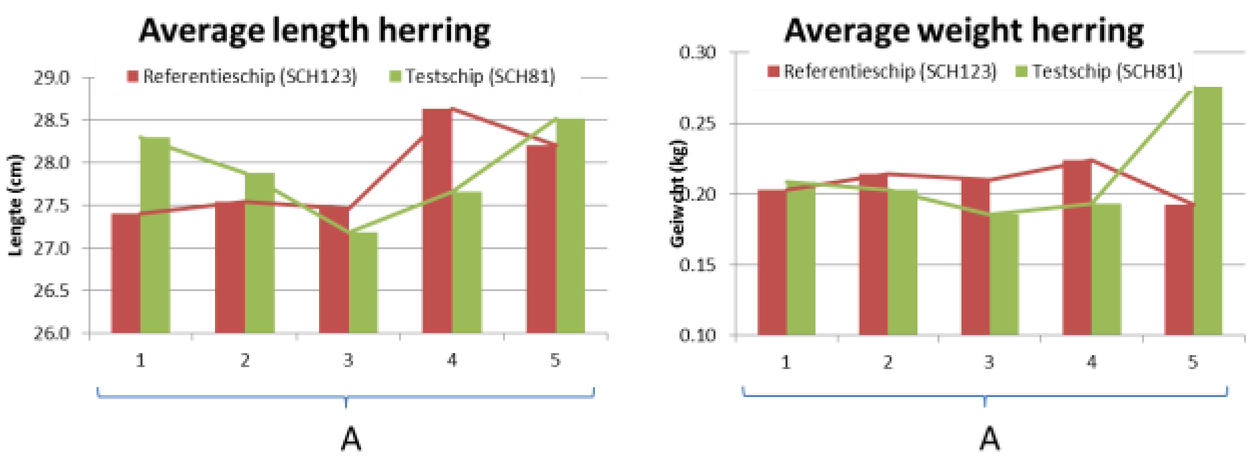

Figure 4.5. Trip 2: Comparison of average herring length (left panel) and weight (right panel) by haul for test vessel Carolien (SCH81) and reference vessel Zeeland (SCH123). On vertical axis length in cm and weight in kg. On the horizontal axis haul number and grid modification: A) Net-type mari 4800; grid before rear net; guiding-panel connected to net bottom; no collars.

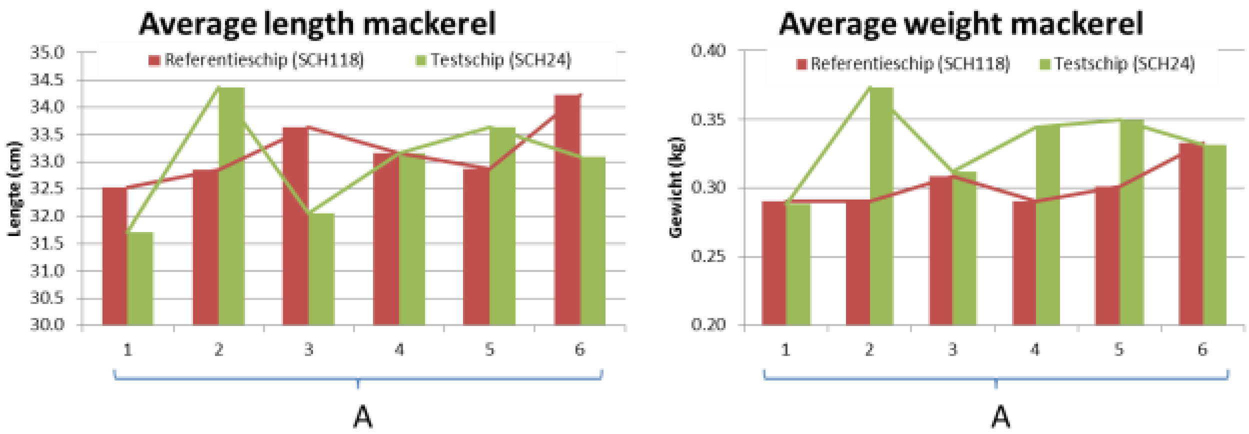

Figure 4.6. Trip 4: Comparison of average herring length (left panel) and weight (right panel) by haul for test vessel Afrika (SCH24) and reference vessel Johanna Maria (SCH118). On vertical axis length in cm and weight in kg. On the horizontal axis haul number and grid modification: A) pelagic net 5600 mesh with grid

In general there is no distinct pattern between the test vessel and the reference vessel for any of the trials or species. Average lengths and weight for herring and mackerel are not consistently higher (or lower) for trial vessels, indicating that avoidance of smaller sized fish was not effective for the tested grid modifications. An indication of a possible effect for average weight of mackerel can be distinguished in trial 4 (figure 4.6 right panel): average weight is considerably higher in the trial vessel for 50% of the compared hauls (n= 6).

Catch comparisons between trial vessels and historical observations from the IMARES discard research.

The current pilot study used the same sampling protocol as is used in the DCF monitoring programme conducted by IMARES (see Helmond et al. 2011). This allows for comparison of the results of the two. Discard ratios for both studies are estimated as the percentage of the total catch. Plotting the discard ratios of the test trips of this pilot study together with the discard ratios of the DCF programme gives a rough indication of the overall effect of the grids during the test trials (Figure 4.7). It is expected that the discard ratio of the test trials will be lower, due to the avoidance of smaller undersized fish. Considering possible seasonal effects in discard ratios, a similar figure was generated for the fourth quarter of the year (Figure 4.8).

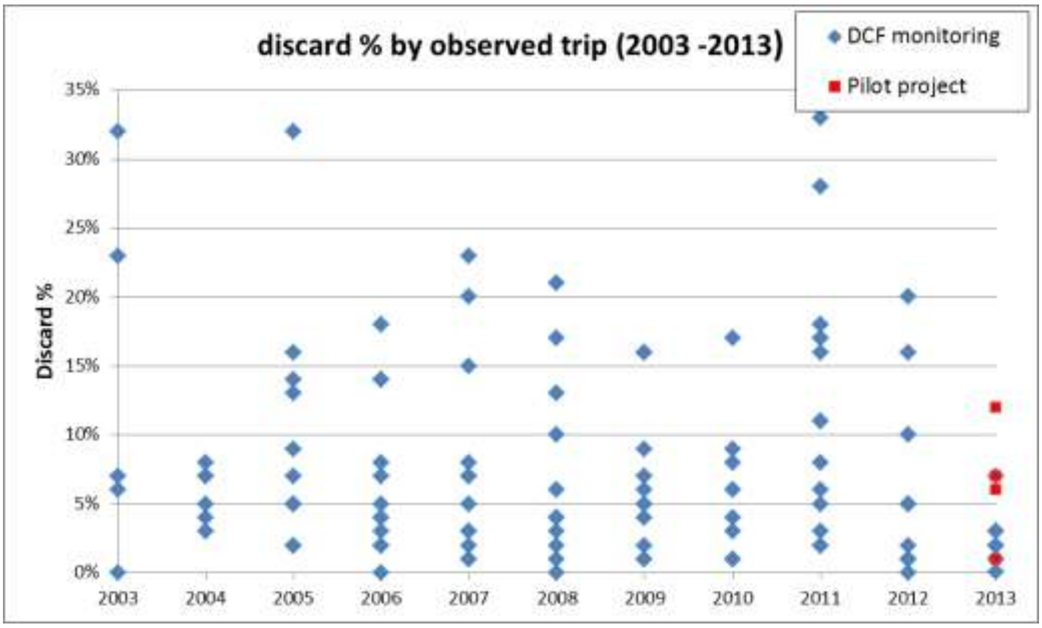

Figure 4.7. Discard ratios per trip per year for the DCF discard monitoring programme for pelagic trawlers in European waters (blue diamonds) and of the trials of the pilot study (red squares). Vertical axis discard ratios in percentage (%) of total catch. Horizontal axis year.

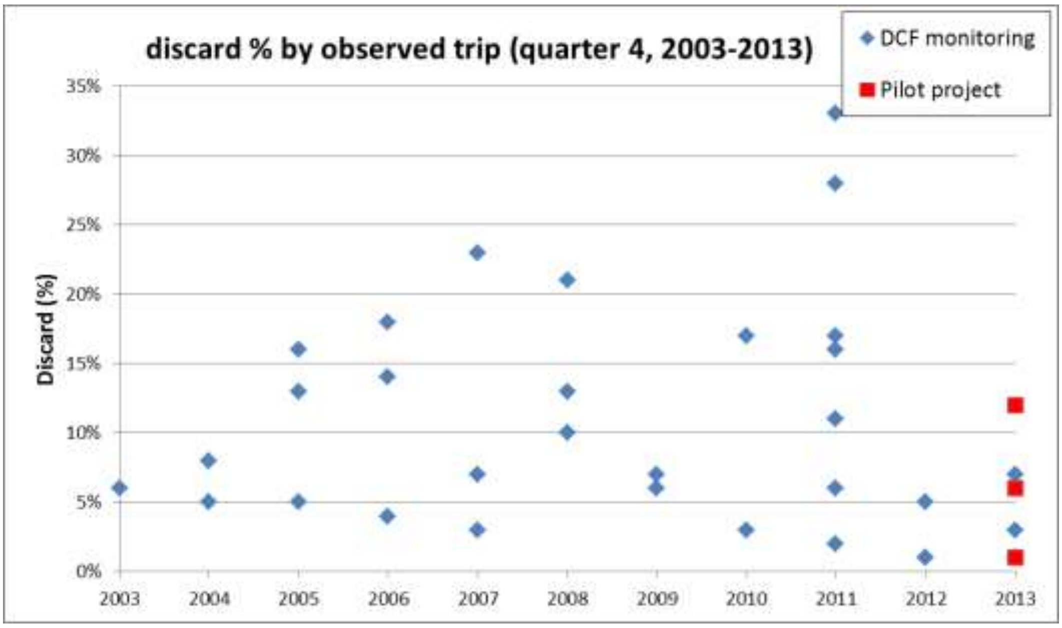

Figure 4.8. Discard ratios per trip in quarter 4 during the period 2003 – 2013 for the DCF discard monitoring programme for pelagic trawlers in European waters (blue diamonds) and of the trials of the pilot study (red squares). Vertical axis discard ratios in percentage (%) of total catch. Horizontal axis year.

Compared with the estimated discard rates of the DCF programme, test trials did not result in consistently different discard ratios (figures 4.7 and 4.8).

First assessment of underwater camera footage of escaping fish

Unfortunately, the camera footage of escaping fish could not be analysed in full detail during the course of the project. However, a dedicated analysis session was held on 3 February 2014 with participation from IMARES observers and researchers and consortium partners.

Figure 4.9. Camera footage from the gear adaptation with flexible tubes (left and middle mackerel, right herring)

Figure 4.10. Camera footage from the gear adaptation with flexible tubes (the escape of a mackerel)

Figure 4.11. Camera footage from the gear adaptation with Dyneema netting.

Some preliminary observations during the video interpretation session:

- The two different types of gear modifications (flexible tubes, Dyneema) appeared to have different escape possibilities for herring and mackerel.
- The flexible tubes showed substantial numbers of escapees of mackerel through the grid, including relatively larger sized mackerel. There were also escapees at the junction of the net and the release panel. It would be possible to make rough estimates of size and vitality of escaping mackerel (but this has not been done yet)
- During the herring trips, there were generally many scales or smaller debris visible on the footage. This was also seen when no herring was entering the net meaning that it could be associated with scales in the net from the previous haul. Relatively few herring escaped. There were several instances where escaped herring would swim along with the net and sometimes even go back into the net.
- With the herring, most of the trials showed low levels of escape behaviours. In one tow, however, when smaller size herring were caught, there were more escapees.

4.2 Handle and use

Testing of a fish mincing device in trial fisheries

- The mincing device in combination with the available freezing plates could operate up to a discard percentage of around 4%. If more plate freezers would be made available for the mince product, this percentage could perhaps be doubled but at the expense of the overall human consumption fish production on the processing deck.
- When larger bycatches of small mackerel were taken (for which no quota was available) these were frozen in whole for a specific bait market . They were packages with FFF marking.
- The quality manager on board of the Carolien (SCH81) generated many different FFF codes for the minced product. For each combination of species, a separate FFF code was generated.
-

Assessment of bio-chemical composition of mince products

Three discard samples of 25 kg each were provided of which 1 kg was prepared for analysis by Nutrilab BV on 29 October 2013. The results are summarized in Table 4.2 below.

Table 4.2 Overview of bio-chemical composition of three mince products samples.

Sample	**FFF134 081138**	**FFF126 081140**	**FFF107 081139**
Composition	100% herring	95% whiting, 5% herring	95% Mackerel, 5% herring
Moisture 103 °C on sand	72 %	80 %	72 %
Dry weight	28 %	20 %	28 %
Crude Protein (Dumas, N x 6,25)	14 %	12 %	13 %
Crude fat (after pre-extraction and hydrolysis)	12 %	6 %	13 %
Crude ash (550 °C)	3 %	3 %	3 %
Fat analysis			
Trans fatty acids	1 %	2 %	1 %
Saturated fatty acids	33 %	31 %	34 %
Monosaturated fatty acids (cis)	39 %	36 %	37 %
Polysaturated fatty acids	26 %	29 %	27 %
Unsaturated fatty acids	66 %	67 %	65 %
Omega-3 fatty acids	23 %	27 %	24 %
Omega-6 fatty acids	3 %	2 %	3 %
Omega-9 fatty acids	30 %	27 %	28 %

The analysed samples were found suitable for production of higher quality fish oil, which has protein as a by-product. Fat level was lower in the sample composed predominantly of whiting.

The composition of the analysed samples was found to be suitable for higher-end markets than fish-meal alone. Aidos (2002) demonstrated the added value of crude and higher quality fish oil fraction from similar products. Refinery of the crude oil increases the market value.

4.3 Document and control

Assessment of the composition of landed bycatch through observations, random sampling and electronic monitoring.

- Observers on board of trial vessels
- Analysis of random samples taken from the discard fraction
- Electronic Monitoring of the bycatch handling procedures

For comparison, relative abundance of a species in a discard sample were calculated, based on the weight fraction of the species in a sample (Figure 4.12). Only four hauls were available that had both observer recordings and frozen blocks. Of these, only two hauls also had video coverage that could be analysed.

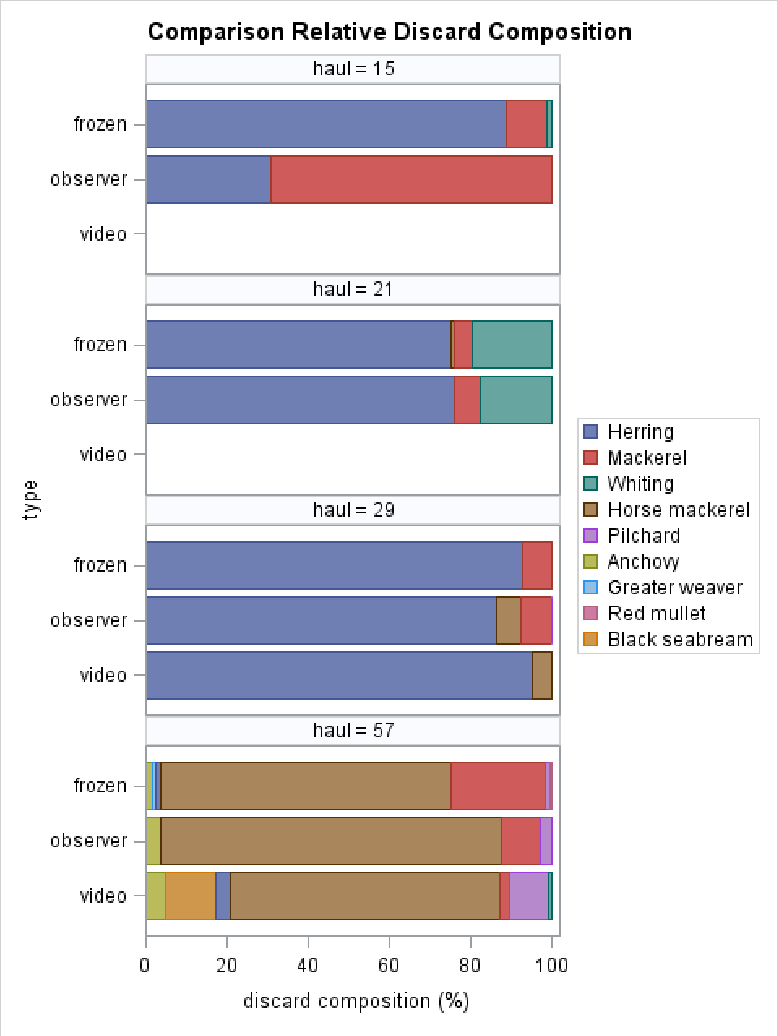

Figure 4.12. Comparison of relative discard composition (abundance per species as percentage of total sample) for four hauls sampled with three different monitoring methods: 1) random discard sample, frozen and analysed at IMARES. 2) Observer on board. 3) Analysing of EM footage. No EM footage available for haul 15 and 21.

In three out of four hauls that could be compared, there was an overall consistency between the different methods for the most abundant species.

For one of four hauls (haul 15) the composition of the discard samples differed considerably between the two methods used (random frozen samples and observing on board) in the proportion of mackerel in the sample. This could be due to the timing of when samples were taken. Mackerel is known to sink to the bottom of the fish tanks (because mackerel do not have a swim bladder), so taking a sample from the beginning of a fish tank discharge could give a different species composition compared to at the end of a tank discharge.

For each of the methods, the number of observed species were counted. The same number of species was observed in the video monitoring as in the frozen samples, but the on-board observers identified less species however. The reasons for these differences are unknown but similar experiences have been made by Archipelago Marine Research in other fisheries where observers need to work at a certain pace while EM and port sampling can pause, speed up and slow down as the need dictates.

Table 4.3 Number of species observed for each monitoring method per haul.

haul	**Frozen samples**	**observer**	**video (EM)**
15	3	2	-
21	4	3	-
29	2	4	2
57	7	4	7

During pelagic fishing trips incidental bycatches of sharks and sea mammals may occur. Incidental bycatches where notes down by the scientific observer (Appendix 4). During the third trip on the Carolien (SCH81), the IMARES observer registered bycatches of sharks (~700 kg) and few rays (5) during the fishery for horse mackerel in the Channel and Bay of Biscay. There was one haul with around 150 kg of sharks, two hauls with around 100 kg of sharks and several hauls with lower amounts of sharks. In comparison with the IMARES DCF discard sampling in 2013, this trip generated a higher bycatch of sharks than all DCF trips together.

Bycatches of sharks were treated in three different ways:

1. Bycatches of large sharks were removed from the "shark-catcher", a device in the net that allows removing large sharks (blue shark, herring shark) before they reach the fish-pump. The removed sharks were noted in the official logbook and by the scientific observer.
2. Bycatches of medium sized sharks which were able to pass the fish pump were removed from the fish-water separator on deck. These were noted by the scientific observer and if required also in the official logbook.
3. Bycatches of small-sized sharks (e.g. dogfish, spotted smooth-hounds) were handled in the factory. Because the sharks could not be fed through the mincing machine, they were manually transported to the rear deck to be discarded. All sharks were counted and weight estimated by the scientific observer.

Archipelago's data review of the EM system

The results of Archipelago's data review of the EM system presented in this section are taken directly from Archipelago's report on the EM trial (Bryan 2014). During imagery review, Archipelago's reviewer observed six instances of large volume discards on the top deck of the vessel. One of these events was a net bleed where small fish were escaping through the codend as it was tightened up. Other events included fish being washed over the side of the deck for three discard events, matter spilling out of the top of the pump for one discard event, and fish being discarded out of the stern (rear) of the vessel for one discard event. Crew discarding individuals from two species (dogfish sharks and tope) were observed directly from the deck during catch handling. No other discarding was documented during the review and those fishing events were confirmed as having retained all catch.
IMARES assessments of EM system

During the first two trips there were several issues with the camera system, both from an operational perspective and from a technical perspective. This is generally what can be expected after the installation and first use of EM systems. The subsequent valid EM coverage days were assessed by an IMARES video observer on the basis of the availability and quality of the footage relative to the number of observer days, i.e. the number of days the scientific observer sampled catches (Table 4.4).

Table 4.4 Overview of observer days and EM monitoring coverage days

Ship	Trip	#Observer days	#EM factory days	#EM reardeck days	EM factory days %	EM reardeck days %
Carolien SCH81	1	15	11	8	73%	53%
Carolien SCH81	2	11	1	1	9%	9%
Carolien SCH81	3	26	26	18	100%	69%
Carolien SCH81	5	21	20	12	95%	57%
Total		**73**	**58**	**39**	**79%**	**53%**

During two large hauls in the first two trips, there was not enough space in the fish tanks and the hold to take all fish on-board. The remaining fish were released from the net (slipping). This could not be observed on the EM system because the cameras were not recording video due to its run on time settings during those hauls.

During one of the two hauls above, the hold was filled too high and a flooding of 15 ton of herring in the factory deck occurred. To remove the fish and the associated water from the factory deck, the welded (former) discard gutters were opened again. The camera system was manually switched off during this operation. After the trip, it was made clear to the crew that the camera system should never be switched off, even during emergencies.

Some other observations on the camera system:

- The system with portable harddisks worked reasonably well, but for the longer trips the size of the harddisks could perhaps be increased (3 TB instead of 1 TB). The system is currently designed such that the crew needs to swap hard drives at sea for fisheries with long fishing trips. In order to allow for more convenient reporting at trip level, a software change would be needed to allow the merging on multiple hard drives into one cohesive data set.
- In daytime, the reardeck images are relatively clear. At night or in bad weather conditions the footage was sometimes difficult to interpret. If video quality is lower, data viewers will either need more time to analyse the footage or they cannot do it at all. Experience of data viewers with a fishery helps viewers to recognize routing and exception and report on such.
- It was suggested to have the reardeck camera's in a container with a window wiper to avoid the impact of water droplets on the lenses. Another solution would be to make the skipper and crew responsible for cleaning the lenses, which is how it is done elsewhere as well.
- The positioning of cameras and extra lighting would be needed on the reardeck in order to better assess the handling of the pump and the coupling of the net to the pump.
- During a haul with a large amount of small mackerel for which no quota was available, the skipper decided to freeze the fish in whole, because this gives a better value on the bait market. This could not be traced on the camera connected with the mincing device because the fish were frozen (and marked with FFF) in the frosters normally used for human consumption production.
- The haul with a large amount of boarfish was clearly visible on the camera system.

On 24 February 2014 a dedicated workshop was organized for the Dutch inspection agency (NVWA), IMARES experts and observers and representatives of Cornelis Vrolijk BV (Carolien SCH81). Observations from that workshop were:

- The harddisks could represent a “single point of failure”. All information is contained on 1 carrier. This poses risks for loss of information. NVWA suggested to keep all information on-board and make a copy of relevant data to the mobile harddisk. Archipelago commented that field services in British Columbia could not remember the last time a hard drive was lost (and this is for several thousand landings per year). The EM system is able to encrypt all data on the hard drive so that no one can view it or tamper with it.

- Could a coating on the lenses be applied (similar as in car racing) to avoid droplets? Alternatively: set the data standards and the 'how' be determined in practice, rather than chasing technological fixes. To be determined: what is the period that camera footage should be kept (and how does that relate to the period for keeping logbooks?
- It is important to clearly determine who is owner of the camera data.
- Could camera data be shared, e.g. via maritime surveillance? And how would this be affected by privacy regulations?

4.4 Technical measures

Derogations from the current Technical Measures Regulation (TM) had to be requested in order to make the selectivity and handling experiments in the project possible. The background for this is that the mesh sizes and the mesh types of the grids in combination with the mesh sizes usually used in the cod-end could form so-called 'forbidden mesh size combinations' under the current TM.

Technical measures for pelagic fisheries have been defined in several parts of the EU legislation (e.g. Reg. 850/98, Reg. 1224/2009, Reg. 39/2013, Reg. 227/2013). The Control regulation 1224/2009 and the Technical Measures regulation 850/1998 will need to be amended to allow for the legal implementation of the landing obligation. An inventory of technical measures specifically applying to pelagic fisheries was made. Table xx below provides these measures together with comments in relation to avoiding discards, handling and using discards and documentation and control of discards.

Table 4.5 Overview of relevant technical measures for pelagic fisheries and comments on the suggested changes.

Article	**Comments**
Article 4 (1) Reg. 850/98 and Annexes I to V 1. For each of the regions or geographical areas mentioned in Annexes I to V, and depending where applicable on the time period, the target species for each range of mesh size are as defined in the relevant Annex.	Combinations of mesh sizes and percentage of target species may lead to forced discarding of bycatches. Under a landing obligation this should be at the discretion of the skipper. The industry argues that application of larger mesh sizes and different mesh types (e.g. hexagonal, rectangular) than prescribed could be allowed in hake and cod boxes.
Article 4 (2a) Reg. 850/98 2. (a) The use, during any fishing voyage, of any combination of towed nets of more than one range of mesh size shall be prohibited	The one net rule may lead to substantial unwanted bycatches in fishing trips where multiple target species are fished in different areas. Under a landing obligation this should be at the discretion of the skipper.
Article 19 (1) Reg. 850/98 Undersized marine organisms shall not be retained on board or be transhipped, landed, transported, stored, sold, displayed or offered for sale, but shall be returned immediately to the sea.	This article should be deleted since it will not be allowed to discard regulated species.

Article	**Comments**
Art. 19 (2a) Reg. 850/98 Derogation to land 10% of undersized fish (below minimum landing size) "Paragraph 1 shall not apply to: (a) sardine, anchovy, herring, horse mackerel and mackerel, within a limit of 10 % by live weight of the total catches retained on board of each of these species."	Needs to be amended to comply with the landing obligation
Art. 22 (1) Reg. 850/98 Restrictions on fishing for mackerel "the retention on board of mackerel which are caught within the geographical area bounded by the following coordinates shall be prohibited [coordinates provided], except where the weight of the mackerel does not exceed 15 % by live weight of the total quantities of mackerel and other marine organisms on board which have been caught in this area."	During the fishery for horse mackerel in the summer, bycatch of mackerel occurs in excess of 15%, which will need to be landed.
Art. 19a (1) Reg. 227/2013 Prohibition of high-grading "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."	This article can be withdrawn as a landing obligation will be in place.
Art. 19b Reg. 227/2013 Moving-on provisions and prohibition on slipping "1. Within Regions 1, 2, 3 and 4, where the quantity of undersized mackerel, herring or horse mackerel exceeds 10 % of the total quantity of the catches in any one haul, the vessel shall move fishing grounds. 2. Within Regions 1, 2, 3 and 4 it is prohibited to release mackerel, herring or horse mackerel before the net is fully taken on board a fishing vessel resulting in the loss of dead or dying fish."	No specific comments
Art. 32a Reg. 227/2013 Catch handling and discharge restrictions on pelagic vessels. "1. The maximum space between bars in the water separator on board pelagic fishing vessels targeting mackerel, herring and horse mackerel operating in the NEAFC Convention Area shall be 10 mm. The bars shall be welded in place. If holes are used in the water separator instead of bars, the maximum diameter of the holes shall not exceed 10 millimetres. Holes in the chutes before the water separator shall not exceed 15 mm in diameter. 2. Pelagic vessels operating in the NEAFC Convention Area shall be prohibited from discharging fish under their water line from buffer tanks or Refrigerated seawater (RSW) tanks."	No specific comments

Article	Comments
Article 42 Reg. 850/98 Processing operations “1. The carrying out on board a fishing vessel of any physical or chemical processing of fish to produce fish-meal, fish-oil, or similar products, or to tranship catches of fish for such purposes shall be prohibited. This prohibition shall not apply to the processing or transhipment of offal. 2. Paragraph 1 shall not apply to the production on board a fishing vessel of surimi and fish pulp.”	The current Technical Measures prohibits the production of fish oil, fish meal or similar products. However the same article allows for the handling and processing of fish on board pelagic vessels into fish pulp. The production of fish pulp under the condition of full documentation of the amount, size and species type, was integral part of this pelagic pilot project (see also section 4.2). Article 42 could be withdrawn under the condition that the composition of the unwanted bycatch can be reliably and verifiably determined.
Footnote in Reg. 39/2013 By-catch provisions At least 95 % of landings counted against this quota shall be horse mackerel. By-catches of boarfish, haddock, whiting and mackerel are to be counted against the remaining 5 % of the quota.	Needs to be retained.

4.5 Process

The pilot project was set up in August 2013 and finished in February 2014. The PFA initiated the project. IMARES was commissioned to lead the project and to do the scientific quality control.

During the course of the pilot project a general agreement on the new CFP and the landing obligation have been agreed by the European Parliament and the Council. The landing obligation for pelagic fisheries will be implemented from January 1st 2015. Although the general outline of the landing obligation is embedded in the new CFP, many operational challenges still remain for the implementation of the policy. The pilot project provided an excellent platform to explore the operational challenges and to prepare for the future implementation.

A key asset for the project was that IMARES was able to work closely together in the consortium consisted of the PFA, the fishing companies, the Dutch ministry of Economic Affairs, the Dutch inspection agency NVWA, Maritiem BV and Archipelago Marine Research. The combination of industry, research, regulators, control and service suppliers created a learning environment in which the practical challenges and results could be discussed and used as a basis for feasible operational measures during the implementation phase of the landing obligation for pelagic fisheries, like:

- exploring technical aspects of gears and how they could be made more selective
- the need for sufficient replicates in order to allow conclusions to be drawn from catch comparisons
- the operation of mincing machines on board the vessels and how they work for different species
- the future roles and responsibilities for documenting and verifying the catches under a landing obligation
- the many different situations in which the vessels operate and may need to handle catches in different ways in order to comply with the landing obligation.

5 Discussion

Avoid

Two types of selectivity grids have been tested during the pilot project: flexi-grids with tubes and Dyneema grids. The operational aspects of the two gears have been extensively explored and lead to conclusions on the feasibility of use during commercial operations. The flexi-grids were vulnerable to damage in the process of hauling and shooting and when taken on the net drum. The dyneema grids performed better on the durability of the gear although with this grid more meshed fish were observed.

The selectivity have mostly been tested during the herring fishery and to a lesser extend in the mackerel and horse mackerel fishery. The herring fishery traditionally has very low discard percentages (Van Helmond et al. 2011). Because the project was initially set up with a starting date of the landing obligation of 1 January 2014 in mind, the selectivity trials were aimed at the second half year of 2014. In retrospect, a more extended trial period that would also cover the horse mackerel and blue whiting fisheries would have been preferable. Bycatches of boarfish - which can be substantial - take place in the horse mackerel fishery. In the current setup, selectivity trials to avoid bycatch of boarfish hardly took place.

The selectivity trials have not yet yielded a clearly distinct pattern between the trial vessels and the reference vessels. Therefore, the selectivity benefits of the selectivity trials cannot be demonstrated unequivocally. The aim was to have trial vessels and reference vessels that would fish with comparable gear in the same area at a close distance. This was found to be difficult to achieve because of business decisions and quota availability on the reference vessels. In total 31 hauls of the 178 hauls taken by the trial vessels could be paired to the reference vessels. This has meant that relatively few comparisons could be made between trial and reference. The need to ascertain a robust protocol for the selection and procedures for reference vessels needs to be properly addressed during the follow-up projects that are scheduled to take place in 2014.

Likewise, the comparison between the selectivity trials and the catch compositions estimated in the routine IMARES discard sampling collection (1993-2013) did not show consistently different discard ratios.
Improving selectivity in pelagic fisheries through release panels may result in lower bycatches of undersized target species or of non-target species. It should be noted that this does not necessarily mean that the escaping fish will survive and remain functioning in a biological sense. Underwater camera footage in the trawl has been captured to allow assessment of the behaviour of the net and the size and species composition of the escaping fish. Potentially this camera footage could also be used to assess the condition and potential damage of the escaping fish (e.g. scale loss). It is recommended that such an analysis of the condition of escapees is carried out, in order to assess the likelihood of survival of escapees in different fisheries.

Handle and use

Unwanted bycatch on the trial vessel was handled through mincing and freezing. Mincing on board proved to be a feasible solution for handling bycatch that allows for an efficient use of freezing capacity. On one occasion, larger quantities of discards were not processed through the mincing machine because of a special bait market. This indicates that different potential routings of discards can be envisioned depending on the species composition.

The chemical analysis of the bycatch composition indicated that they are suitable for production of high quality fish oil with protein as a by-product. This could be interesting for a higher-end markets then fish-pulp as generated in this pilot project because it could generate higher prices for the bycatch. The oil fraction is an important aspect in product valorisation. A strategic analysis of potential market solutions will be taken up in a new project starting in 2014. A comparable project will also be developed for the demersal fishing sector.

Document and control

Three different methods of assessing the species composition of the bycatch were used: observers, frozen samples and video analysis. All methods provided some insight into the species composition of the bycatch. Unfortunately only 2 hauls could be compared using all three methods and 2 additional hauls could be compared for two methods. This clearly requires more work in order to understand the variability and accuracy of the different methods and to develop protocols for documentation of bycatch. This is especially of importance when self-documentation is promoted and the composition of the unwanted bycatch needs to be reliably and verifiably determined.

Bycatches of sharks, rays and marine mammals will need to be treated in different ways because of the different rules that apply to these species. Some protected species (e.g. porbeagle, common skate) may not be kept on board and need to be discarded at sea as soon as possible). For species that are TAC regulated (e.g. rays, spurdog) all specimen need to be landed and subtracted from the quota. A particular challenge in this category are the zero-TAC species like spurdog where it is unclear how the landing obligation and a zero-TAC go together. Also, the need to retain and land the regulated species does not apply to species for which high survival can be demonstrated. The different categories of sharks, rays and marine mammals are sometimes handled in different parts of the catching process (e.g. in the 'shark catcher', in the water-fish separator or at the factory deck). During the trial, there was no specific protocol in place for these different categories of bycatches. In order to document these bycatches, clear guidelines would need to be developed on which approach is applicable to which species. A visual chart of species and handling categories would be very useful.

The use of Electronic Monitoring (EM) to monitor compliance with a no-discard policy worked satisfactorily after the initial technical hurdles were taken. Even though freezer-trawlers are large vessels, it was feasible to monitor the critical parts of the catching and handling process. The trial also yielded a number of concrete recommendations to improve the EM setup, including different types of cameras and lighting. More important than the technical issues with EM, is the development of an operational programme for EM that describes the role and responsibilities of all parties involved. In an operational programme all the regulatory, enforcement, financial and maintenance questions need to be addressed on issues like: who owns the data, how is the data transferred from the operator to a control authority, how will the data be used in case of infringements, who is paying for the equipment and operations etc. The development of an operational programme is typically a regulator-led process that requires much effort and consultation with the different user groups.

Technical measures

The current Technical Measures Regulation was established to regulate where and how fishing could take place with the overall aim to protect juveniles and improve selectivity. STECF has evaluated the effectiveness of technical measures to achieve that aim and concluded that the effectiveness has been low (STECF 2012). Technical measures have tended to increase costs for fishermen because of loss of marketable catch or investment in new equipment. This incentivized fishermen to circumvent technical measures which has resulted in a technological and regulatory arms-race, where new rules are implemented in response to technological innovations by the industry (STECF 2012). In the review by Suuronen and Sardà (2007), they concluded that "the successful use of technical measures appears to depend largely on their acceptance by industry".
Under a landing obligation the drivers for selectivity would be very different from the situation where discarding was required. The landing obligation provides a strong incentive to avoid the bycatch of unwanted species or undersized fish, because they need to be kept on board and deducted from the quota. In line with the evaluations by STECF (2012) and Suuronen and Sardà (2007), it is argued that

the challenge of improving selectivity would be most naturally placed in the hands of the skipper, but under the condition of full monitoring of the catches. Finding technical solutions to bycatch problems may require specific innovations in gear or handling that would not be allowed under the current Technical Measures regulation. This lead to the recommendations in this report for changing or removing specific articles of the TM regulation. For this development of changes in selectivity to happen, it is essential that the catches are reliably and verifiably documented so that a level playing field exists between all fishermen.

In December 2013 the Commission issued a proposal amending several current fisheries legislations in the light of the imminent implementation of the landing obligation. This so-called Omnibus proposal is under discussion in the Council and the European Parliament. The EU pelagic fishing industry, including the Dutch pelagic industry, has already commented on this Omnibus proposal stating that the proposal is at the same time too minimalistic and in several aspects rather confusing. The Omnibus proposal does not include the abolition of the one-net-rule and does not include the abolition of the catch composition rules linked to the use of certain mesh sizes in specific fisheries. The 'real' overhaul of the TM regulation has also been initiated by the European Commission through a consultation process (April 2014). The timeline for the new TM regulation has not been fixed yet, but it is likely that it may only be 2016 before the new TM regulation enters into force. The combination of the Omnibus Regulation as a quick fix to the TM and the real revision of the TM only entering into force in 2016 may provide a difficult situation for fisheries to which the landing obligation will apply from 2015 onwards. In those fisheries the prescriptive TM rules that induce discards will still remain under the Omnibus regulation (e.g. the catch composition rules in combination with mesh sizes) whereas the required loosening of the technical measures may only be applicable from 2016 onwards.

Process

The landing obligation presents important challenges to fishermen, regulators, enforcement, researchers and service providers. The interpretation of the landing obligation still harbours multiple views. In this context it is of utmost importance to have close collaboration between all actors to develop a common understanding on what is needed and what is feasible to allow for the operation and continuation of sustainable fisheries . It is clear that this will require a process of trial and error and adaptive development and implementation of rules. All parties involved realized that there is no quick fix to implement the landing obligation. But projects like this pelagic pilot project are an effective and meaningful method to advance the understanding of the practical aspects of a landing obligation by:

- exploring technical aspects of gears and how they could be made more selective
- making sure that sufficient replicates are available in order to allow conclusions to be drawn from catch comparisons
- exploring the operation of mincing machines on board the vessels and how they work for different species
- developing the future roles and responsibilities for documenting and verifying the catches under a landing obligation
- documenting the different situations in which the vessels operate and may need to handle catches in different ways in order to comply with the landing obligation.

Joint learning is very important because of the many uncertainties surrounding the implementation of the landing obligation and the need to develop buy-in for the regulation at the vessel level.

6 Conclusions

The new EU obligation to land all catches of regulated species will apply to the pelagic fisheries from 1 January 2015 onwards. Although the pelagic fisheries are generally described as single species fisheries with relatively low discard rates, the new regulation still poses a number of specific challenges that need to be addressed prior to the implementation of the regulation. In the first half of 2013, the Pelagic Freezer-trawler Association (PFA) recognized the need to prepare well for the new regulation even though the regulation had not been formally agreed at that stage. The PFA initiated this pilot project to explore possible mitigation strategies to (1) avoid unwanted bycatch, to (2) handle and use unwanted bycatch and to (3) find feasible strategies to document and control the catches. The project started in August 2013 and finished in February 2014. IMARES was commissioned to lead the project with inputs from a consortium consisting of the fishing companies that are members to the PFA, the Dutch ministry of Economic Affairs, the Dutch inspection agency NVWA, Maritiem BV and Archipelago Marine Research. The project was funded by the PFA, who received a compensation in the form of a limited scientific quota.

The main conclusions of the pelagic pilot project are summarized below for the three main research lines.

1) How to avoid unwanted bycatch

- Two types of selectivity grids have been tested during the pilot project: flexi-grids with tubes and Dyneema grids.
- The skipper, crew and technical service providers were most positive about the Dyneema grids that allowed for easier handling.
- The selectivity grids have mostly been tested during the herring fishery and to a lesser extend in the mackerel and horse mackerel fishery. Bycatch of boarfish in the horse mackerel fishery can be an important issue for the Dutch pelagic fishery. Due to the timing of this pilot project, selectivity trials to avoid bycatch of boarfish have been limited.
- The selectivity trials have not yet yielded a clearly distinct pattern between the trial vessels and the reference vessels. The is partly explained by the low number of reference hauls that were available for comparison with the trial hauls.
- Comparison between the selectivity trials and the catch compositions estimated in the routine IMARES discard sampling collection (1993-2013) did not show consistently different discard ratios.

2) How to handle and use unwanted bycatch

- Unwanted bycatch on the trial vessel was handled through mincing and freezing. Mincing on board proved to be a feasible solution for handling bycatch that allows for an efficient use of freezing capacity.
- The chemical analysis of the bycatch composition indicated that they are suitable for production of high quality fish oil with protein as a by-product.

3) How to document and control the catch compositions

- Three different methods of assessing the species composition of the bycatch were used: observers, frozen samples and video analysis. All methods provided some insight into the species composition of the bycatch.
- Unfortunately only four hauls could be compared using at least two methods to assess species composition. In three out of four hauls the catch compositions between different methods were very similar. In one out of four hauls there was a substantial different between the catch composition of the discards estimated by the observer and by the Electronic Monitoring.
- Bycatches of sharks, rays and marine mammals will need to be treated in different ways because of the different rules that apply to these species. In order to document these bycatches, clear guidelines would need to be developed on which approach is applicable to which species. A visual chart of species and handling categories would be very useful.

- The use of Electronic Monitoring (EM) to monitor compliance with a no-discard policy worked satisfactorily after the initial technical hurdles were taken. Even though freezer-trawlers are large vessels, it was feasible to monitor the critical parts of the catching and handling process.
- In order to expand the use of EM on freezer trawlers, the development of an operational programme for EM is required. In the operational programme all the regulatory, enforcement, financial and maintenance questions need to be addressed.

Revising the Technical measures regulation

- Under a landing obligation the drivers for selectivity would be very different from the situation where discarding was required. The landing obligation provides a strong incentive to avoid the bycatch of unwanted species or undersized fish, because they need to be kept on board and deducted from the quota.
- The challenge of improving selectivity would be most naturally placed in the hands of the skipper, but under the condition of full monitoring of the catches. This lead to the recommendations in this report for changing or removing specific articles of the technical measures regulation.
- In December 2013 the Commission issued a proposal amending several current fisheries legislations in the light of the imminent implementation of the landing obligation. The 'real' overhaul of the TM regulation has also been initiated by the European Commission through a consultation process (April 2014) which is thought to enter into force in 2016. The combination of the Omnibus Regulation as a quick fix to the TM and the real revision of the TM only entering into force in 2016 may provide a difficult situation for fisheries to which the landing obligation will apply from 2015 onwards.

Reflections on the process in the pelagic pilot project

- A close collaboration between all actors involved is needed to develop a common understanding on the landing obligation. It is clear that this will require a process of trial and error and adaptive development and implementation of rules.
- Projects like this pelagic pilot project are an effective and meaningful method to advance the understanding of the practical aspects of a landing obligation because they allow for joint learning and the development of buy-in for the regulation at the vessel level.

Recommendations:

- The gear trial analyses presented in this report could have been more informative if more attention have been devoted to the recording of the characteristics of the different trials and the planning for reference material. Based on these findings, we recommend that in follow-up projects, the following elements should be secured:
    - Use standardized descriptions of the different gears used on test and reference vessels. Make sure these descriptions are available and used on all vessels involved.
    - Create close linkages between gear technology service suppliers and researchers carrying out the analysis to define a limited set of gear-tests that can be coded and analysed.
    - Make sure that sufficient reference hauls are available from either reference vessels or from the same vessel but alternating a 'normal' gear with a modified gear.
- Documenting the species composition of mixtures of discards has not been resolved yet in a reliable and verifiable way. This will require more samples to be taken from the mixtures of discards using different methods.
- To further explore the potential role of electronic monitoring in this fishery, an operational programme would be required. Close involvement of the regulatory and enforcement authorities, also in the executive decisions in pilot projects like this, is a key requirement for such a development.

7 Acknowledgements

We would like to thank the observers on the vessels (Co de Klerk and Martien Warmerdam), the quality managers and the crew on board of the trial vessels (Carolien SCH81, Afrika SCH24) and the reference vessels (Johanna Maria SCH118, Zeeland SCH123), and the companies (Cornelis Vrolijk BV, Jaczon BV, Van der Zwan, Parlevliet en van der Plas) for their contributions to this research. Special thanks to Archipelago Marine Research for the close collaboration on the Electronic Monitoring on board of the Carolien SCH81.

8 Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 1th of April 2017 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

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Justification

Rapport C071/14
Project Number: 4301106101

The scientific quality of this report has been peer reviewed by the a colleague scientist and the head of the department of IMARES.

Approved: Aukje Coers
Fisheries scientist

Signature:

Date: 23rd April 2014

Approved: Nathalie Steins
Department Head Fisheries

Signature:

Date: 30th April 2014

Appendix 1 List of meetings and participants

Meetings

Date	Topic	Location
22/8/2013	1st Steering Group meeting	IMARES, IJmuiden
1/11/2013	2nd Steering Group meeting	IMARES, IJmuiden
3/2/2014	Video analysis meeting	IMARES, IJmuiden
7/2/2014	3rd Steering Group meeting	P&P, Valkenburg
24/2/2014	Meeting with Control Agency	IMARES, IJmuiden

Participants

Name	Organization	Email	22/8/2013	1/11/2013	3/2/2014	7/2/2014	24/2/2014
Martin Pastoors	IMARES	Martin.pastoors@wur.nl	X	X	X	X	X
Edwin van Helmond	IMARES	Edwin.vanhelmond@wur.nl	X	X	X	X	
Harriët van Overzee	IMARES	Harriet.vanoverzee@wur.nl		X	X		
Sascha Fässler	IMARES	Sascha.fassler@wur.nl		X			
Bob van Marlen	IMARES	Bob.vanmarlen@wur.nl		X	X		
Marnix Poelman	IMARES	Marnix.poelman@wur.nl		X			
Martien Warmerdam	IMARES	Martien.warmerdam@wur.nl			X	X	
Co de Klerk	IMARES	codeklerk@gmail.com	X				
Gerard van Balsfoort	PFA	gbalsfoort@pelagicfish.eu		X		X	
Arie de Graaf	Cornelis Vrolijk	AdeGraaf@cornelisvrolijk.eu	X	X	X	X	X
Johan Müller	Cornelis Vrolijk	JMuller@cv-ym.nl	X				X
Diek Parlevliet	PP-group	dpa@pp-group.eu	X	X		X	
Eric Roeleveld	Jaczon	ERoeleveld@jaczon.nl	X	X		X	
Rob Banning	W vd Zwan	r.banning@wvanderzwan.nl	X				
Rob Pronk	W vd Zwan	r.pronk@wvanderzwan.nl		X		X	
Erik de Graaf	Maritiem BV	emg@maritiem.com	X	X	X	X	
Jason Bryan	Archipelago	JasonB@archipelago.ca				X	
Henk Offringa	Min. EZ	h.r.offringa@minez.nl	X			X	
Lianne Kersbergen	Min. EZ	m.c.kersbergen@minez.nl		X			X
Carian Emeka	Min. EZ	c.c.emeka@minez.nl					X
Leon Bouts	NVWA	l.a.bouts@minlnv.nl	X				X
Floor Parlevliet	NVWA	floor.parlevliet@vwa.nl		X			X
Diverse NVWA medewerkers	NVWA						X

Appendix 2 Observer reports

Observer reports were generated for the following trips:

Trip	Vessel	Departure	Return	Observer	Gear modification?	Retain discards?
1	Carolien SCH81	24 aug	7 sep	Co de Klerk	yes	Yes
2	Carolien SCH81	15 sep	25 sep	Co de Klerk	yes	Yes
3	Carolien SCH81	11 oct	16 nov	Co de Klerk	yes	yes
4	Afrika SCH24	31 oct	5 nov	Martien Warmerdam	yes	No
5	Carolien SCH81	26 nov	18 dec	Martien Warmerdam	yes	yes

Appendix 3 Catch compositions (in weight, tonnes)

	Trip	1			2			3			4			5		
	Ship	SCH81			SCH81			SCH81			SCH24			SCH81		
	Start	23/aug			14/sep			09/okt			29/okt			25/nov		
	End	08/sep			26/sep			18/nov			08/nov			20/dec		
	Target spec	Herring			Herring			Herring, horse mackerel, WHB			mackerel, horse mackerel			herring, horsemackerel		
	Observer	Co de Klerk			Co de Klerk			Co de Klerk			Marien Warmerdam			Marien Warmerdam		
Species	Latin name	Landings	Discards	%disc	Landings	Discards	%disc	Landings	Discards	%disc	Landings	Discards	%disc	Landings	Discards	%disc
Herring	Clupea harengus	3802	87	2%	3644	61	2%	2083	15	1%	0	0.1	100%	712	7	1%
Mackerel	Scomber scombrus	0	190	100%	0	143	100%	18	138	88%	1166	9	1%	418	101	19%
Horse mackerel	Trachurus trachurus				0	0.2	100%	987	18	2%	0	0.8	100%	223	6	3%
Blue whiting	Micromesistius poutassou							115	1	1%				0	0.1	100%
Boarfish	Capros aper							0	4.9	100%				0	60	100%
Whiting	Merlangius merlangus	0	5.2	100%	0	17	100%	0	0.1	100%				0	0.8	100%
Pilchard	Sardina pilchardus							0	0.1	100%				6.3	0.1	2%
Haddock	Melanogrammus aeglefinus	0	0.4	100%	0	0.2	100%							0	2.5	100%
Black seabream	Spondyliosoma cantharus							0	2.5	100%				0	0.5	100%
Anchovy	Engraulis spp							0	1.6	100%						
Hake	Merluccius merluccius	0	0.1	100%				0	0.3	100%				0	0.9	100%
Grey gurnard	Eutrigla gurnardus	0	0.2	100%										0	0.1	100%
Anglerfish	Lophius piscatorius													0	0.3	100%
Lumpfish	Cyclopterus lumpus	0	0.1	100%												
Sprat	sprattus sprattus	0	0.1	100%												
Poor cod	Trisopterus minutus							0	0.1	100%						
Greater weaver	Trachinus draco							0	0.1	100%						
European squid	Loligo vulgaris							0	0.1	100%						
Lanternfish	Myctophidae							0	0.1	100%						
Red mullet	Mullus surmuletus													0	0.1	100%
Unsampled			*83*	*100%*		*50*	*100%*		*8*	*100%*		*3*	*100%*			
Total		3802	366.1	9%	3644	271.4	7%	3203	189.9	6%	1166	12.9	1%	1359.3	179.4	12%

Appendix 4 Catch compositions of sharks, rays and other (in numbers)

		Trip	1			2			3			4			5			
		Ship	SCH81			SCH81			SCH81			SCH24			SCH81			
		Start	23/aug			14/sep			09/okt			29/okt			25/nov			
		End	08/sep			26/sep			18/nov			08/nov			20/dec			
		Target spec	Herring			Herring			Herring, horse mackerel, WHB			mackerel, horse mackerel			herring, horsemackerel			
		Observer	Co de Klerk			Co de Klerk			Co de Klerk			Marien Warmerdam			Marien Warmerdam			
																		sum
Soort	Species	Scientific name	Landings	Discards	%disc	Landings	Discards	%disc	Landings	Discards	%disc	Landings	Discards	%disc	Landings	Discards	%disc	Discards
Haaien	*Sharks*																	
Haringhaai/neushaai	Porbeagle	Lamnus nasus		4	*100%*					1	*100%*							5
Blauwe haai	Blue shark	Prionace glauca								7	*100%*							7
Doornhaai	Dogfish	Squalus Acanthias		3	*100%*													3
Gladde haai	Smooth-hound	Mustelus mustelus								14	*100%*					30	*100%*	44
Hondshaai	Small-spotted catshark	Scyliorhinus canicula								60	*100%*							60
Kathaai	Nursehound	Scyliorhinus stellaris								1	*100%*							1
Gevlekte gladde haai	Starry smooth-hound	Mustelus asterias								618	*100%*							618
Ruwe haai	Tope	Galeorhinus galeus		11	*100%*					42	*100%*							53
Haaien (alg.)	Shark spp.			2	*100%*													2
	subtotal			*20*	*100%*		*0*			*743*	*100%*		*0*			*30*	*100%*	*793*
Roggen	*Rays*																	
Stekelrog	Thornback ray	Raja clavata								4	*100%*							4
Gevlekte rog	Spotted ray	Raja montagui								1	*100%*							1
	subtotal			*0*			*0*			*5*	*100%*		*0*			*0*		*5*
Grijze zeehond	Grey seal	Halichoerus grypus		2	*100%*											2	*100%*	4
Zwaardvis	Swordfish	Xiphias gladius								2	*100%*							2
Total				22	100%		0			750	100%	0	0		0	32	100%	804