Report on 2016 research projects

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Executive Summary

This report documents the use and outcome of research projects in 2016 based on scientific catches allocated to members of the Redersvereniging voor de Zeevisserij. Although the scientific catches that has been used for the projects mentioned in this report have been allocated by the Netherlands, the report is in English to allow for international dissemination of results.

In 2016, pelagic scientific catches has been allocated to the following projects:

- Industry acoustic survey and genetic research for herring in 6a North
- Self-sampling of the PFA fleet
- PelAcoustics on using acoustics of PFA vessels
- AutoMeasure on the development of an automatic measuring device
- (North Sea) horse mackerel research
- Mackerel egg survey 2016 (with ICES WGMEGS)

In addition, scientific catches has been granted for the SEAT project to the company WZ. This will be documented in a separate report by WZ.

Main results can be summarized as follows:

<table>
<thead>
<tr>
<th>Project</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry acoustic survey and genetic research on 6a herring</td>
<td>Successfully executed first industry acoustic survey on herring in 6a (and 7bc). Results have been presented to ICES Planning Group on Surveys (WGIPS) and herring assessment working group (HAWG). International report available. Genetic baselines for herring have been successfully established. Apparently mostly a divide between northern stocks and southern herring stocks. Northern stock genetics very similar to North Sea herring.</td>
</tr>
<tr>
<td>Self-sampling</td>
<td>The self-sampling on PFA vessels has been rapidly expanding, covering 233 000 tonnes of catch in 2016. The self-sampling gives information on biological properties of the catch in time and space and in relation to the ambient environmental parameters. The self-sampling has been applied as the basis for the stock assessment in the South Pacific and to address specific questions in the North-east Atlantic. A dedicated report on the self-sampling activities is being published.</td>
</tr>
</tbody>
</table>
Catch reporting software is under development now that the NL and UK vessels are using eCatch as their electronic logbook software. A dedicated platform for creating overviews of catch information has been created (mCatch). The modules for Individual Transferable Quota (ITQ) management and production information are under development and close to finishing.

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PelAcoustics</td>
<td>Unfortunately the progress on using acoustic information from vessels has not been taken up during 2016. It is now planned to take place from 2017 onwards.</td>
</tr>
<tr>
<td>AutoMeasure</td>
<td>The automeasure project is developing a new device that will allow automatic measurement of weight and length of individual fish. A contract on the development of the device has been signed early in 2017 with an expected delivery around the summer of 2017. Three student projects have been carried out on automatic species recognition and automatic sorting techniques.</td>
</tr>
<tr>
<td>Horse mackerel research</td>
<td>Although originally labelled as North Sea horse mackerel research, the project has widened to include all horse mackerel caught by the PFA fleet. Focus is on stock identity and on development of indicators of abundance. For the genetic work on stock identity, additional genetic samples of horse mackerel in different parts of their distribution area have been collected in 2016. In addition, historical catch rates of horse mackerel have been collected and preliminary analyses have been carried out and presented to the ICES benchmark workshop on widely distributed stocks.</td>
</tr>
<tr>
<td>Mackerel and horse mackerel egg survey</td>
<td>The PFA and IMARES have successfully carried out one leg of the 2016 mackerel and horse mackerel egg survey and thereby contributed to the overall egg survey of 2016.</td>
</tr>
</tbody>
</table>
Nederlandse samenvatting

In dit rapport wordt het gebruik en de uitkomsten van onderzoeksprojecten in 2016 beschreven op basis van wetenschappelijke vangsten die zijn toebedeeld aan de leden van de Redersvereniging voor de Zeevisserij. Hoewel het wetenschappelijk vangsten voor deze projecten zijn toebedeeld door Nederland, is het rapport in het Engels geschreven om internationale verspreiding van de resultaten mogelijk te maken.

In 2016 zijn pelagisch wetenschappelijk vangsten toegekend voor de volgende projecten:

- Industrie akoestische survey en genetisch onderzoek van haring in gebied 6a
- Self-sampling
- PelAcoustics
- AutoMeasure
- Horsmakreel onderzoek
- Makreel ei-survey 2016 (i.s.m. ICES WGMEGS)

Daarnaast werd opnieuw een verzoek worden ingediend voor het SEAT-II project. Deze aanvraag is gedaan door WZ, maar wel in afstemming met de RvZ.

De belangrijkste resultaten kunnen al volgt worden samengevat:

**Industrie akoestische survey en genetisch onderzoek van haring in gebied 6a**

Succesvolle uitvoering van de eerste industrie akoestische survey op haring in 6a (en 7bc). Resultaten zijn gepresenteerd aan de ICES Planning Group on Surveys (WGIPS) en de haring assessment werkgroep (HAWG). Een internationaal rapport met resultaten is beschikbaar.

Genetische ‘baselines’ (standaarden) voor haring zijn vastgesteld. Het ziet er naar uit dat er vooral een onderscheid is tussen noordelijke en meer zuidelijke haringbestanden. Weinig onderscheid tussen noordelijke bestanden en het Noordzee bestand. Gedurende 2017 zal verder worden gewerkt aan dit onderzoek.

**Self-sampling**

De self-sampling op PFA schepen is snel toegenomen en beschrijft 233 000 ton vangst in 2016. Door de self-sampling is informatie beschikbaar in tijd en
ruimte en in relatie tot lokale omgevingsvariabelen.
De self-sampling is toegepast als basis voor de toe-
standsbeoordeling in de Stille Oceaan (South Paci-
fic) en om specifieke vragen te beantwoorden in de
Noordoost Atlantische oceaan. Een rapport over de

Vangst registratie software is in ontwikkeling nu zo-
wel de NL als VK schepen eCatch gebruiken voor
rapporteren van vangsten. Een toegesneden plat-
form is ontwikkeld voor het maken van overzichten
(mCatch).

| PelAcoustics | Helaas is er weinig voortgang geboekt met het ge-
|              | bruik van akoestische informatie van de schepen in
|              | 2016. Het is nu gepland om dit in 2017 weer op te
|              | pakken. |

| AutoMeasure | Het automeasure project ontwikkeld een nieuw ap-
|             | paraat dat het mogelijk zal maken om automati-
|             | sche metingen te doen van lengte en gewicht van
|             | individuele vissen. Een contract voor de ontwikke-
|             | ling van het apparaat is begin 2017 getekend met
|             | een verwachte levering voor de zomer van 2017.
|             | Drie studenten projecten zijn uitgevoerd naar aut-
|             | omatische soortherkenning en automatische sor-
|             | teertechnieken. |

| Horsmakreel onderzoek | Hoewel oorspronkelijk geoormerkt als Noordzee
|                      | horsmakreel onderzoek, heeft het onderzoek zich
|                      | verbreed tot alle horsmakreel gevangen door de
|                      | PFA vloot. Nadruk ligt op de definitie van bestan-
|                      | den (‘stock identity’) en op ontwikkeling van
|                      | nieuwe indicatoren. Voor het genetische werk zijn
|                      | in 2016 aanvullende monsters verzameld. Histori-
|                      | sche vangst data is verzameld en gebruikt voor ont-
|                      | wikkeling van nieuwe indicatoren. Hoewel de
|                      | resultaten nog niet definitief zijn, zijn eerste resul-
|                      | taten al gepresenteerd op de ICES benchmark
|                      | workshop voor wijd verspreidde bestanden. |

| Makreel en horsmakreel
ei-survey | De PFA and IMARES hebben in 2016 succesvol een
|           | onderdeel van de 2016 makreel en horsmakreel ei-
|           | survey uitgevoerd en daarmee bijgedragen aan de
|           | grote inspanning die de ei-survey is (elke drie jaar). |
1 Introduction

For many years already, the Pelagic Freezer-trawler Association (PFA) has been an active player on the interface between industry, science and management. PFA members have all contributed to data collection initiated by scientific institutes (observer trips, catch sampling, logbook information). In addition, the PFA has initiated and commissioned several scientific research projects, for example on stock structure of horse mackerel, on the improvement of the knowledge base for horse mackerel, catch sampling in Mauritanian waters etc.

In 2014, the PFA has developed their Science and Knowledge strategy 2015-2018 (PFA 2014) that provides for strategic foresight on the directions of research. Important themes in the strategy are: documentation of catch and effort, monitoring of stocks and environment, improvement of selectivity and assessing impacts of fishing.

The utilization of scientific catches provides an important avenue to facilitate the research ambitions of the PFA. That is why we are submitting an integrated request for scientific catches (by year) and that is why we are also reporting on the outcomes in the integrated results document that you have in front of you.

Overall, we believe that fishermen are the eyes and the ears at sea. Being at sea for most of the year, they experience directly what is happening to the ecosystems and the environment. Changes in distributions of species or timing of occurrence, changes in abundance of species, observations of new species in certain area; all aspects that could well be monitored by fishermen out at sea. Making effective use of the presence, the knowledge and the experience of fishermen, has the potential to make significant contributions to our understanding of the oceans and to the management of natural resources. The projects that have been carried out with the support of scientific catches make it possible to take the knowledge of fishermen into account in a structural manner.
2 Research projects

2.1 Industry acoustic survey and genetic research for herring in 6a-north

This project combines the research efforts towards assessing the state of the 6a herring (via an industry acoustic survey during spawning time) and the stock separation between 6a north and 6a south-7bc herring. The research has been carried out together with Wageningen IMARES (now: Wageningen Marine Research), University College Dublin and the member companies of RVZ/PFA.

The collection of acoustic data from commercial vessels has been discussed for a long time already (Melvin and Power 1999, ICES 2007, FAO 2012), but real applications in European waters are very limited. Industry acoustic surveys have successfully been applied in other places like Canada (Melvin and Power 1999, Singh, Melvin et al. 2014), New Zealand (O’Driscoll and Macaulay 2005), USA (Barbeaux, Horne et al. 2013) and Peru (Gutierrez, Castillo et al. 2012). The Dutch research project PelAcoustics has recently demonstrated the potential value and approach for acoustic data collection on board of pelagic freezer-trawlers (Fassler, Brunel et al. 2013, 2015, Fässler, Brunel et al. 2016).

During the ICES benchmark workshop on herring west of the British Isles (ICES 2015), the assessments of 6a North herring and 6a South-7bc herring have been merged into one combined assessment. The main reason for the merging has been that the catches of mixed aggregations in the commercial fishery and in the acoustic survey, could not be separated into the different stock components. Already during the benchmark workshop, additional acoustic information from different fisheries was shown and referred to, however at that stage the information could not be quantified.

The idea of starting an industry acoustic survey for 6a herring, was sparked at the industry workshop on acoustics (2015) and further developed during a dedicated meeting on 6a herring in Edinburgh, 10/9/2015 (PELAC 2015). Several potential uses of industry acoustics were discussed. The most promising contribution from the fishing industry to improve the knowledge base on herring west of the British Isles was the development of an acoustic mini-survey approach.

With regards to the stock structure of herring in 6a and 7bc, a recent industry funded pilot study reanalysed spawning herring samples from the EU WES-THER project (2003-2005) from ICES areas 6aN and 6aS & 7bc, using Next Generation Sequencing (NGS) based approaches. This revealed significant population structure between putative Irish (6aS & 7bc) and Scottish (6aN)
populations. In light of the recent advances in genetic techniques, and the current issues surrounding the assessment of these two stocks, these genetic methods were included as part of the 6a herring research efforts.

Aims

- Contribute to an internationally coordinated industry acoustic survey for herring in 6a and 7bc, with the aim to give minimum biomass estimates of the spawning components in 6a North (August 2016) and 6a South-7bc (December 2017).
- Develop a genetic stock identification tool to enable rapid and cost effective splitting of survey samples and commercial catches of herring in 6aN and 6aS & 7bc into stock of origin.

2.1.1 Results of industry acoustic survey on 6a-7bc herring

In 2016 the first industry-led survey of herring in 6a/7bc. Industry and scientific institutions from Scotland, Netherlands, Ireland, England and Germany successfully carried out scientific surveys with the aim to improve the knowledge base for the herring spawning components in 6a.N and 6a.S, 7b-c, and submit relevant data to ICES to assist in assessing the herring stocks and contribute to establishing a rebuilding plan.

Following agreement on a monitoring fishery TAC of 5800t (EU 2016/0203), the scientific survey was designed based on ICES advice for the timing, location and number of samples required to collect assessment-relevant data from the monitoring fishery (ICES 2016b).

Three industry vessels were used for acoustic surveys in 6aN (Wiron 5-6, Quantas and Zephyr) and one in 6aS/7bc (Atlantic Challenge). All vessel used calibrated scientific echosounders (Simrad EK60 or EK80) either using the ships transducers or a transducer on a towed body. Two other industry vessels (Annie Hillina and Unity) were dedicated to taking samples for morphological and genetic analyses in 6aN, whilst in 6a/7c samples were collected by numerous inshore vessels.

Biological samples taken during the survey and subsequent commercial catches were used to construct a catch-at-age used in ICES 2017 stock assessment (HAWG 16-22nd March 2017). Acoustic survey data on the biomass of the spawning components were review by ICES International Pelagic Surveys working group (ICES 2017a) and found to be reliable to be considered as first data points in possible future time series. Morphometric and genetic data from spawning fish will provide new baseline data required to assess separately the stocks in 6.aN and 6.aS, 7b-c. This information would be considered in a future benchmark assessment.
Following ICES advice on the need for a stock recovery plan for herring in 6a/7bc (ICES 2016b), a draft recovery plan is under development under the auspices of the Pelagic Advisory Council.

With provision made for 5800t monitoring fishery in 2017 (EU 2017/127), plans are underway for follow on survey in 2017, taking into account the recommendations of ICES WGIPS (ICES 2017a). Overall, the 2016 survey effort has been very successful, especially given the very short preparation time available as the quota was only allocated in early July 2016.

2.1.2 Results of herring genetic research

Together with Ed Farrell and Jens Carlsson at University College Dublin and with the other pelagic industries in Europe, we have invested in the building up of knowledge around the genetic make-up of herring stocks in the North Sea and Western waters. The focus is on the development of new genetic markers that could be used for immediate screening of individual fish. To achieve that goal we need to first establish the baseline of what the genetic profile of a herring from a certain spawning location is.

![Preliminary results of the classification of herring stocks in the Northeast Atlantic. 6aN15 and NS15 refer to herring in 6a North and in the North Sea from data collected in 2015, IS15 refers to Irish Sea herring and CS15 and 6aS16 refer to Celtic Sea and 6a South samples in 2015 and 2016, BLT refers to the Baltic Sea (as an outgroup).](image)

A report on the genetic work on herring is foreseen in 2017.
2.2 Self-sampling of the PFA fleet

Documentation of catch and effort of the pelagic freezer-trawlers fleet is a key focus for the PFA research programme. The activities are capitalizing on the sampling that is already being undertaken on most of the freezer-trawler vessels and provides for efficient techniques for collecting robust information.

2.2.1 Self-sampling results

Self-sampling of freezer-trawler vessels started in 2014, but really became established from 2015 onwards. Self-sampling has been carried out in the Northeast Atlantic (FAO area 27), in West-African waters (FAO area 34) and in the Southern Pacific (FAO area 87). An overview of the self-sampling in number of vessels, trips, number of days, total catch of self-sampled vessels and number of length measurements is presented in the text tables below.

<table>
<thead>
<tr>
<th>Year</th>
<th>ntrips</th>
<th>ndays</th>
<th>Catch</th>
<th>nlength</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>4</td>
<td>136</td>
<td>11456</td>
<td>0</td>
</tr>
<tr>
<td>2015</td>
<td>34</td>
<td>747</td>
<td>126907</td>
<td>122417</td>
</tr>
<tr>
<td>2016</td>
<td>79</td>
<td>1412</td>
<td>233410</td>
<td>146024</td>
</tr>
</tbody>
</table>

Number of vessels per year and area

<table>
<thead>
<tr>
<th>Year</th>
<th>27</th>
<th>34</th>
<th>87</th>
<th>(all)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2015</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>2016</td>
<td>8</td>
<td>3</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>(all)</td>
<td>17</td>
<td>3</td>
<td>3</td>
<td>23</td>
</tr>
</tbody>
</table>

Number of trips per year and area

<table>
<thead>
<tr>
<th>Year</th>
<th>27</th>
<th>34</th>
<th>87</th>
<th>(all)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2015</td>
<td>25</td>
<td>0</td>
<td>9</td>
<td>34</td>
</tr>
<tr>
<td>2016</td>
<td>55</td>
<td>20</td>
<td>4</td>
<td>79</td>
</tr>
<tr>
<td>(all)</td>
<td>84</td>
<td>20</td>
<td>13</td>
<td>117</td>
</tr>
</tbody>
</table>

Total catch per year and area

<table>
<thead>
<tr>
<th>Year</th>
<th>27</th>
<th>34</th>
<th>87</th>
<th>(all)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>11456</td>
<td>0</td>
<td>0</td>
<td>11456</td>
</tr>
<tr>
<td>2015</td>
<td>97935</td>
<td>0</td>
<td>28972</td>
<td>126907</td>
</tr>
<tr>
<td>2016</td>
<td>182896</td>
<td>40230</td>
<td>10284</td>
<td>233410</td>
</tr>
<tr>
<td>(all)</td>
<td>292287</td>
<td>40230</td>
<td>39257</td>
<td>371774</td>
</tr>
</tbody>
</table>

With the self-sampling programme, the PFA can now monitor the distribution (spatial, temporal) and the composition (length, weight, fat content) of the catches of a large part of the fleet of freezer-trawlers.

In the Northeast Atlantic the self-sampling programme has monitored the fisheries for blue whiting, horse mackerel, mackerel and herring and the most important bycatch species. There have also been some fisheries for pilchards and

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1 Note that the same vessel may have been active in multiple areas.
anchovy, mostly in the southern North Sea. West of Africa the main catches are sardines and horse mackerel and in the South Pacific mostly Jack Mackerel.

Figure 2 Haul position from self-sampling data 2015 and 2016.

More on the self-sampling results will be available in the dedicated research report on self-sampling that will be issued before the summer of 2017.

During 2016, Floor Quirijns has taken over most of the work of converting the information received from the participating vessels into a comprehensible and consistent data series which includes providing feedback on the trip reports to the vessels. Inge van der Knaap who has worked at PFA from May-December
2016 also greatly contributed to the utilization of the self-sampling data for the horse mackerel analyses.

2.2.2 Development of catch reporting software

The current self-sampling programme is carried out using dedicated Excel spreadsheets to collect the information on board of the vessels. As part of the ambition to harmonize and facilitate the data entry on the vessels, we have been working towards an extension of the electronic logbook software, by adding a number of features that are not part of the mandatory logbook requirements but that are very important for the companies and that could facilitate the self-sampling programme.

After having explored the possibilities with OLRAC in 2015 and early 2016, without much success, the PFA/RVZ decided to look for other suppliers of electronic logbook software who would be interested in taking up this challenge. This resulted in a contract between RVZ and eCatch to develop a pelagic fisheries version of the eCatch onboard electronic logbook system in combination with the dedicated mCatch portal that can be used to generate the required trip reports (LAN, SAL) for the government, but also to supply insight and overviews on the performance and history of the vessels and utilization of ITQs over time. In addition, there will be an integration of an onboard production recording app (mCatch production) within mCatch which is intended to take over the current Excel based versions of production recording by the companies and the ones used for self-sampling.

The contract between RVZ and eCatch was signed on 11/8/2016. A preliminary version of the mCatch app was developed by early December 2017 and a stable version was released on 24/2/2017. Although further refinements may still be needed, the basic functionality of mCatch and eCatch is performing according to the expectations.

The development of the mCatch ITQ module and the mCatch production module had reached the beta testing stage in February 2017. It is expected that both modules will be finalized before the summer of 2017, based on the original contract between RVZ and eCatch.
2.3 Pelacoustics - use vessel acoustics for stock trends

Collecting relevant scientific information from commercial vessel acoustics is a long-standing ambition of the PFA. Since the acoustic equipment on many of the vessels is comparable or very close to scientific standards, making use of commercial vessels for additional data collection next to the regular scientific surveys would be an efficient way to improve the robustness of the knowledge base.

The opportunistic acoustic data recording has unfortunately not taken place during 2016. This is due to the heavy commitments of vessels to other ongoing acoustic projects. However, we are still committed to collecting the opportunistic acoustic data. Using the scientific catches that was allocated in 2016, the acoustic data collection efforts will be facilitated.

2.4 AutoMeasure: the development of an automatic measuring device

The PFA/RVZ self-sampling programme and the routine measurements that take place in the cold-stores both rely on manual registration of length and sometimes semi-automatic registration of weight. However, weight and length (and species) are not jointly recorded. The joint recording of these variables would be very useful for scientific research and understanding growth patterns by area and season. Therefore, the PFA/RVZ is keen to contribute to the development of an automatic measuring and weighing device, if possible also with species recognition.

2.4.1 Student projects on automatic species recognition and automatic sorting

Three students of Wageningen University (Farm Technology Group) carried out their final theses on automatic species recognition and automatic sorting.

- Andries van der Meer
  - Topic: development of vision algorithms to identify different fish species
  - 26 October 2015 – 13 May 2016.

- Teun de Weijer
  - Topic: application of vision algorithms and body morphometry to different fish species from actual catches
  - 4 September 2016 - 7 April 2015

- Marnix van Koeveringe
  - Topic: simulation of onboard fish sorting processes
  - 4 September 2016 - 7 April 2015
The results of the student projects will be presented to fishing industry representatives in May 2017.

2.4.2 Development of an automatic weighing-measuring device

The aim of this part of the project was to develop a test-version of an automatic weighing-measuring device that could be used to collect joined length and weight measurements of individual fish, either in the cold-stores or on board of the vessels.

As a first trial, we rented a SCANTROL FishMeter, an electronic measuring board, which we used during a sea-trip on board of the KW174 Annelies Ilena. Although the measuring board had some reasonable properties, the evaluation showed that it would not be a suitable tool for deployment within the industry (too error prone, too work intensive, no integration with weighing).

After that we have worked with WPL and HAKON to generate a first conceptual model for a combined weight-length measurement device in August 2016. After a number of sessions with quality managers at the different companies, a final contract between WPL/HAKON and RVZ was signed in April 2017, with an expected delivery within three months.

2.5 (North Sea) horse mackerel research

The knowledge base for horse mackerel is weak in general and for the North Sea component it is even weaker. The project aims to improve the knowledge base by providing genetic samples from horse mackerel in different parts of its distribution area and by developing new indicators of abundance based on commercial fisheries data.

2.5.1 Collecting genetic samples of horse mackerel throughout their distribution area

In 2015 the Pelagic Freezer Trawler Association (PFA), through IMARES, funded University College Dublin (UCD) to undertake a pilot study to develop a method of genetic stock identification for discriminating North Sea and Western Horse mackerel (Brunel et al., 2016). The aims of the pilot study were;

1) To develop and validate at least 24 polymorphic microsatellites markers in horse mackerel.

2) To screen spawning fish collected in 2015 from the Western and North Sea stocks to establish a genetic baseline of the spawning stocks and test the presence of population structure.
Sampling was organised between UCD, the Marine Institute, IMARES and the PFA. The primary focus of sampling for the genetic analysis was collection of spawning fish (Figure 1). This was to ensure that samples could be considered to provide a valid baseline as the definition of the Western and North Sea stocks is based on the spatial separation of spawning. Recently developed Next Generation Sequencing (NGS) and Genotyping by Sequencing (GBS) based approaches, which were developed during UCD projects on cod (*Gadus morhua*), boarfish (*Capros aper*) and 6a/7bc herring (*Clupea harengus*) were used for marker development and screening of spawning samples (Carlsson *et al.*, 2013; Farrell *et al.*, 2016; Vartia *et al.*, 2015 & 2014).

The pilot study successfully identified a large number of novel microsatellite, which will facilitate high throughput stock structure identification for future studies of horse mackerel. Initial data analyses were confounded by a poor quality sequencing run and as such the discrimination power between the western and North Sea sample was low. This resulted in the pilot study being unable to conclusively and unequivocally separate the two stocks. However, the level of population structure observed albeit not statistically significant ($F_{ST} = 0.002 – 0.003$) is on par with what has been observed in other marine fish species that show significant stock structure.

This pilot study highlighted the potential of the genetic stock identification in horse mackerel. In order to improve the statistical power and increase the geographical scope of the analysis it was suggested that the sampling area should be widened to include the southern stock and outlier stocks (e.g. Mauritania and Mediterranean samples). The number of samples per stock should also be increased to ensure that a comprehensive baseline of spawning individuals with sufficient statistical power is developed for each stock.

To this end, an additional year of more comprehensive sampling was conducted on the 2016 Mackerel Egg Survey (MEGS) and through industry (PFA) collaboration (Figures 1 & 2 and Table 1). Samples were collected throughout the spawning season from all three stocks and also from Mauritanian waters. Good coverage was achieved and the 2016 sample set is considered to be complete.
Figure 3 Horse mackerel samples collected in 2015 and 2016 from the putative Western, North Sea and Southern stocks for genetic analysis.

For 2017 it is foreseen to continue the genetic sampling for one more year and to organize for the collected data to be analysed.

2.5.2 Compiling historical catch and effort data

During 2016, we have initiated the collection of fisheries data from personal logbooks of skippers of six vessels that have been operating under Dutch, German and English flag. In those personal logbooks, skippers noted down the haul, date, time, position, environmental variables, fishing gear characteristics, estimated catch and in most cases also an indication of species composition. The oldest logbooks were from 1998 and the newest from 2016.

The estimated catch was split up into the catch of different species by automatically decoding the comments field because that contained indications of the species compositions.

The historical catch data can provide an important source of information to help improve the knowledge base for fisheries management, especially in the case of data-poor stocks like horse mackerel or Greater argentines. Because the information is spatially and temporally resolved, this information could also provide clues on the behaviour of fish under different circumstances (area, depth, tide, temperature, etc).
Results of the data collection and subsequent analyses have been presented at the ICES Benchmark for widely distributed stocks (WKWIDE 2017). Unfortunately the analyses could not be fully completed prior to the benchmark which means that some work will still need to be done.

### 2.6 Mackerel egg survey (with ICES WGMEGS)

The European pelagic fishing industry has offered to contribute to the tri-annual ICES coordinated 2016 egg survey for mackerel and horse mackerel. The Pelagic Freezer-trawler Association (PFA) had offered to contribute to the Celtic Sea and northern part of Bay of Biscay assignment during the first two weeks of May.

From 10 till 25 May IMARES carried out a mackerel and horse mackerel egg survey on board the FV Atlantic Lady H190. This research was commissioned by the by the PFA as part of the international mackerel and horse mackerel egg survey coordinated by ICES. Five researchers and nine crew members were on board of the vessel.

Due to the excellent weather circumstances during the survey was successful and this demonstrates that fishing vessels are a suitable platform for a plankton survey, although in bad weather situations a smaller vessel like the Atlantic Lady could limit the survey execution due to lower stability.

Of the 89 planned plankton stations 85 were sampled. During the survey it was possible to sort and analyse all samples on board. Also a first check of sorting of the samples was carried out. Further quality control will be carried in the laboratory.
Both crew and researchers were positive about the joint experience and welcomed the possibility to learn about each other’s practices. Some impressions below.
3 Acknowledgments

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4 References


