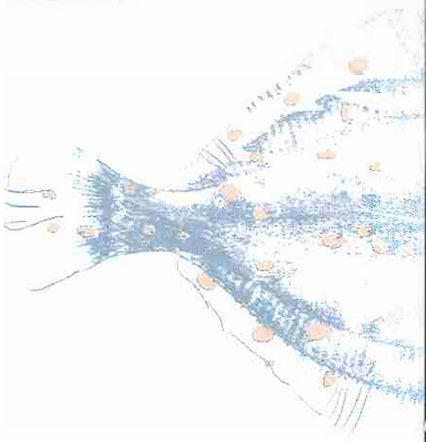
WAGENINGEN UR
For quality of life

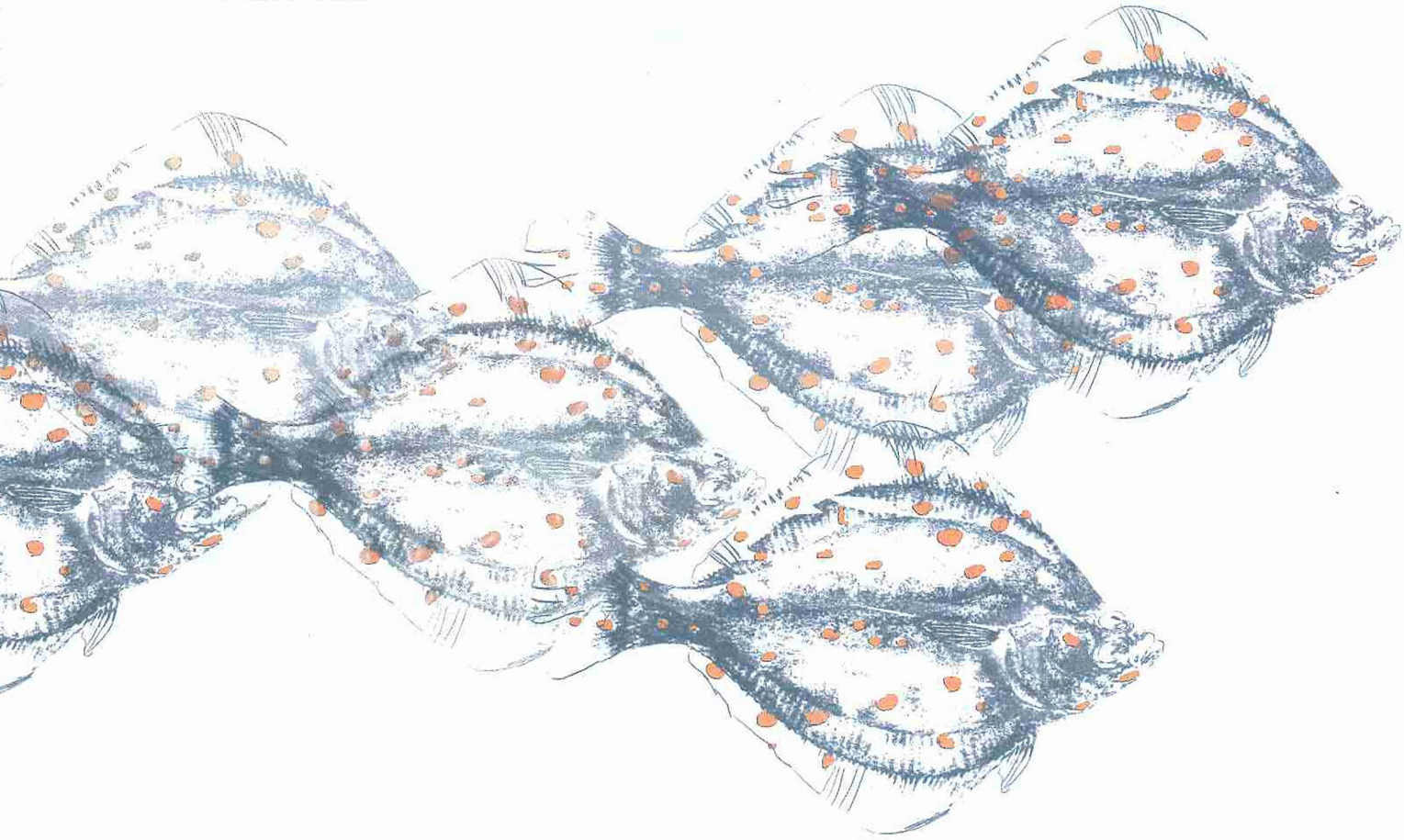
The KB WOT Fisheries Programme carried out in 2015



C.J.G. van Damme & S.W. Verver

CVO Report 16.007

March 2017



Centrum voor Visserijonderzoek (CVO)

Stichting Wageningen Research
Centre for Fisheries Research (CVO)

The KB WOT Fisheries Programme carried out in 2015

C.J.G. van Damme & S.W. Verver

CVO report: 16.007

Commissioned by:
Ministerie van EZ
Directie Agrokennis
Cluster Onderzoek en Kennisvalorisatie
Postbus 20401
2500 EK DEN HAAG

Project number: 4311300016
BAS code: KB-24-005-001

Publication date: 30 March 2017

Stichting Wageningen Research
Centre for Fisheries Research (CVO)
P.O. Box 68
1970 AB IJmuiden
Phone. +31 (0)317-487418
Fax. +31 (0)317-487326

Visitor address:
Haringkade 1
1976 CP IJmuiden

Note: Both DLO and IMARES changed names in 2016. This report refers to the new names as these are already commonly used at the time of publication. Stichting DLO is now registered as Stichting Wageningen Research while IMARES was renamed to Wageningen Marine Research.

Digital Object Identifier (DOI): https://doi.org/10.18174/412011

© 2017 CVO

CVO rapport UK V07

Table of Contents

Summary

The KB WOT Fisheries programme is established to maintain and develop the expertise needed to carry out the statutory obligations of the Netherlands in fisheries monitoring and advice. It is also a flexible program which responds to changes over time in WOT requirements, fisheries management and policy needs. While maintaining the core expertise and flexibility, the KB WOT programme also strives to be innovative and participate in the development of fisheries science. The programme operates within the context of the Common Fisheries Policy (CFP), the EU Marine Strategy Framework Directive (MSFD) and the EU Maritime Policy.

The KB WOT fisheries programme is established annually and positioned around a number of themes. In 2015 14 projects were originally awarded. However, one project could not meet all the original objectives and with the remaining budget a 15th project was started on the tool development for fish ageing and maturity staging. These 15 projects were successfully completed. The programme focused on the research into the impact of fisheries on the seafloor, development of tools for electronic monitoring, data storage and dissemination and method development for assessment of marine resources. As always the core element of the KB WOT Fisheries was maintaining and developing key expertise for the WOT programme. A large part of the budget was therefore used for projects that standardise fish ageing, provide quality control of discard, ichthyoplankton and shellfish monitoring and development of fisheries acoustics techniques and expertise. These topics are vital for the quality of fish stock assessments and management.

Of the 15 projects funded in 2015, seven were carried out in collaboration with institutes outside the Netherlands. As resources and expertise from these other countries contribute to the KB WOT Fisheries programme, these collaborations provided a large amount of added value to the programme. Another large part of the KB WOT resources is specifically dedicated to international collaboration and exchange of science. This ensures that Wageningen Marine Research researchers remain at the centre of scientific developments and international fisheries research.

The programme was also very productive in terms of publications, presentations and developing new methods or tools for fisheries research. Over 15 international presentations were given at meetings, workshops and symposia, and 22 international and national reports written. 8 new methods or models were developed, 3 peer reviewed publications published and 5 scientific publications prepared.

Samenvatting

Het KB WOT Fisheries programma is ontwikkeld om de expertise te onderhouden en ontwikkelen, die nodig is voor het uitvoeren van de wettelijke taken van Nederland op het gebied van visserij monitoring en advisering. Daarnaast, is het een flexibel programma dat ook inspeelt op veranderingen in WOT behoeften en visserij beleid en beheer. Naast de kernexpertise en flexibiliteit probeert het KB WOT programma ook innovatief te zijn om te kunnen participeren in wetenschappelijke ontwikkelingen. Het programma wordt uitgevoerd binnen de kaders van de Common Fisheries Policy (CFP), de EU Marine Strategy Framework Directive (MSFD) en de EU Maritime Policy.

Het KB WOT Visserij programma wordt jaarlijks vastgesteld rond een aantal thema's. Het programma voor 2015 bevatte origineel 14 projecten. Een daarvan was niet in staat om alle geplande doelstellingen te halen. Met het budget dat daardoor vrij kwam is een 15^{e} project uitgevoerd waarin een tool ontwikkeld is voor de kalibratie van leeftijds- en rijpheidsbepaling van vis. Deze 15 projecten zijn succesvol uitgevoerd. De focus van het programma was gericht op onderzoek naar de invloed van visserij op de zeebodem, ontwikkeling van methoden voor elektronisch monitoren en ontwikkeling van methoden voor het assessment van visbestanden. De kern van het programma was natuurlijk de ontwikkeling en het onderhouden van noodzakelijke kern expertises voor het WOT programma. Een groot deel van het budget is daarom besteed aan projecten voor het standaardiseren van leeftijdsbepaling van vis, kwaliteitscontrole en verbetering van bijvangst, ichthyoplankton en schelpdier monitoring en ontwikkelen van visserij akoestische technieken en kennis. Deze onderwerpen zijn van essentieel belang voor het behouden van de hoge kwaliteit van assessments van visbestanden.

Van de 15 projecten in 2015 zijn er zeven uitgevoerd in samenwerking met instituten buiten Nederland. Deze samenwerking zorgt voor extra toegevoegde waarde aan het KB WOT Visserij programma doordat andere landen kennis en middelen bijdragen. En ander groot deel van het KB WOT programma was specifiek gebruikt voor internationale samenwerking en uitwisseling van kennis en wetenschap. Op deze manier blijven Wageningen Marine Research onderzoekers in het centrum van wetenschappelijke ontwikkelingen en internationaal visserij onderzoek.

Het KB WOT programma heeft in 2015 ook veel gepubliceerd en geproduceerd. Meer dan 15 internationale presentaties zijn gepresenteerd tijdens bijeenkomsten, vergaderingen, workshops en symposia. In totaal zijn er 22 (inter-)nationale rapporten geschreven en 8 nieuwe methoden of modellen ontwikkelt. Tot slot zijn er 3 peer reviewed wetenschappelijke artikelen gepubliceerd en 5 wetenschappelijke manuscripten opgezet.

1 Introduction

The main objective of the KennisBasis (KB) WOT fisheries programme is to maintain and develop expertises which are vital to carry out the Dutch statutory obligations (WOT) in fisheries monitoring and advice on fishery management. The statutory tasks are evolving with time, as are fishing methods and policy needs. This requires the KB WOT programme to be proactive while maintaining and developing the key expertises. The KB WOT Fisheries programme is an annually reviewed multiannual programme. Through the yearly review the programme is flexible and it has clearly defined objectives and deliverables. The programme operates within the wider Wageningen KB programme and is since 2015 embedded within the Wageningen KB theme 'System Earth Management'.

The statutory obligations comprise the advice and actions needed to carry out the national and European fishery policies. The (future) policy needs originate mainly from the existing and upcoming EU directives, commitments relevant for fisheries for the Common Fisheries Policy (CFP), national freshwater policy, habitats directive, water quality directive and the Marine Strategy Framework Directive (MSFD). Reliable science-based advice is essential for fisheries management and policy. A combination of data and information collection with enhanced understanding of the marine and aquatic (eco)systems forms the source for providing such science-based advice. Long-term data collection programmes are setup to provide data.

Maintenance and underpinning of key expertises necessary to carry out the statutory tasks is het main objective of the KB WOT Fisheries programme. As a result the programme improves the efficiency with which the WOT Fisheries programme is executed. A combination of effective research aimed at present needs of EZ and the EU, together with more strategic research, to anticipate future policy and research needs and developments, creates a programme which is both innovative and supportive. The KB WOT Fisheries budget is utilised to maintain, improve and develop the expertise in the research areas of fisheries dynamics, fish biology, monitoring, marine and freshwater ecology and management systems. An important priority of the programme is to stimulate international exchange of knowledge, method and technique developments and international collaboration. Additionally the programme tries to stimulate scientific output of the scientists involved in carrying out the statutory tasks.

2 The programme in 2015

The research priorities for the 2015 KB WOT Fisheries programme were based on the apparent requirements of the WOT Fisheries programme. The priority is maintenance and development of key expertise, essential to carry out the statutory tasks, followed by exchange of scientific knowledge and the development and innovation required for current and future WOT tasks. The remaining funds are used for strategic initiatives.

Provision of robust science and advice can only be achieved with excellent and innovative research in the KB WOT programme. The results of monitoring programmes and delivered advice for national and international fisheries management needs to be excellent. This level of science and quality control can only be achieved with international exchange of knowledge and developments and publication of research in international scientific, peer reviewed, journals. A considerable part of the KB WOT budget is therefore reserved for exchange of science.

2.1 Research themes

The research areas which were considered high priority for the KB WOT fisheries programme in 2015 were:

1. Ecosystem approach
2. Maintaining Quality
3. International Exchange

A fourth topic was identified when the KB WOT fisheries programme was developed which was co-funding for a proposal of a long term multi-annual EU project on innovation and development of acoustic survey techniques and expertise. However, this proposal was not granted and the budget was allocated to an acoustic project under theme ‘Maintaining Quality’.

2.2 Rationale for the choice of research themes

The ecosystem approach is important to the ‘green’ knowledge structure setup by EZ and also to the development of fisheries management in the Netherlands and the EU. The marine and aquatic ecosystems are continuously developing and changing, and consequently the relative significance of parts of an ecosystem can vary over time. Some changes are fluctuations caused by regular cycles, while others occur due to longer time change and seem to be more permanent. A consequence of this is that the productivity of marine and freshwaters systems fluctuates over a range of temporal scales. Good management of the ecosystems and its resources requires a good understanding of the variability, causes and the extent of these changes. As these natural changes also interact with human impact the consequence is that the fisheries (eco)system is highly dynamic, and sometimes unpredictable. Only a good understanding of the vibrant system will allow the necessary assessment of risks, stock sizes, harvestable resources, and analyses and discrimination between natural and anthropogenic effects on the ecosystem.

Also management and policy regarding marine and aquatic resources is continuously developing. The EU has moved from fish stock management to management of the fisheries, including measures to regulate fishing effort and reduce discards. From 2015 onwards, landing obligations (discard ban) have been established and will be extended in the coming years. Fisheries impact on the environment has been studied. However, there still exists a need for further knowledge to aid management of marine and aquatic resources. For EU data requirements member states are required to carry out monitoring programmes for single and multiple stocks. At the same time EU regulations, such as MSFD, require

data collection for a number of selected descriptors, ecosystem elements which are sensitive to fishing activities. This calls for combined integral monitoring programmes.
A substantial part of the KB WOT budget is reserved to support these international duties and projects are requested and selected which deal with these specific needs of the WOT fisheries programme. Peer reviewed manuscripts will ensure quality control of the research on these topics.

The core of the KB WOT programme is the maintenance and development of the key expertises and development of routine techniques, skills and tools needed to carry out the statutory obligations. This includes age reading, maturity assessment, stock assessment, acoustic and remote sensing techniques and data collection. Courses, workshops and exchanges, usually coordinated by ICES, are an important part of maintaining and developing these core skills. (Inter) national exchange of experience and techniques is a crucial element of the development of fisheries science within the EU. These workshops and symposia are also key for the creation of new innovative products and methods, hence the staff involved in the statutory tasks needs to participate in these meetings.

2.3 Projects funded through the KB WOT fisheries programme in 2015

Yearly, scientists are invited to submit proposal to several themes which are selected by the KB WOT management team (delegated programme leader and Head of CVO). The proposals are reviewed and judged for relevance for the WOT statutory tasks, development of relevant new methods and scientific relevance. This review is carried out by the KB-WOT management team in close cooperation with a scientific advisory committee. The projects in the table below were funded in 2015. The annual reports of each project are attached to the end of this report.

BAS No	Title	Project leader	Research Theme	Planned	Realised
KB-14-012-063	Program management	Cindy van Damme		€27.676,-	€27.676,-
KB-14-012-064	International Exchange	Cindy van Damme	3. International exchange	€143.775,-	€143.775,-
KB-14-012-065	Fish ageing	Loes Bolle	2. Maintaining Quality	€60.308,-	€55.000,-[1]
KB-14-012-066	FUSION (Fisheries information from using VMS and acoustics in combination)	Sascha Fässler	1. Ecosystem Approach	€29.700,-	€29.700,-
KB-14-012-067	Underpinning Acoustics	Sascha Fässler	2. Maintaining Quality	€58.500,-	€58.500,-
KB-14-012-068	Improved accuracy and error estimates in shellfish stock assessments	Karin Troost	2. Maintaining Quality	€49.730,-	€49.730,-
KB-14-012-069	Validation of discard data from the Dutch self-sampling program	Ruben Verkempynck	1. Ecosystem Approach	€33.400,-	€33.400,-
KB-14-012-070	Seeing the forest for the trees	Jan Jaap Poos	1. Ecosystem Approach	€11.240,-	€11.240,-
KB-14-012-071	Development of automated data upload to DATRAS	Ingeborg de Boois	2. Maintaining Quality	€19.410,-	€19.410,-
KB-14-012-072	SPI-FISH: Benthic impacts of fishing trawls	Lorna Teal	1. Ecosystem Approach	€31.200,-	€31.200,-
KB-14-012-073	Unravelling the hidden in SAM	Thomas Brunel	1. Ecosystem Approach	€ 15.840,-	€15.840,-
KB-14-012-074	RIBS	Ingrid Tulp	1. Ecosystem Approach	€38.090,-	€38.090,-
KB-14-012-075	An assessment of a currently used method to stun and kill fish during surveys	Hans van de Vis	2. Maintaining Quality	€35.091,-	€35.091,-
KB-14-012-076	CLUPID: Clupeoid larvae identification	Cindy van Damme	2. Maintaining Quality	€34.000,-	€34.000,-
KB-14-012-077	WebGr	Cindy van Damme	2. Maintaining Quality		€5.308,-

The total KB WOT budget €588.000,- (excluding WUR charges) was expended in 2015.

[1] Project could not be carried out completely due to staffing problems. For the remaining budget a new project was executed: KB-14-012-077

3 Highlights of the programme in 2015

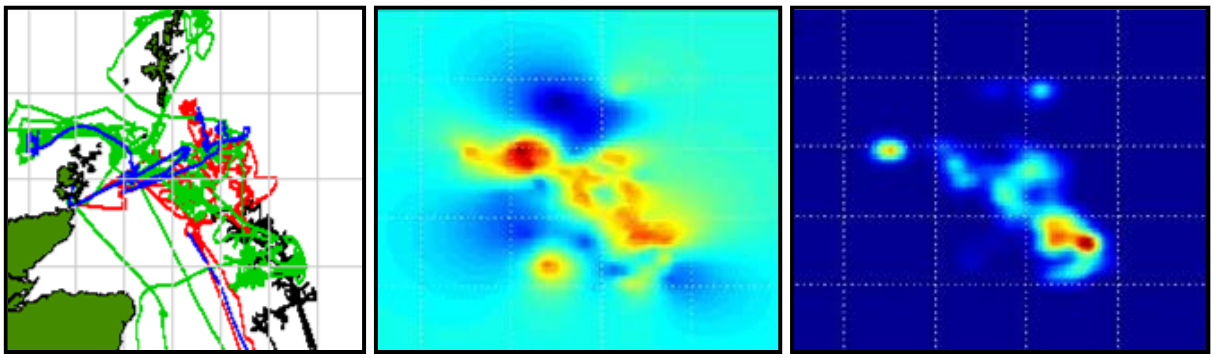
With the many proposals submitted it was again possible to establish a diverse program meeting all requirements in 2015. Originally 14 projects were rewarded at the start of 2015. However, one project could not be carried out the proposed work completely because of staffing problems. The budget which was not used due to this was awarded to a new project 'WebGr'. In total 15 projects were carried under the KB WOT fisheries programme in 2015.
The budget for KB WOT Fisheries was granted only in March. Because of this delay in the start of the projects not all planned activities could be finished in 2015. However, despite this all project were able to deliver many important and interesting findings. A showcase example delivering great output is the 2015 FUSION project.

3.1 FUSION (Fisheries information from using VMS and acoustics in combination)

Fishing vessels can be seen as top-predators targeting fish. Based on that, assumptions can be made about the location of fishing vessel activity and how this represents fish distributions or if their behaviour can be linked to resource extraction. Vessel Monitoring by Satellite data (VMS) is often used as analyses of vessel activity and represents a useful source of information to tackle fisheries behaviour and fisheries resource questions. VMS has previously been applied to estimate fishing effort at high resolution, link catch and fishing effort, and to study aggregation behaviour and spatial behaviour of fishermen.
Many pelagic fishing trawlers, targeting species such as mackerel Scomber scombrus, herring Clupea harengus and blue whiting *Micromesistius poutassou*, are equipped with state of the art acoustic equipment, such as sonar and echosounders, catch monitoring systems, computers connected to the internet and communication lines to other skippers. These 'predators' can therefore be very well informed on the availability and distribution of their 'prey'. However, use of such equipment also opens new research possibilities, as the data on catch information and acoustic fish detections are often digitally available. This data can be linked to VMS information, and thereby not only inform on the spatio-temporal distribution of pelagic vessels but also on observations of the targeted fish resource. For example, acoustic backscatter can be converted to an estimate of fish biomass and directly linked to the behaviour of the skipper based on the VMS information.

Till recently, estimating fish biomass was the core business of predominantly fish(eries) scientists. Making use of advanced stock assessment methodologies, absolute estimates of fish biomass are made, which serve as input for future catch scenarios for management purposes. These methods make extensive use of various data sources collected for example on-board fishing vessels or by scientific surveys. Owing to changes in environmental conditions, financial constraints or capacity restrictions, data may sometimes become lacking or not applicable, resulting in potentially biased estimates or increased uncertainty. Availability of more data sources potentially covering a fish stock over a longer time period on a continuous basis is therefore desirable. Since fishing vessels are often greater in number, they have the potential to collect data of a fish resource over a wide temporal and spatial range.
In this project we linked one-to-one acoustic backscatter, converted into fish biomass, of a pelagic fishing fleet to their spatio-temporal distribution and VMS like information such as speed and heading. We investigated if there is a robust relationship between the fish biomass observed by the fishing vessels using their calibrated acoustic equipment, and indicators derived based on fishing behaviour (such as effort and effort accumulation). We simultaneously analysed fish biomass encountered and recorded acoustically by the fishing vessels during a fishing season and linked this to the spatio-temporal effort they exhibited during the fishing activities. For the comparison, indicators of Biomass Per Unit of Effort (BPUE) were calculated and predicted on the basis of VMS information only. Since pelagic fisheries are known to show no decline in CPUE with decreasing stock sizes, our analyses focussed on a change in fishing behaviour expressed through a number of spatio-temporal indicators.

The results showed that there was a reasonable relationship between VMS activity-related fish abundance estimates and those actually observed by the vessels echosounders. Therefore, the approach could be applicable in areas where fisheries independent data is difficult to obtain to provide an additional source of information for stock assessment.
The time spent at a certain spatial location is a good indicator of fish biomass. However, the indicators are not strong enough to directly derive biomass from VMS. This can results in complete miss of hotspots. There is some disagreement between fishermen and scientific observations. But it is likely that the indicators are very informative of the discrepancy between fishermen and scientific observations. Studying the relation between fishermen behaviour and pelagic resource distribution it can be concluded that inter-ship distance indicates attraction (and communication) with high aggregations of fish. But the activity is very vessel specific (and not easy to define).



Tracks of different pelagic fishing vessels in the northern North Sea (left) from which acoustic and VMS data were collected to produce distribution maps of fish biomass derived from acoustic echosounder data (middle) and VMS activity (right).

3.2 Tools and method development

Methods, tools and programming code have been developed using the R and SQL programming packages for analyses of fish catch and acoustic data as well as images of the seafloor. Statistical analysis methods for combining VMS and fishing vessel acoustic data developed and tested, and for computing descriptors of the process error in assessment of fish stock have been developed.
Programming code for generating figures and tables from the Wageningen Marine Research database depicting effort and landings for different fishing metiers, as well as data extraction from the database Frisbe into the DATRAS format has been produced.

A trawl camera system to aid collection of commercial catch data on fishing vessel has been further developed and tested.

3.3 Standardisation of techniques, data accessibility and quality control

Advances were made in to fish ageing of flatfish (sole, flounder, lemon sole and dab), pelagic fish (herring, greater argentine and blue whiting) and Norway pout and whiting. In order to increase standardisation and quality of age reading, task-sharing has also started between ILVO (Belgium) and Wageningen Marine Research. Age reading of species of which only a few otoliths are collected will be shared between the institutes.
A new version of WebGr has been developed with the help of KB WOT Fisheries. WebGr is vital for the standardisation and quality control of fish ageing and maturity staging.

For the collection of biological data fish need to be killed. An assessment was carried out whether the current method used for stunning and killing fish is in agreement with the current Dutch law on the use of animals in experiments.

Improvements in the identification of species in acoustic and plankton samples has been carried out. The species identification library for acoustic identification of fish has been further develop, by improving the recognition of already available species identification and adding new species identification. To improve the identification of herring-like fish larvae an ImageJ macro for semi-automated measurement of fish larvae and counting of myotomes in 30-60% of the body length has been developed.

Quality control of data collections and data accessibility is important for the statutory tasks. Due to the complexity of the complexity of the re-submission methodology it was time-consuming to update the ICES DATRAS database, containing international survey data, after modifications carried out to the data at the Wageningen Marine Research database Frisbe. Software has been developed to streamline and speed up this process and improve the detection of inconsistencies between the two databases. Discard sampling is carried out using two methods, observer and self-sampling. Bias and consistency in sampling discards from hauls between the two sampling methods from the co-sampled hauls is now available. This has improved the insight in the difference between these methods considerably.

Assessing effects of fishing gear on the sea floor and benthic fauna was also part of the 2015 programme. To study effects of beam and pulse trawling on the seabed a user-friendly SPI image analysis software was developed. Also an analysis of the potential effect of sweeping the sea floor by shrimp nets on the settlement of mussels was carried out. In some years a negative effect of shrimp fishing on the occurrence of young mussels was found and others a positive effect.

3.4 Recent publications resulting from the KB WOT fisheries programme

Three peer reviewed publication resulted in 2015 which were partially funded by KB WOT Fisheries.

Trenkel, V.M., Lorance, P., Fässler, S.M.M. and Høines, Å.S. (2015). Effects of density dependence, zooplankton and temperature on blue whiting Micromesistius poutassou growth. Journal of fish biology 87 (4), 1019-1030.

Van de Wolfshaar, K.E., Tulp, I., Wennhage, H., and Støttrup, J.G. (2015). Modelling population effects of juvenile offshore fish displacement towards adult habitat. Marine Ecology Progress Series 540, 193-201.

Van der Kooij, J., Fässler, S.M.M., Stephens, D., Readdy, L., Scott, B.E., and Roel, B.A. (2015). Opportunistically recorded acoustic data support Northeast Atlantic mackerel expansion theory. ICES Journal of Marine Science. doi: 10.1093/icesjms/fsv243.

In addition the below manuscripts for submission are in preparation:
2015

Fässler et al (in prep). Variability in Atlantic mackerel target strength and its effects on acoustic abundance estimates.

Fässler et al (in prep). Methods for determining in situ target strength.

Fässler et al (in prep). Spatial analysis methods to combine fishing fleet behaviour and fish biomass from acoustic and VMS information.

Teal et al. (in prep). SPI image analysis software.

Tulp et al (in prep). Relationships between intertidal benthos and shrimp fisheries in the Wadden Sea and the Dutch coastal zone.

2014

Wolfshaar & Kooten Manuscript (in prep). Undersized bycatch may promote the growth of harvestable fish'.

Fässler et al (in prep). Deriving 'behavioural' parameters from acoustic fishing vessel data.

2013

Fässler et al. (submitted). Pelagic fish in the gateway to the Wadden Sea: abundance and behaviour in relation to the tide.

Damme et al. (in prep). Can the standard IBTS-MIK survey provide reliable data on herring recruitment and spawning locations.

Fässler et al. (in prep). Depth-dependent finite element models of herring (Clupea harengus) target strength using magnetic resonance imaging (MRI) of swim bladders.

Fässler et al. (in prep). Information on pelagic fish stocks around the British Isles derived from acoustic data collected on commercial fishing vessels.

Fässler et al. (in prep). Herring habitat quality from acoustically derived zooplankton abundance in the Northern North Sea.

Fässler et al. (in prep). The distribution of blue whiting west of the British Isles" and "Vertical migration of mesopelagic fish west of the British Isles.

Next to the above peer reviewed manuscripts results of the KB WOT projects were also disseminated in other ways. There were also 22 internal and international reports and presentations from projects, workshops and expert group meetings which were partially financed through KB WOT Fisheries and contribute directly to the development of WOT fisheries monitoring and advice.

Chen, C., Troost, K. van Asch, M. and Craeymeersch J.A. 2016. Coastal shellfish survey WOT: update stratification.

Troost, K., Perdon, J., Jol, J. and Craeymeersch, J.A. 2016. Efficiency of sampling gears. Results of a comparison between two versions of the towed bottom dredge.

Craeymeersch, J.A., Troost, K. and van Asch, M. 2016. Variance estimating in Dutch shellfish stock assessments.

Craeymeersch, J.A., Troost, K., van Stralen, M., van den Ende, D., and van Zweeden, C. 2016. Accurateness of mussel bed mapping. Some first thoughts.

ICES (2015). First Interim Report of the Working Group on Biological Parameters (WGBIOP), 7-11 September 2015, Malaga, Spain. ICES CM 2015/SSGIEON:08

ICES (2014). Report of the Workshop on Age reading of Horse Mackerel, Mediterranean Horse Mackerel and Blue Jack Mackerel (WKARHOM2), 26-30 October 2015, Santa Cruz de Tenerife, Spain. ICES CM 2015/SSGIEOM:14

ICES (2015). Report of Workshop on Age Reading of DAB (WKARDAB2), 17-20 November 2015, Hamburg, Germany.

ICES (2015). Second Interim Report of the Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR). ICES CM 2015/SSGIEOM:27, 15.IMA0224

ICES (2015). Second Interim Report of the Working Group on Integrated Assessments of the North Sea (WGINOSE). ICES CM 2015/SSGIEA:06

ICES (2015). Report of the Working Group on Integrative Physical-biological and Ecosystem Modelling (WGIPEM). ICES CM 2015/SSGIEA:01

ICES (2015). Final Report of Working Group 2 on Cod and Plaice Egg Surveys in the North Sea (WGEGGS2). ICES CM 2015/SSGIEOM:26

ICES (2015). Report of the Workshop on the ICES Egg and Larval Database (WKIELD). ICES CM 2015/SSGIEOM:33

ICES (2015). Second Interim Report of ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB). ICES CM 2015/SSGIEOM:22

ICES (2015). Report of the Working Group on Crangon Fisheries and Life History (WGCRAN). ICES CM 2015/SSGEPD:07

ICES (2015). Report of the Data and Information Group (DIG). ICES CM 2015/SCICOM:02

ICES (2015). Second Interim Report of the Working Group on Fisheries Acoustics, Science and Technology (WGFAST)

ICES (2015). Report of the Working Group on the value of Coastal Habitats for Exploited Species (WGVHES). ICES CM 2015/SSGEPI:19

ICES (2015). First Interim Report of the Working Group on Working Group on Biological Parameters (WGBIOP). ICES CM 2015/SSGIEOM:08

ICES (2015). Report of the Workshop on scrutinisation procedures for pelagic ecosystem surveys (WKSCRUT). ICES CM 2015/SSGIEOM:18

ICES (2015). Report of the Workshop on Maturity Staging of Mackerel and Horse Mackerel (WKMSMAC2). ICES CM 2015/SSGIEOM:17

ICES (2015). Report of the Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V). ICES CM 2015/ACOM:56

ICES (2015). Report of the Workshop on Egg staging, Fecundity and Atresia in Horse mackerel and Mackerel (WKFATHOM). ICES CM 2015/SSGIEOM:01.

4 International partnership and collaboration

Fish do not stick to man-made artificial boundaries in the water. Thus management of the fisheries is by its nature international and embedded in the European fisheries policies. As a results many of the statutory tasks are undertaken in collaboration with research institutions in Europe, but also outside Europe. Monitoring at sea, sampling of catches, method and tool development, the analyses of data, fish stock or ecosystem assessments and provision of advice are all carried out in international context. International collaboration is the basis for the required expertise to carry out and maintain the high standards of the WOT tasks.

Of the 15 projects carried out in 2015 , 7 were in collaboration with scientists from institutes outside the Netherlands. This resulted in added value in the form of resources and expertise from other countries to the KB WOT Fisheries programme. One project is specifically allocated to international exchange of staff and science. This project made it possible for Wageningen Marine Research colleagues to participate in studies of predator-prey interactions, ecosystem modelling, fisheries induced evolution, developing new methods for fish stock assessments, improving survey and fishing technologies, evaluating management measures for various fish stocks, marine biodiversity, egg production methods and surveying ichthyoplankton.

Over 15 international presentations were given at working groups and symposia. Through the KB WOT Fisheries programme Wageningen Marine Research scientists joined forces with scientists from institutes from all over het world, including: Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, Lithuania, Norway, Portugal, Russia, Spain, Sweden, United Kingdom, United States of America, Austria, Italy, Greece, Australia, Greenland and the Faroe Islands.

5 Conclusion

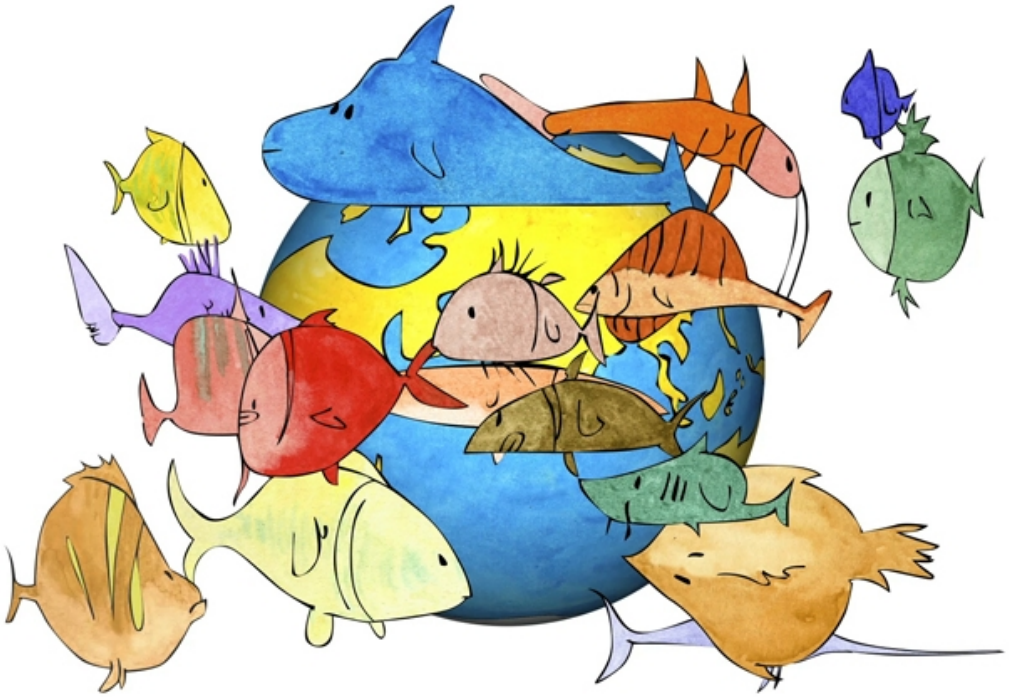
The KB WOT Fisheries programme was very productive in 2015, but one project could only carry out part of the original objectives. The 15 projects carried out in 2015 were successful and produced good results and developments, from maintaining quality in collecting biological samples, fish ageing, shellfish, acoustic, discard and ichthyoplankton sampling, data storage and dissemination to more strategic research in fisheries acoustics, electronic monitoring, effect of trawling on the seafloor and developing methods for fish stock assessments. There was also a large amount of added value to the programme in 2015 through international collaboration and participation in international meetings, workshops and symposia.

The KB WOT Fisheries programme resources were used to:

- Exchange and developed knowledge and methods and cooperate with (inter)national colleagues.
- Ensure data storage and data accessibility
- Maintain and develop expertise needed for the WOT Fisheries programme.
- Develop new methods and ideas to provide better understanding and improve efficiency in carrying out WOT Fisheries tasks.
- Stimulate dissemination of results in (peer-reviewed) publications and on (inter)national fora.

Quality assurance

CVO utilises an ISO 9001:2008 certified quality management system (certificate number: 187378CC1-2015-AQ-NLD-RvA). This certificate is valid until 15 September 2018. The certification was issued by DNV GL Business Assurance B.V



Signature

CVO Report: 16.007
Project number: 4311300016

Approved by: Ing. S.W. Verver
Head WOT, Centre for Fisheries Research

Signature:

Date: 30 March 2017

Annex 1. Annual Reports of KB WOT Fisheries Projects 2015

Title	1. Program management
Number	4311300001
Project leader	Cindy van Damme
Other researchers in WUR	Rian Schelvis and Sieto Verver
Researchers outside WUR	None
BAPS number	KB-14-012-063
Budget	27.676,-
Goals of project	To manage and develop the KB WOT Fisheries programme within WUR KB theme System Earth Management (SEM)
Target group for research	Fisheries research, management and advice.

PROGRESS 2015

Results	Main results: Due to a late start of the larger WUR KB themes there was a delay in the start of the KB WOT fisheries programme. Afterwards the programme ran well. The programme contained 14 different projects in three different themes. One project for co-funding of an EU project did not proceed because the EU project was not granted. The remaining 13 projects were carried out successfully.
	Products: A report with the planned programme and a report with the results of the programme.
Did the work follow plans (science or financial)?	Yes, but due to the late start of the larger WUR KB themes the KB WOT Fisheries programme could not start until March. Despite this the projects in the programme were carried out successfully.
Developed expertise	The programme has maintained and developed expertise to underpin the statutory task of the Netherlands in fisheries research.
Science publications	A Wageningen Marine Research symposium was organised on 19 January 2016 were all projects presented their results of the KB WOT projects carried out in 2015 to other Wageningen Marine Research scientists.
General publications	The planning report for KB WOT fisheries 2016, and the final report for KB WOT 2014. 1) The KB WOT Fisheries Programme carried out in 2014. CVO report: 15.008 2) KB WOT Fisheries 2016 - Maintaining Excellence and Innovation in Fisheries Research. CVO report: 16.002
Other outputs	A programme of research in 2015, and preparations for the programme in 2016.
Any links to Wageningen University projects?	None
What is relevant for EZ fisheries or ecosystem management?	The KB WOT Fisheries programme is fundamental to the maintenance and development of the expertise that underpins the statutory obligations of fisheries monitoring and advice for the Netherlands. The structure of the KBWOT Fisheries programme reflects the recent discussions on the research direction between Wageningen Marine Research, CVO and EZ. A review of the functioning of the WUR KB programme, including the KB WOT

	fisheries was carried out in 2014. This found that the programme was forward looking, viewed high quality innovative science as important and yet maintained the direction considered important by EZ. Through the KB programme EZ is able to carry out the statutory tasks and can develop science-based management. Through the KB programme the Netherlands has an international important science institute that cooperates with the industry, NGO's and international partners. Thus the KB WOT programme appears to utilise the expertise available to DLO on fisheries and look to the future research needs of society.
Describe collaboration with any partners outside WUR (national)	Close links through ICES, the EU STECF, PICES and FAO. Plus a network of marine researchers in Universities across Europe and North America.

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	Fisheries managers and research coordinators in EZ
Summary and Conclusions of Project	This project manages the KB WOT fisheries programme within the WUR KB 24 theme 'System Earth Management'. It has produced a report with the results of the programme in 2014 and a report with the proposed programme for 2016. Within the KB WOT Fisheries programme 14 projects in three different themes (1. Ecosystem approach to fishery management; 2. Maintaining Quality in data collection; 3. International Exchange of expertise) were granted at the start. One project for co-funding of an EU project did not proceed because the EU project was not granted. The 14 projects were carried out successfully. However, one project could not be carried out completely due to staffing problems. For this remaining budget a new project was started and carried out.
Dutch summary and conclusions	Dit project beheert het KB WOT visserij programma binnen het WUR KB 24 thema 'System Earth Management'. Er zijn twee rapporten gepubliceerd, met de resultaten van het programma uit 2014 en het geplande programma voor 2016. Binnen het KB WOT Visserij programma zijn er in 2015 in totaal 14 projecten toegekend in drie verschillende thema's (1. Ecosystem approach to fishery management; 2. Maintaining Quality in data collection; 3. International Exchange of expertise). Een van de projecten kon niet doorgaan omdat dit als co-financiering voor een EU-voorstel diende, welke niet is toegekend. De 14 projecten zijn succesvol uitgevoerd. Maar er was 1 project dat het budget niet helemaal kon opmaken vanwege personeel problemen, daarom is er voor het overblijvende budget een nieuw project opgestart en uitgevoerd.

INTERNATIONAL

Was the project part of an international network?	The management of the KB WOT fisheries programme is a national project. However, in preparing the planning of the yearly programme international collaboration is a major topic.
Who were the international partners?	None
Has the project been associated with international funding sources (EU, DGIS etc) or	One project was meant as co-funding for an EU-project. However, this EU-proposal was not granted.

research programmes?	
How much funding came from these sources?	None
How did the project position Wageningen Marine Research internationally?	The programme places Wageningen Marine Research in a strong position in fisheries and marine science.

Title	2. International exchange
Number	4311300002
Project leader	Cindy van Damme
Other researchers in WUR	Ingeborg de Boois, Lorna Teal, Karen van de Wolfshaar, Bob van Marlen, Ingrid Tulp, Sascha Fässler, Andre Dijkman-Dulkes, David Miller, Ineke Pennock, Ewout Blom, Hanz Wiegerinck
Researchers outside WUR	None
BAPS number	KB-14-012-064
Budget	143.775,-
Goals of project	To fund participation in international science networks and ICES meetings.
Target group for research	Wageningen Marine Research and ICES scientists and technicians and the fisheries science community.

PROGRESS 2015

Results	Main results: Wageningen Marine Research active participation and contribution to 17 international workshops and study groups on fisheries, fish ecology, stakeholder involvement, evolutionary effects of fishing, development of new survey methods and age reading organised by ICES. This brought in added value and technology transfer to the Netherlands. Wageningen Marine Research personnel participated in the following networks and ICES groups: Data and Information Group (DIG), Working Group on Integrative Physical-biological and Ecosystem Modelling (WGIPEM), Working Group on Fisheries-Induced Evolution (WGEVO), Workshop on the Value of Coastal Habitats for Exploited Species (WGVHES), Working Group on Fishing Technology and Fish (WGFTFB), Working Group on Electrical Trawling (WGELECTRA), Working Group on Fisheries Acoustics and Technology (WGFAST), Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR), Working Group on Cod and Plaice egg surveys in the North Sea (WGEGGS2), Working Group on Integrated Assessments of the North Sea (WGINOSE), Workshop on the ICES Egg and Larval Database (WKIELD), Working Group on Crangon Fisheries and Life History (WGCRAN), Report of the Working Group on Working Group on Biological Parameters (WGBIOP), Workshop on scrutinisation procedures for pelagic ecosystem surveys (WKSCRUT), Workshop on Maturity Staging of Mackerel and Horse Mackerel (WKMSMAC2), Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V), and Workshop on Egg staging, Fecundity and Atresia in Horse mackerel and Mackerel (WKFATHOM)
	Products: Second Interim Report of the Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR). ICES CM 2015/SSGIEOM:27, 15.IMA0224 Wageningen Marine Research nota WGISUR - 27-29 januari 2015 - Kopenhagen - IB-mw, Second Interim Report of the Working Group on Integrated Assessments of the North Sea (WGINOSE). ICES CM 2015/SSGIEA:06, Report of the Working Group on Integrative Physical-biological and Ecosystem Modelling (WGIPEM). ICES CM 2015/SSGIEA:01, 15.IMA0463 Wageningen Marine Research nota WGIPEM 16-20 maart 2015 Plymouth KW, Final Report of Working Group 2 on Cod and Plaice

	Egg Surveys in the North Sea (WGEGGS2). ICES CM 2015/SSGIEOM:26, Report of the Workshop on the ICES Egg and Larval Database (WKIELD). ICES CM 2015/SSGIEOM:33, 15.IMA0376 CVO nota WKIELD 27-29 April Copenhagen - C.v. Damme- lcs, Second Interim Report of ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB). ICES CM 2015/SSGIEOM:22, CVO/15.IMA0764- BvM-lcs, Report of the Working Group on Crangon Fisheries and Life History (WGCRAN). ICES CM 2015/SSGEPD:07, CVO/15.IMA0651.IT.mb, Report of the Data and Information Group (DIG). ICES CM 2015/SCICOM:02, 15.IMA0622 .IB.mb. Wageningen Marine Research memo DIG 18-20 May 2015, Second Interim Report of the Working Group on Fisheries Acoustics, Science and Technology (WGFAST). ICES CM 2015/SSGIEOM:21, 15.IMA0648 SMMF-bc, Report of the Working Group on the value of Coastal Habitats for Exploited Species (WGVHES). ICES CM 2015/SSGEPI:19, 15.IMA0652.KW.ro, First Interim Report of the Working Group on Working Group on Biological Parameters (WGBIOP). ICES CM 2015/SSGIEOM:08, Report of the Workshop on scrutinisation procedures for pelagic ecosystem surveys (WKSCRUT). ICES CM 2015/SSGIEOM:18, Report of the Workshop on Maturity Staging of Mackerel and Horse Mackerel (WKMSMAC2). ICES CM 2015/SSGIEOM:17, Report of the Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V). ICES CM 2015/ACOM:56, Report of the Workshop on Egg staging, Fecundity and Atresia in Horse mackerel and Mackerel (WKFATHOM). ICES CM 2015/SSGIEOM:01.
Did the work follow plans (science or financial)?	Yes, meetings were selected and attendance was planned.
Developed expertise	The developed expertise underpins Wageningen Marine Research research in technical measures, acoustic, fish identification, fish ecology, stock assessment methods, ageing and maturity determination in fish, pulse trawl, evolutionary effects of fishing, data provision, biodiversity and stock structure.
Science publications	Each group has produced a report which is published on the ICES website: http://www.ices.dk/community/groups/Pages/default.aspx
General publications	Besides the ICES reports, a Wageningen Marine Research nota is published after each meeting with the main findings of the meeting and results that are of importance for Wageningen Marine Research and the ministry of EZ.
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	None
What is relevant for EZ fisheries or ecosystem management?	Products and expertise central to the development and research of fisheries in the Netherlands.
Describe collaboration with any partners outside WUR (national)	Mostly across the North Atlantic marine science community but now also with FAO and with scientists from countries involved in PICES (Japan, Korea, China).

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Wageningen Marine Research active participation and contribution to 17 ICES lead workshops and study groups on fisheries, fish ecology, stakeholder involvement, evolutionary effects of fishing, development of new survey methods and age reading. This brought in added value and technology transfer to the Netherlands. Wageningen Marine Research personnel participated in the following networks and ICES groups: Data and Information Group (DIG), Working Group on Integrative Physical-biological and Ecosystem Modelling (WGIPEM), Working Group on Fisheries-Induced Evolution (WGEVO), Workshop on the Value of Coastal Habitats for Exploited Species (WGVHES), Working Group on Fishing Technology and Fish (WGFTFB), Working Group on Electrical Trawling (WGELECTRA), Working Group on Fisheries Acoustics and Technology (WGFAST), Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR), Working Group on Cod and Plaice egg surveys in the North Sea (WGEGGS2), Working Group on Integrated Assessments of the North Sea (WGINOSE), Workshop on the ICES Egg and Larval Database (WKIELD), Working Group on Crangon Fisheries and Life History (WGCRAN), Report of the Working Group on Working Group on Biological Parameters (WGBIOP), Workshop on scrutinisation procedures for pelagic ecosystem surveys (WKSCRUT), Workshop on Maturity Staging of Mackerel and Horse Mackerel (WKMSMAC2), Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V), and Workshop on Egg staging, and Fecundity and Atresia in Horse mackerel and Mackerel (WKFATHOM).
Dutch summary and conclusions	Wageningen Marine Research actieve deelname en bijdrage aan 17 ICES workshops en studiegroepen over de visserij, vis ecologie, belanghebbenden betrokkenheid, evolutionaire effecten van de visserij, de ontwikkeling van nieuwe onderzoeksmethoden en leeftijd aflezen. Dit bracht toegevoegde waarde en de overdracht van kennis en technologie naar Nederland. Personeel van Wageningen Marine Research heeft in 2013 deelgenomen aan onderstaande netwerken en ICES groepen: Data and Information Group (DIG), Working Group on Integrative Physical-biological and Ecosystem Modelling (WGIPEM), Working Group on Fisheries-Induced Evolution (WGEVO), Workshop on the Value of Coastal Habitats for Exploited Species (WGVHES), Working Group on Fishing Technology and Fish (WGFTFB), Working Group on Electrical Trawling (WGELECTRA), Working Group on Fisheries Acoustics and Technology (WGFAST), Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR), Working Group on Cod and Plaice egg surveys in the North Sea (WGEGGS2), Working Group on Integrated Assessments of the North Sea (WGINOSE), Workshop on the ICES Egg and Larval Database (WKIELD), Working Group on Crangon Fisheries and Life History (WGCRAN), Report of the Working Group on Working Group on Biological Parameters (WGBIOP), Workshop on scrutinisation procedures for pelagic ecosystem surveys (WKSCRUT), Workshop on Maturity Staging of Mackerel and Horse Mackerel (WKMSMAC2), Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE

	V), and Workshop on Egg staging, en Fecundity and Atresia in Horse mackerel and Mackerel (WKFATHOM).

INTERNATIONAL

Was the project part of an international network?	Yes, part of ICES.
Who were the international partners?	Institutes and universities from Australia, Belgium, Canada, Denmark (including Greenland and Faroe Islands), Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, the United Kingdom, and the United States of America. Plus links to FAO fisheries units.
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No, but this project underpins the research behind the Data Collection Framework (DCF) concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.
How much funding came from these sources?	None
How did the project position Wageningen Marine Research internationally?	Through this project Wageningen Marine Research scientists are able to exchange knowledge and science developments in the centre of the European network of fisheries research organisations.

Title	3. Fish ageing
Number	4311300003
Project leader	Loes Bolle
Other researchers in WUR	Peter v.d. Kamp, Ineke Pennock, André Dijkman, Jan Beintema, Marcel de Vries, Peter Groot, Kees Groeneveld, Betty van Os, Gerrit Rink, Thomas Pasterkamp, Norie v.d. Meeren, Margreth Roling
Researchers outside WUR	None
BAPS number	KB-14-012-065
Budget	60.308,-
Goals of project	Maintaining and developing quality of fish age determinations.
Target group for research	Fisheries scientists and marine ecologists.

PROGRESS 2015

Results	Main results: • International calibration: Sole exchange (coordinated by Wageningen Marine Research, 3 readers); herring exchange (1 reader); dab exchange (coordinated by Wageningen Marine Research & TI, 2 readers); dab workshop (WKARDAB2, co-chaired by Wageningen Marine Research & TI, 1 reader); horse mackerel workshop (WKARHOM2) participation cancelled due to illness reader (part of direct costs could not be refunded). • Education: Training of new age readers: blue whiting (almost completed), horse mackerel (almost completed), flounder (completed), lemon sole (just started), whiting (stopped, see task-sharing), greater argentine (almost completed), Norway pout (completed). • Task-sharing between ILVO & Wageningen Marine Research: ILVO will read NL-IBTS whiting otoliths • Other: sorting out problems (input errors & missing data) with age data from the IJsselmeer survey 2005-2014 • Other: contributed to funding of WebGR rescue plan (funds available due to cancellation of participation in horse mackerel workshop)
	Products: Results of international calibration exercises are documented in reports and summarised in the annual ICES WGBIOP report.
Did the work follow plans (science or financial)?	Yes
Developed expertise	Maintenance of key expertise fish ageing.
Science publications	
General publications	• ICES (2015) First Interim Report of the Working Group on Biological Parameters (WGBIOP), 7-11 September 2015, Malaga, Spain. ICES CM 2015/SSGIEON:08 • Report sprat exchange 2013 • Report whiting exchange 2014 • Report horse mackerel exchange 2014 • Report of the Workshop on Age reading of Horse Mackerel, Mediterranean Horse Mackerel and Blue Jack Mackerel (WKARHOM2), 26-30 October 2015, Santa Cruz de Tenerife, Spain. ICES CM 2015/SSGIEOM:14 Expected soon: • Report sole exchange 2015 • Report herring exchange 2015 • Dab exchange results 2015 are included in WK report • Report of Workshop on Age Reading of DAB (WKARDAB2), 17-20 November 2015, Hamburg, Germany.
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects –

	Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	No
What is relevant for EZ fisheries or ecosystem management?	Almost all population dynamic research carried by Wageningen Marine Research, whether for scientific publications or for fisheries management advice, is age structured. Hence maintenance of the expertise fish ageing is of great importance.
Describe collaboration with any partners outside WUR (national)	WGBIOP calls for international workshops and exchanges when considered necessary. Furthermore WGBIOP facilitates international collaboration and tuning of protocols for procedures, training and quality control.

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Key expertise fish ageing is crucial for all age structured population dynamic research, including stock assessments and hence fisheries management advice. Maintenance of this key expertise is achieved by international calibration, training and QA procedures.
Dutch summary and conclusions	De kernexpertise leeftijdsbepalingen van vissen is van essentieel belang voor alle leeftijds-gestructureerde populatie dynamisch onderzoek, zoals de toestandsbeoordelingen van visbestanden en daarmee de visserijadviezen. Onderhoud van deze kernexpertise wordt bewerkstelligd door internationale kalibratie, training en kwaliteitsborging.

INTERNATIONAL

Was the project part of an international network?	Yes. An international fish ageing network is established through the ICES Working Group on Biological Parameters (WGBIOP)
Who were the international partners?	Research institutes throughout Europe, that are involved in fish ageing (e.g. ILVO in Belgium, IFREMER in France, DTU Aqua in Denmark, TI in Germany, IMR in Norway, CEFAS and AFBI in the UK, The Marine Institute in Ireland).
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	Fish ageing performance contributes to the standing of Wageningen Marine Research within international (ICES) network. International coordination and calibration of fish ageing contributes to the quality of ICES work (e.g. stock assessments).

Title	4. FUSION (Fisheries information from using VMS and acoustics in combination)
Number	4311300004
Project leader	Sascha Fässler
Other researchers in WUR	Niels Hintzen, Sander Glorius and Bram Couperus
Researchers outside WUR	
BAPS number	KB-14-012-066
Budget	29.700,-
Goals of project	The project aimed to develop methods to infer pelagic fish biomass from VMS data. This was done using very high-resolution (±1 data point per second) spatial data of acoustic fish detections recorded on pelagic trawlers. These data were converted into VMS-like information (decrease tempo-spatial resolution) to test whether VMS analysis of fishing behaviour can be linked to the fish biomass/school structure detected by echosounders.
Target group for research	Fisheries scientists, marine spatial planners, fisheries managers and fishing industry.

PROGRESS 2015

Results	Main results: The project ued existing acoustic fishing vessel data sets which were resampled to mimic a VMS data set. Standard & enhanced VMS analysis methods (developed in this project) were used to link fisheries behaviour (spatial fishing activity) to the acoustic data. The analysis method then linked vessel activity to biomass and distribution of pelagic fish.
	Products: Programming code to analyse VMS & fishing vessel acoustic data.
Did the work follow plans (science or financial)?	Yes
Developed expertise	Spatial analysis methods to combine fishing fleet behaviour and fish biomass from acoustic and VMS information.
Science publications	Manuscript in preparation.
General publications	Short report.
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	No
What is relevant for EZ fisheries or ecosystem management?	EZ has an interest to implement the ecosystem approach to fisheries by use of practical meaningful indicators. The project investigated if these indicators can be provided in a simple, direct, objective, and repeatable manner.
Describe collaboration with any partners outside WUR (national)	None

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Moving towards an ecosystem approach increases the need for quantitative, direct, simple, and reliable methods to assess the abundance of fish resour-ces and the impacts of fishing activities on the ecosystem. Knowledge on estimating fish resource abundance from simple analyses of VMS could suffice, but it requires understanding of fisheries behavior related to fish biomass. This study links the understanding of VMS fisheries behaviour to acoustically observed fish abundance and biomass during fishing trips.
Dutch summary and conclusions	De transitie naar een ecosysteem benadering vereist quantitatieve, directe, simpele en betrouwbare methoden om de visstand en de impact van visserij op het ecosysteem te bepalen. Kennis over hoe van VMS een schatting verkregen kan worden van vis biomassa kan hierin volstaan, maar dit vereist een studie naar visserijgedrag in relatie tot visstand. Deze studie koppelt visserijgedrag, in kaart gebracht met VMS, aan visstand en biomassa die geobserveerd is met acoustische technieken gedurende een visreis.

INTERNATIONAL

Was the project part of an international network?	No
Who were the international partners?	
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	The results of this project are potentially interesting for international communities such as ICES or other areas of the world where the same methods (VMS information & acoustic fishing vessel data) are available. This includes areas where funds are limited to monitor pelagic fisheries in detail (such as the South Pacific).

Title	5. Underpinning Acoustics
Number	4311300005
Project leader	Sascha Fässler
Other researchers in WUR	Ben Scoulding, Bram Couperus, Dirk Burggraaf, Kees Bakker, Erwin Winter, Ben Griffioen, Dick de Haan and Daniel Benden.
Researchers outside WUR	None
BAPS number	KB-14-012-067
Budget	58.500,-
Goals of project	Acoustic methods are an important source of information for standard fish stock assessment but also for monitoring purposes of the wider ecosystem. In order to maintain the quality of the information provided, it is important to invest into the development and maintenance of hydroacoustic expertise within Wageningen Marine Research.
Target group for research	Pelagic ecosystem monitoring scientists and stock assessors.

PROGRESS 2015

Results	Main results: Organisation of the international BioAcoustics Day, contribution to ICES Acoustics Symposium and attendance of scrutinising workshop WKSCRUT. Products: Scientific publications, species identification library, further development of the trawl camera system.
Did the work follow plans (science or financial)?	Yes
Developed expertise	Pelagic ecosystem monitoring.
Science publications	Manuscripts in preparation: • Variability in Atlantic mackerel target strength and its effects on acoustic abundance estimates. • Methods for determining in situ target strength. Published papers: Van der Kooij, J., Fässler, S.M.M., Stephens, D., Readdy, L., Scott, B.E., and Roel, B.A. Opportunistically recorded acoustic data support Northeast Atlantic mackerel expansion theory. ICES Journal of Marine Science. doi: 10.1093/icesjms/fsv243. • Trenkel, V.M., Lorance, P., Fässler, S.M.M. and Høines, Å.S. Effects of density dependence, zooplankton and temperature on blue whiting *Micromesistius poutassou* growth. Journal of fish biology 87 (4), 1019-1030.
General publications	
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	No
What is relevant for EZ fisheries or ecosystem	Maintaining and developeing the quality of pelagic monitoring work for the statutiry tasks (WOT and DCF).

management?	
Describe collaboration with any partners outside WUR (national)	Through the BioAcoustics Day.

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Underpinning Acoustics is part of a multiannual project that aims to maintain and develop hydroacoustic survey techniques. In the process of moving towards integrated ecosystem monitoring there is a need for consistent and efficient characterisation of different ecosystem components. The project makes use of existing acoustic data to build up an identification library of pelagic ecosystem components.
Dutch summary and conclusions	Dit onderzoek is onderdeel van een meerjarig project dat fundamenteel is gericht op handhaving en ontwikkeling van akoestische onderzoekstechnieken. In het streven naar geïntegreerde ecosysteem monitoring is er een behoefte aan consistente en efficiënte karakterisatie van verschillende ecosysteem componenten. Het project maakt gebruik van bestaande visserij-akoestische gegevens om een identificatie-bibliotheek van pelagische ecosysteem componenten op te bouwen.

INTERNATIONAL

Was the project part of an international network?	Relevant partners in the ICES network.
Who were the international partners?	IMR, IFREMER, CEFAS, Marine Scotland and Marine Institute Ireland.
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	The project helped to maintain and raise the Wageningen Marine Research active acoustics profile on a national and international level.

Title	6. Improved accuracy and error estimates in shellfish stock assessments
Number	4311300006
Project leader	Karin Troost
Other researchers in WUR	Johan Craeymeersch, Margriet van Asch and Chun Chen
Researchers outside WUR	None
BAPS number	KB-14-012-068
Budget	49.730,-
Goals of project	Annually the stocks of fished bivalve species are estimated in Dutch coastal waters, the Wadden Sea, the Oosterschelde and the Westerschelde (WOT Schelpdieronderzoek). Within the same program, mussel and oyster beds are mapped, and the area estimated, annually in spring throughout the entire Wadden Sea. Although much effort is done to keep the accuracy high, there are items where further improvement might be reached. The objectives of this project were: a. Optimize the stratified grid so that a trend-break is avoided, and the grid is suitable for stock assessments of multiple species. b. Improve knowledge on the behaviour of different dredge configurations and understand the differences in gear efficiency, leading to an optimization of the dredge and eventual consequences for changing gears. c. Optimize the variance estimation of stock assessments. d. Estimate the uncertainty of mussel bed area assessments
Target group for research	Ministries of EZ and I&M and companies obliged to perform North Sea impact assessments.

PROGRESS 2015

Results	Main results: a. New stratification did not result in smaller variance. Thus, the present stratification should be kept for now. b. The modified dredge had better bottom contact, as expected. However, for many species the average number per litre of sample and per square meter of seafloor were significantly lower for the modified dredge then for the traditional dredge. We could not make conclusions yet what mechanism caused the observed differences. Therefore, the traditional dredge will be maintained in the WOT surveys. c. In this study we compared three alternative variance estimators: the estimator for simple random sampling, and estimator using bootstrapping, and an estimator following a model-based approach. The second one is the one used at present. Overall, the estimates do not differ very much. Thus, at least for the two species investigated (*Ensis directus* and *Spisula subtruncata*), there seems to be no need to follow a model-based approach. However, the influence of spatial autocorrelation is likely much larger for stock assessments at a much smaller scale. d. In this report we tried to get some insights about the accurateness of the mussel bed mapping in the Dutch Wadden Sea. Error might be due to GPS error,

	individual differences in demarcating the contours, and errors due to need for reconstruction of not visited beds. First impression is that error is rather small.
	Products: Reports in preparation.
Did the work follow plans (science or financial)?	Yes
Developed expertise	Improved skill in error estimates on different types of survey data.
Science publications	Reports in preparation: • Chen, C., Troost, K. van Asch, M. and Craeymeersch J.A. 2016. Coastal shellfish survey WOT: update stratification. • Troost, K., Perdon, J., Jol, J. and Craeymeersch, J.A. 2016. Efficiency of sampling gears. Results of a comparison between two versions of the towed bottom dredge. • Craeymeersch, J.A., Troost, K. and van Asch, M. 2016. Variance estimating in Dutch shellfish stock assessments. • Craeymeersch, J.A., Troost, K., van Stralen, M., van den Ende, D., and van Zweeden, C. 2016. Accurateness of mussel bed mapping. Some first thoughts.
General publications	
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	No
What is relevant for EZ fisheries or ecosystem management?	The results will increase accuracy, and variance estimation, of the annual WOT shellfish surveys. And also indirect relevance through impact assessments.
Describe collaboration with any partners outside WUR (national)	None

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Annually the stocks of fished bivalve species are estimated in the Dutch coastal waters, the Wadden Sea, the Oosterschelde and the Westerschelde (WOT Schelpdieronderzoek). Within the same program, mussel and oyster beds are mapped, and the area estimated, annually in spring throughout the entire Wadden Sea. Although much effort is done to keep the accuracy high, there are items where further improvement might be reached. Within this project we focused on a) a possible improvement of the stratification used in the coastal surveys, b) a comparison of two type of dredges, of which one is currently used for WOT surveys, c) different methods of variance estimation and d) accuracy of the mussel bed mapping. New stratification designs did not result in larger accuracy and, therefore, present stratification will not be changed. Overall, the present method to estimate variation, i.e. bootstrapping, is fine. First impression is that mussel mapping is accurate. The two types of dredges result in different estimates

	of the density of several species. However, the mechanism causing these differences, is not understood and need further research.
Dutch summary and conclusions	Jaarlijks worden de bestanden van commercieel geëxploiteerde schelpdieren in de kustzone, de Waddenzee, de Westerschelde en de Oosterschelde geschat (WOT Schelpdieronderzoek). Er wordt veel aandacht besteed aan de nauwkeurigheid van deze schattingen. In het kader van dit project is nagegaan of a) er een betere stratificatie in de kustzone mogelijk is, b) in hoeverre de schattingen bij gebruik van 2 types bodemschaven, waarvan een op dit moment gebruikt voor WOT, verschillen, c) in hoeverre de manier waarop momenteel de variantie geschat wordt (bootstrapping) adequaat is, en d) hoe nauwkeurig de schatting van het areaal mosselbanken in de Waddenzee is. Het project heeft niet geresulteerd in een betere stratificatie, d.w.z. resulterend in kleinere confidentie-intervallen. Dus zal de huidige opzet vooralsnog verder gevolgd worden. Bootstrapping blijkt een geschikte manier om de variantie te schatten, in ieder geval voor een schatting van het bestand in de gehele kustzone. De twee type bodemschaven resulteren in verschillende schattingen. We begrijpen helaas niet waarom, en verder onderzoek is daarom nodig. In kader van WOT zal vooralsnog de tot op heden gebruikte schaaf verder gebruikt worden.

INTERNATIONAL

Was the project part of an international network?	No
Who were the international partners?	
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	Maintain a leading position in monitoring of shellfish (and benthos). This will attract interest for international cooperation e.g. in EU projects (EMODnet).

Title	7. Validation of discard data from the Dutch self-sampling program
Number	4311300007
Project leader	Ruben Verkempynck
Other researchers in WUR	Chen Chun, Edwin van Helmond and Karin van der Reijden.
Researchers outside WUR	Sebastian Uhlmann (ILVO)
BAPS number	KB-14-012-069
Budget	33.440,-
Goals of project	Gain better insight in datasets collecting in the Dutch demersal discards programme for potential of using datasets for validation. The goal of this study is to investigate bias and consistency in sampling discards from hauls between the two sampling methods (observer and self-sampling) from the co-sampled hauls.
Target group for research	Researchers using discard and monitoring data.

PROGRESS 2015

Results	Main results: A better insight in the potential of self-sampling data compared to observer data for validation methods for counts of numbers of 37 species.
	Products: Draft manuscript.
Did the work follow plans (science or financial)?	Financially plans were followed, scientifically plans did not deviate from methods proposed in the proposal.
Developed expertise	Insight in potential of self-sampling and observer-collected data.
Science publications	Draft manuscript.
General publications	
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	No
What is relevant for EZ fisheries or ecosystem management?	Better and efficient collection of discard data.
Describe collaboration with any partners outside WUR (national)	None

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Matched trips were compared for number of species and detectability, total number and mean length of fish, and benthos numbers. Observers scored less on number of sampled species compared to self-sampling data. 37 species were observed in observer data. For some fish species number and mean length was

	significantly different over collection methods. A better insight in the potential of observer data for validation methods can be derived. A manuscript for submission to a peer-reviewed journal was drafted.
Dutch summary and conclusions	Gekoppelde reizen werden vergeleken op basis van het aantal soorten, het totale aantal en de gemiddelde lengte van vis, en benthos aantallen. Opstappers detecteerden minder bemonsterde soorten vergeleken met de self-sampling data; 37 soorten werden ontdekt in de opstappers data. Sommige vissoorten weken significant af in aantallen en gemiddelde lengte over de opstappers en self-sampling data. Een beter inzicht in het potentieel gebruik van opstappersdata voor validatie kan ontwikkeld worden. Een eerste versie van manuscript voor publicatie in een wetenschappelijk tijdschrift werd geschreven.

INTERNATIONAL

Was the project part of an international network?	Yes, cooperation with ILVO.
Who were the international partners?	Sebastian Uhlmann (ILVO).
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	Wageningen Marine Research is leading in the development and use of self-sampling for discard monitoring.

Title	8. Seeing the forest for the trees
Number	4311300008
Project leader	Jan Jaap Poos
Other researchers in WUR	Peter van der Kamp Niels Hintzen
Researchers outside WUR	None
BAPS number	KB-14-012-070
Budget	11.240,-
Goals of project	Developing automated scripts for summarizing and displaying fisheries dependent data.
Target group for research	Wageningen Marine Research scientists.

PROGRESS 2015

Results	Main results: Figures and tables depicting effort and landings for different fishing metiers in Wageningen Marine Research report style.
	Products: Documented R script that generates figures and tables depicting effort and landings for different fishing metiers.
Did the work follow plans (science or financial)?	Yes, but no discards were added to the report.
Developed expertise	Automated report generation in R and Sweave.
Science publications	None
General publications	Pdf file for Wageningen Marine Research internal use with summary of fisheries dependent data (effort and landings).
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	None
What is relevant for EZ fisheries or ecosystem management?	A generally available overview of effort and landings from the different metiers can help as a check for future data extraction routines. The results thus aid in quality assurance for the fisheries advice.
Describe collaboration with any partners outside WUR (national)	None

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	This project developed computer code for a standardized report with basic information about the development of the Dutch fishing fleet in terms of fishing effort and landings. This basic information provides an overview of the developments in Dutch fisheries.☐
Dutch summary and	In dit project is computer code ontwikkeld die een standaard rapportage maakt

conclusions	met informatie over de ontwikkelingen van de Nederlandse visserij in termen van visserij inspanning en aanlandingen. De resultaten in de rapportage kunnen gebruikt worden om een overzicht te krijgen van de ontwikkelingen in de Nederlandse visserij.

INTERNATIONAL

Was the project part of an international network?	No
Who were the international partners?	None
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	

Title	9. Development of automated data upload to DATRAS
Number	4311300009
Project leader	Ingeborg de Boois
Other researchers in WUR	Peter van der Kamp and Daniël Benden
Researchers outside WUR	Vaishav Soni (ICES)
BAPS number	KB-14-012-071
Budget	19.410,-
Goals of project	Facilitate easy synchronisation of ICES survey database DATRAS from Wageningen Marine Research database Frisbe, without as little manual handling as possible.
Target group for research	International marine scientists working with the DATRAS data.

PROGRESS 2015

Results	Main results: The data can be extracted from Frisbe in the correct format using SQL language that can be incorporated in the database to fully automate the process. Both databases can communicate with each other and Frisbe can detect which data should be updated in DATRAS.
	Products: • SQL scripts for data extraction of Frisbe in DATRAS format • Software for communication between DATRAS (ICES) and Frisbe (Wageningen Marine Research) to detect inconsistencies between last change in Frisbe and last upload in DATRAS • Software in Frisbe to detect which datasets should be updated • Software for communication between DATRAS (ICES) and Frisbe (Wageningen Marine Research) for uploading purposes – to be tested early 2016
Did the work follow plans (science or financial)?	Due to late agreement on KB WOT Fisheries finances the project did only start by the end of Q1. The late final decision on the KB WOT Fisheries finances made it difficult for ICES Data Centre to fully plan the work for 2015. It was decided that during 2015 the Wageningen Marine Research facilities will be developed, and that the final implementation within ICES scheduled for early 2016.
Developed expertise	Knowledge on the communication between databases in general, and between Frisbe and DATRAS in particular. Knowledge on the SQL extraction of data from Frisbe in DATRAS format. Nothing specifically has been developed for the market, although the obtained knowledge can and will also be used to develop automated submission of Wageningen Marine Research data to other data portals as well as resubmission of DATRAS data in other countries.
Science publications	
General publications	
Other outputs	Impact analysis describing the steps to be taken to incorporate automated resubmission to DATRAS in Frisbe. Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	No
What is relevant for	Upload to international databases is one of the criteria for the statutory task

EZ fisheries or ecosystem management?	surveys. Although there are no criteria on the data quality, it is assumed that data quality has to be as good as possible, and updates should be applied to all databases as soon as possible. Wageningen Marine Research WOT survey data (BTS, IBTS, and in near future also DYFS and SNS) are stored at ICES, in the ICES Database on Trawl Surveys (DATRAS). As the information is also stored in the Wageningen Marine Research database Frisbe, all minor revisions in Frisbe should be corrected in DATRAS too. This is currently however not easily possible, as data to DATRAS have to be submitted manually, and only complete sets by survey, year and quarter including all data types (haul, length and age information) can be submitted. The current system leads to major differences between the two datasets. The new system will lead to coherent and up to date sets.
Describe collaboration with any partners outside WUR (national)	No national collaboration, only international (ICES).

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Dutch survey data are stored at Wageningen Marine Research (Frisbe) and at the ICES Data Centre (DATRAS), but due to the complexity of the current re-submission methodology it is time-consuming to update DATRAS after every small modification in Frisbe. This project should result in near real-time automated updates to DATRAS. Within this project software has been developed to let both databases communicate with each other. During 2016 the system will be operationalised.
Dutch summary and conclusions	Op dit moment worden Wageningen Marine Research WOT survey data opgeslagen op Wageningen Marine Research (Frisbe) en bij ICES (DATRAS). Door de huidige methode van aanleveren van updates aan DATRAS is het niet mogelijk om iedere kleine wijziging in Frisbe snel door te voeren in DATRAS. Dit project moet resulteren in een bijna real-time update van DATRAS op het moment gegevens in Frisbe zijn gewijzigd. Gedurende het project is software ontwikkeld om beide databases met elkaar te laten communiceren. In de loop van 2016 zal het systeem operationeel zijn.

INTERNATIONAL

Was the project part of an international network?	Yes
Who were the international partners?	ICES
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No

How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	The results of the exercise will be presented in the ICES data and Information Group (DIG). The contact between ICES data centre and Wageningen Marine Research has extended, and Wageningen Marine Research is more visible as a reliable partner for database improvements.

Title	10. SPI-FISH: Benthic impacts of fishing trawls
Number	4311300010
Project leader	Lorna Teal
Other researchers in WUR	Daniel Benden
Researchers outside WUR	None
BAPS number	KB-14-012-072
Budget	31.200,-
Goals of project	The objective is to develop and assess the use of sediment profile imaging (SPI) as a tool for studying trawl impacts and establish the effects of trawling on the sediment mixing depth (MDI; Teal *et al*. 2010). MDI serves as a proxy for sediment function (carbon and nutrient cycles). An increase/decrease in sediment mixing depth can be associated with an increase/decrease in the magnitude of benthic nutrient fluxes/carbon cycling. Specifically the project aims to: 1) develop image analysis software for objective and quantitative assessment of sediment profle images 2) describe and compare acute effects of three gears (beam, pulse, shrimp) on the MDI at two contrasting sites 3) combine SPI results with benthic sampling and multi beam data for a more complete picture of the impacts and to to assess the use of SPI as a rapid assessment tool of seabed function (useful for MSFD).
Target group for research	Science and Policymakers, fishing gear technologists and fishing sector.

PROGRESS 2015

Results	Main results: A user-friendly SPI image analysis software was developed which has been applied to recently collected SPI images to look at effects of beam and pulse trawling on the seabed. Whilst the images have been analysed, the main results will be available once these have been put into context alongside other data (multibeam, benthic sampling) which is expected in 2016 (via collaboration with ILVO). A meeting to map out a manuscript is planned in March 2016.
	Products: Software ready to use for analysing SPI images.
Did the work follow plans (science or financial)?	The work closely followed plans but did not complete all the steps (step 3), mainly due to the wait on other data to be provided by other institutes. The project was completed within the financial budget provided.
Developed expertise	Image analysis expertise further developed. First real SPI image analysis software developed.
Science publications	Manuscript to be submitted in 2016.
General publications	
Other outputs	SPI image analysis software. Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	None
What is relevant for EZ fisheries or	The outcomes of the analysis and the planned manuscript on effects of beam and pulse trawls on the seabed will be of interest to the EZ.

ecosystem management?	
Describe collaboration with any partners outside WUR (national)	SPI data was collected on board the VLIZ vessel Simon Stevin in collaboration with ILVO and linked to EU project BENTHIS. The results will be combined with data from ILVO (fieldwork collaboration) into a manuscript.

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Recent fieldwork studies have shown that it is difficult to assess the acute impact of trawl gear on benthic organisms. However trawl gear may also impact the benthic system in other indirect ways, changing the sediment environment and disrupting biogeochemical cycling. Here we explored the potential of using the SPI camera as a rapid assessment tool of benthic impacts. Whilst collecting data with SPI is a rapid process, the method has been limited by the time-consuming and subjective process of image analysis. The main objective achieved in this project was to develop software for analysis of SPI images. The software is user-friendly and aims to make the process of image analysis less subjective than it has been in the past, adding considerable potential to the SPI method. SPI images collected in the field showed clear effects of trawling on the sediment and also differences between tickler chains and pulse fishing methods. Final conclusions related to trawling impacts can be drawn once additional data (multibeam, sediment characteristics) becomes available (manuscript expected in 2016).
Dutch summary and conclusions	Recente veldwerkstudies hebben laten zien dat het moeilijk is om te beoordelen wat de directe invloed is van visnetten op de bentische organismen. Maar misschien hebben de vistuigen ook een ander indirect effect op de bentische systemen, zoals het veranderen van het sediment en het verstoren van de biochemische cyclus. In dit onderzoek hebben we de mogelijkheid van het gebruik van de SPI camera onderzocht, om als snelle beoordelingsmethode voor de gevolgen op het benthos te dienen. Hoewel het verzamelen van gegevens met de SPI camera heel snel gaat, wordt de analyse van de gegevens gehinderd door een tijdrovende subjectieve beoordeling van de beelden. Het voornaamste resultaat van dit project was de ontwikkeling van software voor automatische beeldanalyse. Deze software is gebruiksvriendelijk en resulteert in een minder subjectieve analyse waardoor het een belangrijk voordeel biedt aan het gebruik van de SPI methode. De tijdens het veldonderzoek verzamelde SPI beelden lieten zien dat er duidelijke effecten op het sediment zijn en ook dat er verschil is tussen tuig met wekkerkettingen en puls tuig. De definitieve conclusie kan pas geformuleerd worden als andere gegevens (multibeam, sediment karakteristieken) beschikbaar komen. (publikatie wordt verwacht in 2016).

INTERNATIONAL

Was the project part of an international network?	No. However, the project made use of data collected under EU FP7 project BENTHIS and the output will contribute to results of BENTHIS.
Who were the international partners?	All fieldwork was carried out in collaboration with ILVO.

Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	EU FP7 project BENTHIS.
How much funding came from these sources?	The fieldwork was funded by BENTHIS.
How did the project position Wageningen Marine Research internationally?	Wageningen Marine Research is leading in the development of software to automate analyses of sediment profile images.

Title	11. Unravelling the hidden in SAM
Number	4311300011
Project leader	Thomas Brunel
Other researchers in WUR	David Miller and Niels Hintzen
Researchers outside WUR	Einar Hjorleifsson
BAPS number	KB-14-012-073
Budget	15.840,-
Goals of project	Understanding the mechanics of the statistical model used for the assessment of fish stocks, focussing particularly on the process error.
Target group for research	Stock assessment experts and fisheries managers.

PROGRESS 2015

Results	Main results: Definitions of indicators to quantify the process error. Analysis of the trade-off in SAM between the process error and other parameters or characteristics of the assessment. Recommendations on how to use indicators of the process error when setting up a SAM assessment.
	Products: A R function in the FLSAM library (freely available on internet) to compute descriptors of the process error. A report of the main activities and findings of the project.
Did the work follow plans (science or financial)?	Yes
Developed expertise	Understanding of the mechanics and trade-offs in SAM allowing for a more critical review of the quality of a SAM assessment.
Science publications	Not yet but the results will be discussed with other SAM experts to see if they are worth publishing.
General publications	
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	No
What is relevant for EZ fisheries or ecosystem management?	Awareness of the need to consider the process error in SAM assessments.
Describe collaboration with any partners outside WUR (national)	None

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None

Summary and Conclusions of Project	The project looked into the importance of the process error in SAM through 1) a comparison of SAM assessments for a range of fish stocks and 2) a sensitivity analysis of the influence of the process error in a selection of assessments. The results show that the magnitude of the process error and the amount of correlation in the process error varied among stocks, and were unrelated with each other. Large process error is observed when the assessments produce a good fit to the catch data, indicating that a good fit to the catches is not a guarantee of good assessment since all the variability might be hidden in the process error. It was also found that large process error was generally associated with large assessment uncertainty. Finally, the importance of the correlation structure could not be explained. It is considered that it is a sign that the model is unable to accommodate for some trend (spurious or real) in the data, and moves it to the process error, but this could not be demonstrated.
Dutch summary and conclusions	Het project heeft gekeken naar de invloed van een procesfout in SAM door 1) een vergelijking van SAM toestandsbeoordelingen bij verschillende visbestanden en 2) een gevoeligheidsanalyse van de invloed van de procesfout in een selectie van de toestandsbeoordelingen. De resultaten laten zien dat de grootte van de procesfout en de hoogte van de correlatie in de procesfout varieerde tussen de bestanden en niet aan elkaar gerelateerd waren. Grote procesfouten zijn gevonden als de toestandsbeoordelingen goed passen bij de vangstdata. Dit is een indicatie dat een goede relatie met de vangstdata niet altijd de garantie geeft tot een goede toestandsbeoordeling omdat afwijkingen verborgen kunnen zijn in de procesfout. Er is ook gevonden dat een grote procesfout vaak gerelateerd is met een grote toestandsbeoordelingsonzekerheid. Tot slot, de belangrijkheid van de correlatiestructuur kan niet verklaard worden. We denken dat dit een teken is dat het model niet in staat is om een trend in de gegevens te ondersteunen (twijfelachtig of echt) en het daardoor verplaatst naar de procesfout. Maar dit kon niet aangetoond worden.

INTERNATIONAL

Was the project part of an international network?	No
Who were the international partners?	Einar Hjorleifsson IMR, Iceland.
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	None
How did the project position Wageningen Marine	Wageningen Marine Research is one of the few institutes with increased understanding of this complex but widely applied assessment model.

Research internationally?	

Title	12. RIBS (Relationships between intertidal benthos and shrimp fisheries in the Wadden Sea and the Dutch coastal zone)
Number	4311300012
Project leader	Ingrid Tulp
Other researchers in WUR	Niels Hintzen, Johan Craeymeersch, Sander Glorius, Margriet van Asch and Karin Troost
Researchers outside WUR	None
BAPS number	KB-14-012-074
Budget	38.090,-
Goals of project	Investigate the spatial relationships between shrimp fisheries effort and fishing intensity and trends in benthic community development, hereby accounting for variation caused by abiotics.
Target group for research	Policy makers, NGO's and scientific world.

PROGRESS 2015

Results	Main results: This project achieved three things: 1) A functioning dataset on the distribution of shrimp fishing in the Wadden Sea and coastal area for the period 2006-2014. 2) A corrected database on the occurrence of 1 year old shellfish. 3) An analysis of the potential effect of sweeping the sea floor by shrimp nets on the settlement of mussels. Because of a lack of spat fall (2011 and 2012) and lack of black box data on the distribution of mussel seed fishing this analysis was limited to three years. In 2 out of 3 years a negative effect of shrimp fishing on the occurrence of young mussels was found and in one year a positive effect. Because of the limited number of years and large year to year variation in settlement locations, no definite conclusions can be drawn, but we will continue the work and extend the time series with 3 years by making the black box data available.
	Products: Manuscript in preparation.
Did the work follow plans (science or financial)?	Yes
Developed expertise	VMS data use for shrimp fisheries was greatly improved, and the time series extended by hindcasting.
Science publications	Manuscript for submission to a peer reviewed journal is in preparation.
General publications	
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	Beheer garnalenvisserij.
What is relevant for EZ fisheries or ecosystem management?	Shrimp fisheries is economically one of the most important fisheries in the Netherlands and carried out largely in Natura2000 sites. Yet, the effect of shrimp fisheries on the benthos community has received little research attention. In this project we used the information of the mussel survey carried out in spring and VMS data to investigate the relationship between shrimp fisheries and the potential settlement of shellfish. We wanted to test the hypothesis that the regular

	and intense sweeping of the sea floor by shrimp nets may prevent the intertidal settlement of shellfish larvae and disturb the development of intertidal musselbanks.
Describe collaboration with any partners outside WUR (national)	None

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	In this project we used and reworked three different dataset: 1. VMS data for the shrimp effort was aggregated for the period 2006-2014 based on a smart combination of datasets thereby circumventing the lack of detailed logbook data in the period before 2010. Now we have a full dataset for the whole distribution area of the Dutch shrimp fleet in this period. 2. Data from the intertidal mussel survey were checked, corrected if necessary and completed (in the case of broken shells, biomass had to be estimated). In 2011 and 2012 there was no spat fall, so these years were excluded from the analysis. 3. Black box data were used to derive mussel seed fisheries. These events were excluded prior to the analysis. Only for the years 2010, 2013 and 2014 these data were available in the right format. In the analysis (limited to 2010, 2013 and 2014) we tried to explain the presence/absence of 1 year old mussels by the intensity of shrimp fishing in the previous year and water depth. In two years (2010, 2013) we found that the probability of encountering mussels decreased with increasing fishing intensity, in 2014 the relationship was reversed. Year to year variation in the distribution of settlement was highly variable, therefore the analysis would benefit from the inclusion of more years (2006-2009). We will proceed first with trying to include these years.
Dutch summary and conclusions	In dit project hebben we drie verschillende datasets gebruikt en bewerkt. 1. VMS data voor de garnalenvloot is samengesteld voor de periode 2006-2014 door het slim combineren van drie verschillende datasets. Hiermee is het probleem omzeild dat alleen vanaf 2010 de logboekdata volledig genoeg zijn ingevuld. Nu hebben we een gebiedsdekkend beeld van de activiteit van de Nederlandse garnalenvloot over de Waddenzee en kustzone in deze periode. 2. De data van de intergetijde mosselsurvey zijn gecheckt, en waar nodig gecorrigeerd en aangevuld (in het geval van gebroken schelpen moest de biomassa geschat worden). 2011 en 2012 waren jaren zonder zaadval, deze jaren zijn uit de analyse gelaten. 3. Black box data van de mosselzaadvisserij zijn gebruikt om gebieden die bevist zijn te identificeren en uit te sluiten voor de analyse. Alleen voor 2010, 2013 en 2014 waren deze data in een opgewerkte vorm beschikbaar. In de analyse hebben we geprobeerd om de aan- of afwezigheid van eenjarige mosselen in het voorjaar te verklaren aan de hand van de visserij intensiteit in het voorafgaande jaar en waterdiepte. In twee jaren (2010 en 2013) vonden we dat

	de kans op vestiging van mosselen lager was op intensiever beviste plekken dan op minder intensief beviste plekken. In 2014 was die relatie omgekeerd. Er bleken grote verschillen in de plekken waar van jaar op jaar eenjarige mosselen werden aangetroffen. Daarom proberen we nu om de jaren waarvan de black box gegevens nog ontbreken (2006-2009) alsnog toe te voegen, om zo hopelijk een duidelijker beeld te krijgen.

INTERNATIONAL

Was the project part of an international network?	No
Who were the international partners?	None
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	This project was focussed on the Dutch Wadden Sea and coastal area, but results and the approach taken in the project are of high interest for other shrimp fishing countries.

Title	13. An assessment of a currently used method to stun and kill fish during surveys
Number	4311300013
Project leader	Hans van de Vis
Other researchers in WUR	Olvin van Keeken (Wageningen Marine Research) and Marien Gerritzen (Wageningen Livestock Research).
Researchers outside WUR	None
BAPS number	KB-14-012-075
Budget	35.091,-
Goals of project	The Dutch law on the protection of experimental animals requires that fish are stunned and killed with minimal discomfort to collect tissues for analysis (Anonymous, 2016). For statutory tasks (WOT), fish are collected during surveys at sea. On board otoliths are extracted from the heads of fish to determine their age. Prior to the extraction of otoliths, the fish brains are cut with a knife for stunning and killing. However, no reported studies are available whether the application of a cut through the brains can be applied effectively. The issue is whether or not the cut results in an immediate and irrecoverable loss of consciousness, i.e. minimal discomfort. It is known that other mechanical methods that result in brain damage of fish can induce an immediate and irrecoverable loss of consciousness. Behavioural responses only cannot be used as robust indicator for loss of consciousness, as these data need to be interpreted with caution. Major species used by Wageningen Marine Research in stock assessment are plaice (*Pleuronectes platessa*), sole (*Solea solea*) and dab (*Limanda limanda*). We therefore, decided to focus our pilot evaluation on the current procedure to extract otoliths from these species.
Target group for research	The audience comprise institutes in the Netherlands and Sweden that study live fish in the field, and ethical committees in these countries.

PROGRESS 2015

Results	Main results: 8 plaice, 8 sole and 7 dab were available and used for the project.
	Products: a report with results and recommendations.
Did the work follow plans (science or financial)?	Yes
Developed expertise	Knowledge on the effect the stunning and killing before the biological sampling of flatfish and the effect this has on the fish.
Science publications	Wageningen Marine Research confidential report.
General publications	
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	None
What is relevant for EZ fisheries or ecosystem management?	It is relevant to assess whether the current method used for stunning and killing of fish before collecting biological samples is in agreement with the Dutch law on the use of animals in experiments.
Describe	We collaborated with Wageningen Livestock Research, Wageningen UR (Marien

collaboration with any partners outside WUR (national)	Gerritzen) for interpretation of EEG and ECG data.

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	The procedure used by Wageningen Marine Research to stun and kill fish before extracting otoliths and other biological samples from plaice (*Pleuronectes platessa*), sole (*Solea solea*) and common dab (*Limanda limanda*) was assessed by registration of EEG's and ECG's and observation of behaviour. Results of this project are currently being analysed.
Dutch summary and conclusions	De huidige methode die Wageningen Marine Research gebruikt om vis te bedwelmen en te doden voor otolieten uit schol (*Pleuronectes platessa*), tong (*Solea solea*) en schar (*Limanda limanda*) te halen is geanalyseerd met behulp van registratie van EEG's en ECG's, en observatie van gedrag. Resultaten van dit onderzoek worden momenteel verder uitgewerkt.

INTERNATIONAL

Was the project part of an international network?	No
Who were the international partners?	
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	It is relevant to assess whether the current method for stunning and killing of fish is in agreement with the (inter)national law on the use of animals in experiments.

Title	14. CLUPID: Clupeoid larvae identification
Number	4311300014
Project leader	Cindy van Damme
Other researchers in WUR	Ineke Pennock and Ruben Hoek
Researchers outside WUR	Norbert Vischer (UVA) and Raoul Kleppe (student CAH Vilentum Almere)
BAPS number	KB-14-012-076
Budget	34.000,-
Goals of project	To improve clupeoid larvae identification and establish a means of quality control of the identification.
Target group for research	Ichthyoplankton scientists and image analyses users.

PROGRESS 2015

Results	Main results: Currently clupeoid larvae identification is done by counting myotomes from head to tail under a dissecting microscope. It is difficult to assess where to start and where to stop counting. At the start of the project we tried to find various measurements, e.g. head length, position of the pylorus or anus. These did not prove to be useful in identification in image analyses. Because it is difficult to count the myotomes right after the head and at the tail end a method was developed to identify part of the larvae and count numbers of myotomes in that part. An ImageJ macro was developed in which semi-automated larvae can be measured. Due to fixation in formaldehyde larvae are bent. By putting some points over the length of the larvae from the nose to the tail tip length is measured. Based on the total length, the part from 30% of the total length to 60% of the total length is identified. In this part the number of myotomes are counted and measured automatically. Unfortunately this number of myotomes is not a measure to distinguish between the clupeoid larvae herring, sprat and pilchard. Sprat has a much lower number of myotomes compared to herring and pilchard, but the latter two species overlap in number and size of the myotomes. The macro does give the possibility to store individual larvae for quality control.
	Products: ImageJ macro for semi-automated measurement of fish larvae and counting of myotomes in 30-60% of the body length.
Did the work follow plans (science or financial)?	Yes, but due to the late agreement of the larger WUR KB themes, this project could not start before March.
Developed expertise	Clupeoid larvae identification and development of ObjectJ macros for ImageJ. Nothing has been developed for the market, but ObjectJ macros are freeware available on the ObjectJ website.
Science publications	None
General publications	
Other outputs	Presentation for the Wageningen Marine Research KB WOT results 2015 projects – Wageningen Marine Research mini symposium.
Any links to Wageningen University projects?	No

What is relevant for EZ fisheries or ecosystem management?	Each year four herring larvae surveys are carried out under the WOT Fisheries programme for the North Sea herring assessment. For these surveys approximately 100.000 clupeoid larvae are caught and of these 12.500 individual larvae need to be identified to species. The developed macro provides a means for quality control of the clupeoid larvae identification and length measurements, however it cannot be used to distinguish herring from pilchard larvae.
Describe collaboration with any partners outside WUR (national)	Norbert Vischer from the UVA developed the ImageJ macro.

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Each year four herring larvae surveys are carried to assess North Sea herring spawning stock biomass and recruitment. These surveys are part of the statutory tasks of the Netherlands. In the samples of these surveys approximately 12.500 individual larvae need to be identified to species. Currently clupeoid larvae identification is done by counting myotomes from head to tail under a dissecting microscope. Because it is difficult to count the myotomes right after the head and at the tail end a method was developed to identify part of the larvae and count numbers of myotomes in that part. An ImageJ macro was developed in which semi-automated larvae can be measured. Due to fixation in formaldehyde larvae are bent. By putting some points over the length of the larvae from the nose to the tail tip length is measured. Based on the total length, the part from 30% of the total length to 60% of the total length is identified. In this part the number of myotomes are counted and measured automatically. Unfortunately this number of myotomes is not a measure to distinguish between the clupeoid larvae herring, sprat and pilchard. Sprat has a much lower number of myotomes compared to herring and pilchard, but the latter two species overlap in number and size of the myotomes. The macro does give the possibility to store individual larvae for quality control.
Dutch summary and conclusions	Elk jaar worden er door Wageningen Marine Research 4 haring larven surveys uitgevoerd om een bestandsschatting te doen van Noordzee haring en een schatting van recruitment te geven. Deze surveys zijn onderdeel van de WOT taken. Uit de monsters van deze surveys moeten er ongeveer 12.500 individuele larven worden geïdentificeerd. Momenteel wordt de identificatie gedaan door het tellen van de myotomen van kop tot staart. Omdat het moeilijk is om de myotomen te tellen vlak achter de kop and bij de aanzet van de staart een methode was ontwikkeld om het aantal myotomen in een gedeelte van een larf te tellen. Een ImageJ macro was ontwikkeld in welke het mogelijk is om semiautomatisch de larf te meten. Door de fixatie in formaline zijn de larven vaak krom. Door handmatig een aantal punten over de larf te zetten van de neus tot de staartpunt wordt de lengte over deze punten berekend. Gebaseerd op deze totale lengte van de larf wordt het gedeelte vanaf 30% van de lichaamslengte tot 60% van de lichaamslengte bepaald. In dit gedeelte van de larf wordt automatisch het aantal myotomen geteld en opgemeten. Helaas is deze methode niet voldoende om haring, sprot en pelser van elkaar te onderscheiden. Sprot heeft een veel lager aantal myotomen, maar er is overlap in

	het aantal myotomen en de lengte van de myotomes tussen haring en pelser. De macro geeft wel de mogelijkheid om larven individueel op te slaan voor kwaliteitscontrole.

INTERNATIONAL

Was the project part of an international network?	No, but the herring larvae surveys are international surveys carried out under ICES supervision. An ImageJ macro that could aid quality control and speed up the larvae identification would be a tool to be used internationally.
Who were the international partners?	None
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	Wageningen Marine Research is part of the international group would carries out herring larvae surveys in the North Sea.

Title	15. WebGr
Number	4311300015
Project leader	Cindy van Damme
Other researchers in WUR	Sieto Verver
Researchers outside WUR	Iñaki Quincoces (AZTI, Spain) and Els Toreele (ILVO, Belgium)
BAPS number	KB-14-012-077
Budget	5.308,-
Goals of project	To update WebGr so it can be continued to use as web tool for fish age reading and maturity staging calibration exchanges and workshops.
Target group for research	Fish age readers, maturity stagers and assessment scientist.

PROGRESS 2015

Results	Main results: WebGr version 1 did not function properly anymore and stored data and pictures were about to be lost. A rescue plan was developed for WebGr version 2 by the ICES Working Group for Biological Parameters (WGBIOP). This project provided half of the budget needed to finance the WebGr rescue plan. The other part of the budget was provided by ILVO, Belgium.
	Products: WebGr version 2.
Did the work follow plans (science or financial)?	Yes, a rescue plan was developed by ICESWGBIOP.
Developed expertise	Nothing has been developed for the market, but WebGr is free available for anyone involved in fish age reading and maturity staging.
Science publications	None
General publications	None
Other outputs	A new version of the web tool WebGr.
Any links to Wageningen University projects?	None
What is relevant for EZ fisheries or ecosystem management?	Fish age reading and maturity staging are important parameters for the assessment of all commercial fish species. WebGr is a web tool to be used for international calibration and quality control of fish age reading and maturity staging.
Describe collaboration with any partners outside WUR (national)	Iñaki Quincoces from AZTI, Spain, is one of the original developers of WebGr, het prepared WebGr version 2. Wageningen Marine Research and ILVO provided the budget for the development of WebGr versions 2.

SAMENVATTING VOOR KENNIS ONLINE

Non scientific partners	None
Summary and Conclusions of Project	Fish age reading and maturity staging are important parameters for the assessment of all commercial fish species. WebGr http://webgr.azti.es/workshop/search/myws/ is a web tool to be used for international calibration and quality control of fish age reading and maturity

	staging. The goal of this project was to update WebGr so it can be continued to use as web tool for fish age reading and maturity staging calibration exchanges and workshops. WebGr version 1 did not function properly anymore and stored data and pictures were about to be lost. A rescue plan was developed for WebGr version 2 by the ICES Working Group for Biological Parameters (WGBIOP). This project provided half of the budget needed to finance the WebGr rescue plan. The other part of the budget was provided by ILVO, Belgium.
Dutch summary and conclusions	Vis leeftijdsbepaling en maturity staging zijn belangrijke parameters voor de bestandsschattingen van alle commerciële vissoorten. WebGr http://webgr.azti.es/workshop/search/myws/ is een web tool voor internationale kalibratie en kwaliteitscontrole van leeftijdsbepaling en maturity staging van vis. Het doel van dit project was om WebGr te updaten zodat het gebruikt kan blijven worden als web tool voor vis leeftijdsbepaling en maturity staging uitwisselingen en workshops. WebGr versie 1 werkte niet meer naar behoren en opgeslagen data en foto's dreigden verloren te gaan. Een reddingsplan was ontwikkeld door de ICES Werk Groep voor Biologische Parameters (WGBIOP). Dit project heeft het reddingsplan voor de helft gefinancierd. De andere helft is door ILVO uit België gefinancierd.

INTERNATIONAL

Was the project part of an international network?	Yes, WebGr is an international tool and the rescue plan was developed by ICES WGBIOP. Wageningen Marine Research and ILVO financed the rescue plan and AZTI updated WebGr.
Who were the international partners?	AZTI, Spain and ILVO, Belgium
Has the project been associated with international funding sources (EU, DGIS etc) or research programmes?	No
How much funding came from these sources?	None
How did the project position Wageningen Marine Research internationally?	WebGr is a very important tool for international calibration of fish age reading and maturity staging. Wageningen Marine Research organises and chairs calibrations and exchanges of several fish species for these parameters. The fact that Wageningen Marine Research and ILVO financed the rescue plan put these two institutes further at the centre of these calibrations.