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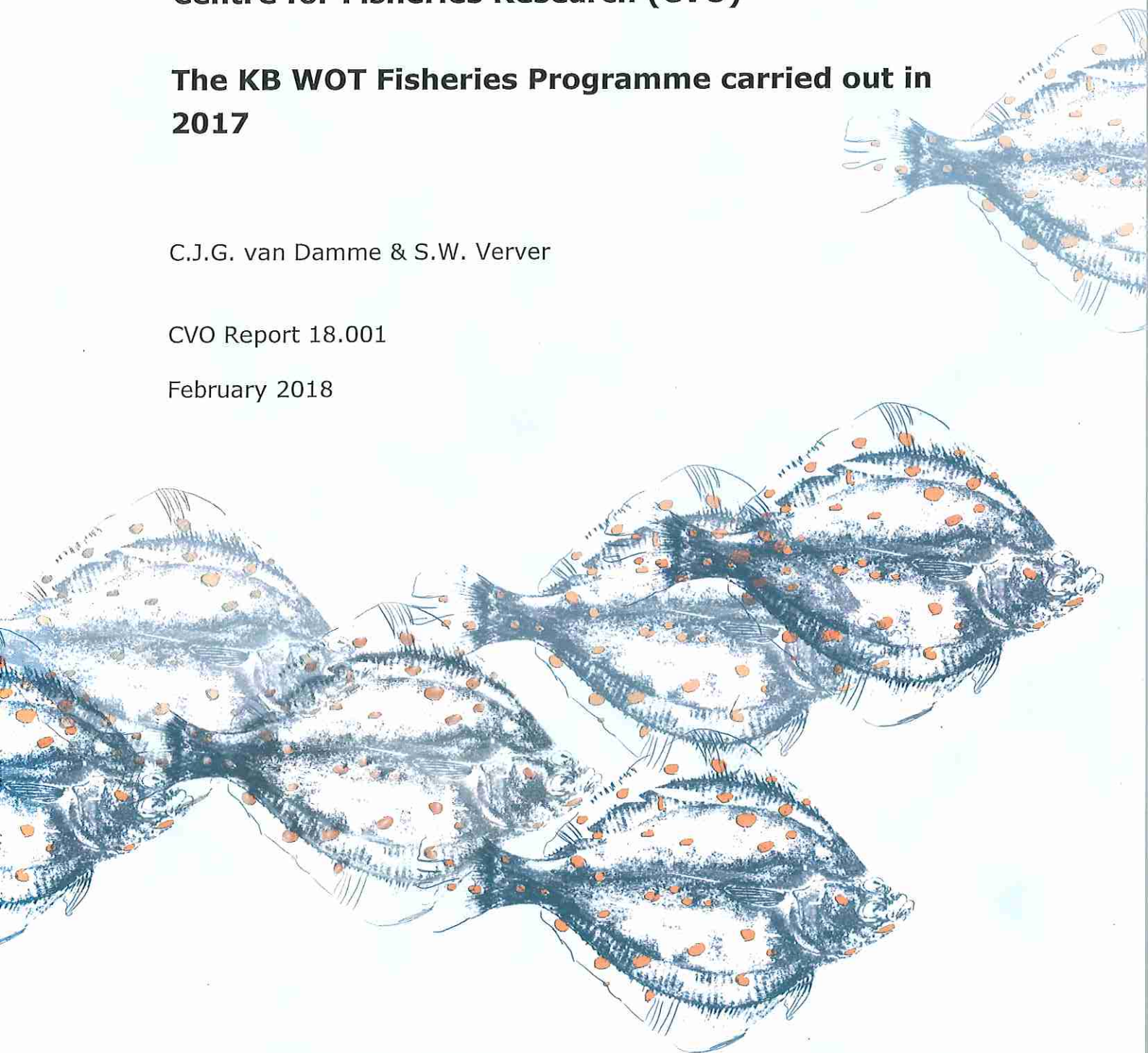
**Stichting Wageningen Research  
Centre for Fisheries Research (CVO)**

**The KB WOT Fisheries Programme carried out in  
2017**

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

CVO Report 18.001

February 2018



**Centrum voor Visserijonderzoek (CVO)**



# Stichting Wageningen Research Centre for Fisheries Research (CVO)

## The KB WOT Fisheries Programme carried out in 2017

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

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## Summary

The main objective of the KB WOT Fisheries programme is to maintain and develop the key expertises needed to execute the statutory tasks in fisheries monitoring and advice of the Netherlands. The KB WOT programme has clear objectives and deliverables. It is however also a flexible programme that is able to respond to changes in WOT requirements due to changing fisheries management and policy needs. It is an innovative programme contributing and participating in developments in fisheries science, while at the same time maintaining key expertises to carry out the statutory tasks. The programme operates within the context of the Common Fisheries Policy (CFP), the EU Marine Strategy Framework Directive (MSFD), EU Data collection Framework and the EU Maritime Policy.

The KB WOT fisheries programme is an annual programme established around strategic themes. In 2017 13 projects were originally awarded. However, one project could not meet all the original objectives, due to developments outside the programme. With the remaining budget a new project was kicked-off in the second half of the year. The 14 projects within the programme were successfully carried out. The focus of the programme in 2017 was on research into development of tools and methods for monitoring catches on board commercial vessels, data storage and accessibility and method development for assessment of marine resources. As the basis of the KB WOT Fisheries is maintaining and developing key expertise for the WOT programme, a considerable part of the funds was used for projects that standardise fish ageing, fish and shellfish monitoring and development of fisheries acoustics techniques and expertise. These are essential topics to ensure high quality in assessments and management of fish stocks.

Four of the projects in 2017 were performed in an international context, together with other institutes and scientists from around the globe. As knowledge and resources from these other countries contribute to the results of the KB WOT projects, this collaboration provides added value to the programme. Next to the collaboration in projects, a large part of the KB WOT Fisheries budget is specifically reserved for international cooperation and exchange of knowledge and developments. Through this Wageningen Marine Research researchers involved in WOT Fisheries remain at the heart 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. 21 international presentations were given at meetings, workshops and symposia, and 19 international and national reports were written with the aid of KB WOT Fisheries funds. 6 new methods or models were developed and 1 peer reviewed publication.



## Samenvatting

Het belangrijkste doel van het KB WOT Visserij programma is het onderhouden en ontwikkelen van de kernexpertises, welke noodzakelijk zijn voor het uitvoeren van de wettelijke taken van Nederland op het gebied van visserij monitoring en advisering. Het KB WOT Visserij programma heeft duidelijk omschreven doelen en resultaten. Het blijft daarnaast ook een flexibel programma dat probeert in te spelen op aanpassingen in de WOT behoeften, doordat het visserijbeleid en beheer veranderd. Om te kunnen deelnemen aan wetenschappelijke ontwikkelingen die het programma ook innovatief te zijn. De Common Fisheries Policy (CFP), de EU Marine Strategy Framework Directive (MSFD) en de EU Data verzameling framework (DCF) en de EU Maritime Policy, vormen de kaders waarbinnen het KB WOT programma wordt uitgevoerd.

Het KB WOT Visserij programma wordt jaarlijks vastgesteld rond een aantal thema's. Het programma van 2017 ging van start met 13 verschillende projecten. Door ontwikkelingen buiten het KB WOT programma was het binnen een project niet mogelijk om alle geplande activiteiten uit te voeren. Met het vrijgekomen budget is halverwege het jaar een nieuw project opgestart. Deze 14 projecten in het programma zijn verder met succes uitgevoerd. Het KB WOT programma was in 2017 gericht op onderzoek naar de ontwikkeling van middelen voor het monitoren van vangsten aan boord van commerciële schepen, dataopslag en toegankelijkheid en het ontwikkelen van methoden voor bepaling van de grootte van vis- en scheldierbestanden. Het hoofddoel van het KB WOT Visserij programma is het onderhoud en ontwikkeling van de kern expertises die noodzakelijk zijn voor het uitvoeren van wettelijke onderzoekstaken Visserij. Een groot deel van het budget is dan ook besteed aan het standaardiseren van leeftijdsbepaling van vis, vis en schelpdier monitoring en de ontwikkeling van visserij akoestische technieken. Deze onderwerpen zijn van groot belang voor het behouden van de hoge kwaliteit van de bepaling van de grootte en het beheer van visbestanden.

Vier van de 14 projecten die in 2016 zijn uitgevoerd, zijn uitgevoerd in samenwerking met onderzoekers van internationale instituten. Dit is een toegevoegde waarde aan het KB WOT programma, doordat middelen en kennis uit deze andere landen bijdragen aan de resultaten van het programma. Ook wordt er specifiek een groot deel van het budget gealloceerd voor internationale uitwisseling van kennis en wetenschap en samenwerking. Hierdoor hebben onderzoekers van Wageningen Marine Research de mogelijkheid in het hart te blijven van wetenschappelijke en internationale ontwikkelingen op gebied van visserijonderzoek.

In 2017 is er ook veel gepubliceerd binnen het KB WOT programma. 21 presentaties zijn gepresenteerd tijdens internationale bijeenkomsten, vergaderingen, workshops en symposia. In totaal zijn er 19 internationale en nationale rapporten geschreven en 6 nieuwe methoden of modellen ontwikkelt. Daarnaast is er ook 1 peer reviewed wetenschappelijke artikel gepubliceerd dat mede tot stand is gekomen met budget van KB WOT Visserij.



## 1 Introduction

The KennisBasis (KB) WOT Fisheries programme has been established to maintain and develop the core expertises which are necessary to carry out the statutory obligations (WOT) in fisheries monitoring and advice on fisheries management. The KB WOT Fisheries, while maintaining and progressing the core expertises, is also a proactive programme. Thus, the programme can deal with the changes over time in the statutory tasks, due to advancements and progress in fishing methods, fisheries science and policy needs. The KB WOT Fisheries programme is flexible and able to respond to changes while it also has clearly defined objectives and deliverables. This is achieved through a yearly review of the programme. The programme operates within the wider Wageningen Research KB programme and is since 2015 embedded within the Wageningen KB theme 'System Earth Management'.

The statutory obligations comprise the advice and tasks 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). Sound fisheries management and policy can only be achieved through reliable science-based advice. Only data and information collections combined with improved understanding of the marine and aquatic (eco)systems can deliver such advice. Long-term (inter)national data collection programmes are carried to provide this data and information.

Underpinning the key expertises needed to carry out the WOT tasks, is the foremost objective of the KB WOT Fisheries programme. Thus the efficiency, with which the WOT Fisheries programme is executed, is improved exceedingly. The KB WOT Fisheries programme is both innovative and supportive, as it is a combination of operational research, directed at current national (LNV) and international (EU) needs, with more strategic studies, anticipating future policy and research requirements and developments. The KB WOT Fisheries budget is deployed for maintenance, enhancement and development of the expertise in the research areas of fisheries dynamics, fish biology, monitoring, marine and freshwater ecology and management systems. International cooperation and exchange of knowledge, techniques and developments, are also a high priority of the KB WOT Fisheries programme. In addition, the programme encourages scientific output by scientists involved in the execution of the statutory tasks.



## **2 The programme in 2017**

The basis of the research for the KB WOT Fisheries programme in 2017, were the apparent needs to execute the WOT Fisheries programme. The main objective of the KB WOT Fisheries programme is maintaining and developing the key expertises, which are essential for the Fisheries statutory tasks. A high priority is also international collaboration and exchange of scientific knowledge and developments required to carry out present and upcoming WOT tasks. Remaining budget is utilised for more strategic research.

Strong science and advice essential to carry out the WOT Fisheries obligations can only be achieved through exceptional and ground-breaking research. Fisheries management needs to be based on outstanding data and advice collected in long-term data collections. This level quality control and science can only be achieved with international exchange and publication of results in international peer reviewed scientific journals. The KB WOT Fisheries programme allocates a considerable amount of the funds for international exchange and cooperation.

### **2.1 Research themes**

The research themes of the KB WOT fisheries programme in 2017 were:

1. Evaluating, improving and underpinning the WOT Fisheries programme
2. International Exchange

### **2.2 Rationale for the choice of research themes**

The provision of information and tools, but also improving current methods and management are essential to evaluate, improve and underpin the WOT Fisheries programme. Also marine and aquatic management and policy are continuously developing. International fish stock management is based on management of the fisheries, regulating fishing effort and reducing discards. More and more studies focussing on fisheries impact on the environment are carries out, but there is still a continued need for further knowledge to support the marine and aquatic resources management.

For EU data collection requirements, member states are obliged to setup and execute single and multiple stock fisheries monitoring programmes. At the same time, EU regulations, such as MSFD, require data collection for a number of selected descriptors, ecosystem elements that are sensitive to fishing activities. Marine and fresh water productivity is subject to changes over a range of temporal scales. Recent changes are being well-documented, but the relative importance of components of an ecosystem can change over time. Interaction of these natural fluctuations with human activities makes the fisheries system dynamic and sometimes unpredictable. To response to these needs combined integral monitoring programmes need to be carried out. 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. Quality control of this science on these topics is ensured through publication in peer-reviewed manuscripts.

Maintaining and developing key expertises and development of routine techniques, skills and tools needed to carry out the WOT Fisheries tasks form the core of the KB WOT Fisheries. These expertises include 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. Exchange of science and techniques on national and international level is an essential component to develop European fisheries science. These workshops and



symposia also form the basis for new innovative tools and methods. It is therefore essential that staff carrying out the statutory tasks participate in these meetings.

## 2.3 Projects funded through the KB WOT fisheries programme in 2017

For 2017, WOT Fisheries project leaders and Wageningen Marine Research Support Teams, with high relevance for WOT Fisheries, were invited to submit proposals to the research themes selected by the KB WOT management team. To keep the innovation and out-of-the-box thinking WOT project leaders are requested to seek input from other researchers.

The proposals were reviewed and judged for relevance to the WOT statutory tasks, development of relevant new methods and scientific relevance. The projects in the table below were funded in 2017. The annual reports of each project are attached to the end of this report.

BAS No	Title	Project leader	Research Theme	Planned	Realised
KB-24-005-001	Programme Management	Cindy van Damme		€28.000,-	€28.000,-
KB-24-005-002	International Exchange	Cindy van Damme	2	€154.412,-	€158.003,- <sup>1</sup>
KB-24-005-003	Fish Ageing	Loes Bolle	1	€81.584,-	€78.019,- <sup>1</sup>
KB-24-005-008	Remote Sensing of Intertidal Mussel beds	Karin Troost	1	€30.640,-	€30.640,-
KB-24-005-019	Ecosystem acoustics	Benoit Berges	1	€38.144,-	€38.144,-
KB-24-005-020	Migration of WOT shellfish database	Margriet van Asch	1	€26.990,-	€18.365,- <sup>2</sup>
KB-24-005-021	Trendspotter	Ingrid Tulp	1	€27.320,-	€25.268,-
KB-24-005-022	Collection and storage of data on board of Tridens II	Ralf van Hal	1	€5.500,-	€5.500,-
KB-24-005-023	Improving herring larvae surveys indices (HERLARS)	Cindy van Damme	1	€62.224,-	€62.224,-
KB-24-005-024	Density-dependent individual growth reduction of North Sea plaice	Tobias van Kooten	1	€43.280,-	€35.290,-
KB-24-005-025	Incidental Bycatch	Edwin van Helmond	1	€23.660,-	€19.526,-
KB-24-005-026	Developing tools to incorporate ecosystem considerations into management	Thomas Brunel	1	€32.000,-	€32.000,-

<sup>1</sup> Fish ageing needed less budget to carry out the planned tasks. The remaining budget from this project were moved to the project International exchange.

<sup>2</sup> Due to database developments lacking behind it was not possible to carry out all planned tasks in KB-24-005-020. Therefore, a subproject was started further developing the automated DATRAS upload (KB-24-005-020a). This is a follow-up of a KB WOT project carried out in 2015.



### 3 Highlights of the programme in 2017

Many excellent proposals were submitted to the KB WOT Fisheries call, hence it was again possible to launch a broad programme of outstanding projects. Originally 13 projects were rewarded at the start of 2017.

However, the project 'Migration of WOT shellfish database' could not be carried out completely. This project was depending on database developments in other projects. These developments went slower than expected and some of the work was therefore postponed to 2018. A new project 'Development of automated data upload to DATRAS' was kicked off. This was a further development of a KB WOT project carried out in 2015.

Also the planned tasks of the project 'Fish ageing' required less budget. The remaining budget was added to the project 'International exchange', which allowed for scientists to participate in ICES meetings which were not programmed at the end of 2016, but were of vital importance to carry out the statutory tasks.

Under the KB WOT Fisheries programme 14 projects were carried out successfully in 2016. The projects delivered many important and interesting findings. Examples of these projects are 'Catch monitoring' and 'Remote Sensing of Intertidal Mussel beds'.

#### 3.1 Catch monitoring

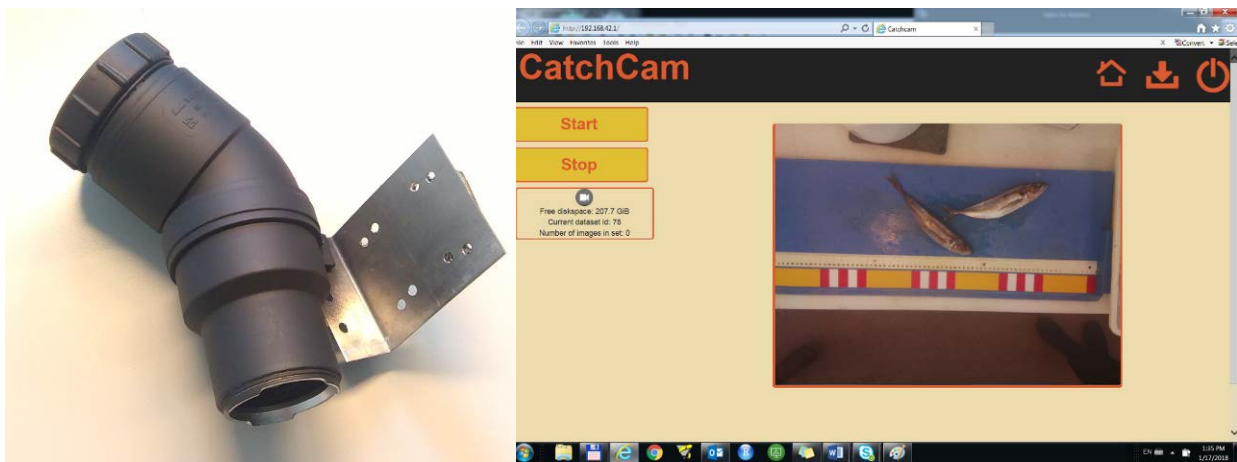
In 2013 the reform of the European Common Fisheries Policy (CFP) introduced a phased implementation of the obligation to fully report and land all catches. Beyond its primary objective of reducing (or eliminating) discards, this Landing Obligation (LO) implies that fishers become accountable for their entire catches of regulated stocks and not for the landed fraction only. The LO shifts the basic principles of EU fisheries management from a landing-based framework to a catch-quota system. However, without a high level of at-sea monitoring and enforcement, there is little incentive to comply with the LO (Batsleer *et al.* 2013; Condie *et al.* 2013; Msomphora and Aanesen 2015; Borges *et al.* 2016). Rather than selling unwanted catches of small fish for non-human consumption at a low price (Mangi and Catchpole 2014), there will be a strong incentive to maximize (individual) quota and continue to discard illegally (Condie *et al.* 2014; Eliassen *et al.* 2014).

The introduction of the LO will also have an effect on the WOT sampling programmes on-board commercial fishing vessels. Sampling methodologies will have to change from discard sampling programmes to catch sampling programmes. Several different methodologies to facilitate this change are tested. In this study the possibilities to record catch composition with digital video technology, also known as remote electronic monitoring (REM), is investigated. A switch from discard to a catch sampling strategy implies an increase in sampling size, i.e. discards being a smaller fraction of the total catch. Collecting larger samples on board is challenging. A higher workload, more time or more human resources are needed, and there is an increasing level of interference with the crew. In addition, due to technical modifications on-board the vessels, it is increasingly difficult and dangerous to collect unsorted catch samples. This is particularly the case for larger pelagic trawlers, due to renewed catch sorting devices, closed hopper systems and fast running conveyor belts.

Already several studies described the potentials of REM in providing much wider (and more random) coverage of the fleet than the more conventional, e.g. observer programme, will ever achieve (e.g. Kindt-Larsen *et al.* 2011; Needle *et al.*, 2015; van Helmond *et al.*, 2016). The same is also true, for sampling the catch on board a vessel: video recording the catch during transport over the conveyor belt to the sorting machine or during the manual sorting process provides a complete coverage of the catch. Taking or selecting pictures results in a (random) 'snap-shot' or 'virtual sample' of the catch, e.g. 50 – 100 snap shots, during the total duration of catch processing, will provide an accurate estimate of the

catch composition. Compared to the current protocol, where observers sample only one or two baskets of fish from the total catch, digital snap shots provide a higher sampling density, and therefore, a more representative sample of the catch. In addition, the risks of taking digital pictures with a camera that can be controlled by a laptop from a distance will be considerably less, than taking a physical catch samples from a fast running conveyor belt.

However, current REM systems are expensive (€10.000,-) and need to be custom made for a particular vessel, thus, cannot be easily transferred between vessels. The aim of this project is to develop an electronic monitoring system that helps observers in the WOT programme to improve catch recording on board commercial fishing vessels. This means a simple to use, portable, easy to build, low budget electronic monitoring system. In 2016, a first prototype of the electronic monitoring system CatchCam was developed (Fig. 3.1.1). This prototype consist of a digital camera, which is controlled by a single-board computer system (Raspberry Pi). As storage a 240Gb SSD drive was used. All other electronics used are available in any (online) electronics store for less than €250,-. A waterproof housing was built from PVC tubes, which can be bought in any hard ware store for a couple of euros. To control the monitoring system, a single-board computer software was developed in combination with a Graphical User Interface (GUI) to enable to control the system from a regular laptop (Fig. 3.1.1). The tools used to develop the software and GUI are all open source.



**Figure 3.1.1.** *Prototype of CatchCam and the Graphical User Interface (GUI).*

Several test runs during research surveys were conducted and evaluated in 2017. Housing proved to be sufficient in the moist and damp environment on the sorting decks, a for electronics hostile surrounding of saline water. To fix the system on-board a strong magnet is used, this proved to be sufficient during the trials. Finding metal structure to mount the camera system was never a problem.

Expanding the control options with zoom and camera angle regulation will be helpful, but this still needs to be developed.

With the current setup of the system, it is possible to describe catch composition through manual review of the footage. The quality of the pictures is sufficient to detect and count different species on a conveyor belt (Fig. 3.1.2).



**Figure 3.1.2.** *CatchCam* footage of the catch during the herring acoustic survey.



**Figure 3.1.3.** The laboratory setup.

Storage and control of recordings are the main bottlenecks of the current system. A 'bug' in the software is causing a time delay in storing footage. In addition, manual control increases the risk of recording useless footage is large, e.g. recording when there is no catch on the conveyor belt. Recording unnecessary information directly effects the storage capacity of the system. Both issues need to be resolved before starting test runs on board commercial vessels in 2018.

To be able to estimate the catch composition accurately the sampling size of each haul should be as large as possible, in other words, the more pictures analysed per haul the better. However, manual review of a significant number of pictures of unsorted catch takes time. Automated review of footage will increase the efficiency of the process considerably. This can be accomplished by using computer vision technology. To facilitate this process the *CatchCam* system was used to collect data, i.e. pictures of horse mackerel and Norway lobster (*Nephrops*) in a laboratory set up (Fig. 3.1.3). More laboratory sessions are planned in 2018. In cooperation with the section Farm Technology (of Wageningen UR), algorithms will be developed that describe the number of fish of a particular species in a picture frame, hence automated registration of fish and crustaceans. When the system is calibrated for length measurements, there is an opportunity to facilitate dockside or market monitoring, particularly for the more time consuming tasks like measuring shrimps.

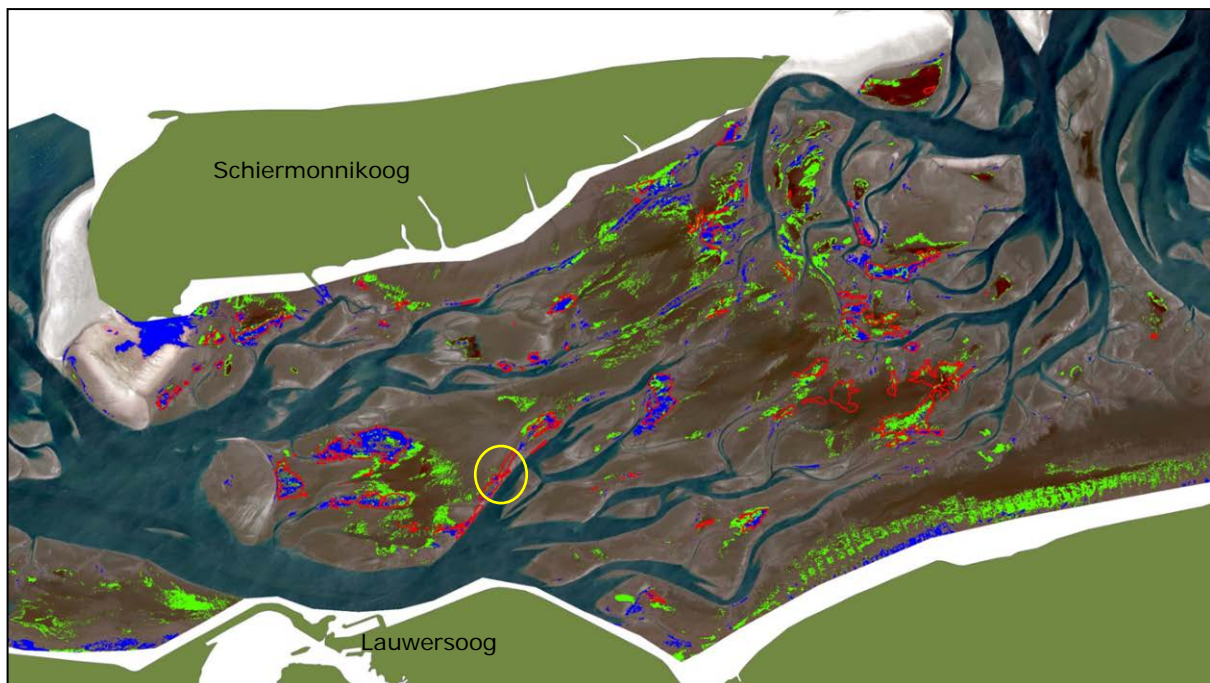
So far, the potential of the *CatchCam* system to facilitate on board sampling is clear. The collected data can be used to estimate catch composition. However several issues, most of them software related, need to be solved before the system can be functional on board commercial vessels. Computer vision technology will improve the efficacy of the system and also creates opportunities for other monitoring programmes, like commercial sampling.

### 3.2 Remote Sensing of Intertidal Mussel beds

Because fieldwork on bivalve shellfish beds is highly time consuming, there is a high potential for improvements in efficiency by using innovative remote sensing techniques such as satellite and unmanned aerial vehicle (UAV) imagery. In 2015 a cooperation between Wageningen Marine Research and Wageningen Environmental Research was started, with the aim to explore the suitability of these techniques for mussel bed research. In 2015 a first field pilot was performed, where images of an oyster bed in the Wadden Sea were acquired by UAV. Results were promising enough to start a project that was funded by KB WOT Fisheries in 2016 and 2017.

#### Satellite

In 2016, a first mussel/oyster bed distribution map was made of part of the Dutch Wadden Sea using satellite images. This map looked promising, and the aim for 2017 was to construct a map for the entire Wadden Sea, for several years (2015-2017), and to validate these maps with field data. Before the WOT shellfish stock assessment campaign in the Wadden Sea in the spring of 2017, a Wadden Sea wide map based on the most recent satellite images should have been available, to allow for the collection of field reference data directed specifically at locations that give either false positive (where image analysis recognizes a mussel bed where there is none) or false negative (where image analysis does not recognize an existing mussel bed) signals. Field reference data other than the contours of existing mussel- and oyster bed was, however, not collected because the Wadden Sea wide map was not finished in time. In 2017, satellite data were acquired of the years 2015, 2016 and 2017, and Wadden Sea wide images were prepared by stitching different areas with different recording dates together. For the analysis, in 2016 tests were made using programmes such as Ecognition and Isodata (Fig. 3.2.1), and in ArcGIS Pro.



**Figure 3.2.1.** Satellite image of the Wadden Sea in 2015 near the island of Schiermonnikoog. Red contours are contours of mussel- and oyster beds mapped on foot in the WOT campaign of 2015. Green and blue are areas 'recognized' by the Isodata software as shellfish beds. Outside the red contours, still too many areas are 'recognized' as shellfish beds, while there are none present. The method therefore needs further fine-tuning using field data directed at these 'false positives'. The yellow circle marks location "Schildknopen" where most of the UAV campaigns were performed.

Although these tests seemed to give good results, when applying them to images of another year, new problems were encountered. Because these new problems were encountered at the end of 2017, analyses could not be finished before the end of 2017. The aim for 2018 (also funded by KB WOT Fisheries) is to finish the analyses, report and train scientists in the analysis techniques and start implementing the new technique in the WOT shellfish stock assessment.

### Unmanned Aerial Vehicle

In 2016 and 2017, two different UAVs fitted with different cameras, and also different image analysis techniques, were tested on three beds in the Wadden Sea and Oosterschelde Bay (Fig. 3.2.2). In 2017, the bed at location Schildknopen in the Wadden Sea (Fig. 3.2.1) was revisited twice, to be able to assess the effect of seasonal difference on the analysis techniques, and to see whether changes occur in bed morphology.



**Figure 3.2.2.** *Jappe is flying the DJI Phantom UAV at location "Schildknopen" in the WaddenSea.*

Different methods for analysis of the acquired images were tested until finally classification in ArcGIS Pro seemed the best working option. However, as also happened with the satellite images, techniques that worked well on a first set of images did not work as well on a new set of images acquired on a later date. First results show that UAV imagery is a promising technique but is still difficult to apply because of a combination of legal restraints (accessibility, need for at least 2 pilots, limited flying distance, etc.), technical restraints (lifetime of batteries, reflection of sunlight by wet surfaces, etc.) and relatively low tolerances towards weather conditions (equipment is not rain proof, wind force should be no more than 4 Bft). In the short term the method does not seem beneficial for mapping contours of shellfish beds in the WOT Fisheries surveys since determining bed contours according to the trilateral TMAP protocol is much less time consuming on foot and renders more information about the bed composition. UAV imagery does seem suitable for more detailed studies on mussel- and oyster bed development, such as within the WOT Nature & Environment monitoring of a number of mussel beds in the Wadden Sea.

### 3.3 Tools and method development

New and innovative tools were developed in 2017 for the monitoring of catch composition on board vessels (see also 3.1). Innovative tools, such as drones, were tested for use in standard monitoring (see also 3.2).

Methods and programming code have been developed using Python and (geo)statistical programming packages. Python code has been further developed for fish detection and automated extraction of 3D characteristics of fish schools from echoview datasets.

For monitoring shellfish in the coastal zone, a method has been developed to identify different types of shellfish beds from satellite images. This will be implemented into the regular Wageningen Marine Research shellfish monitoring.

For ecosystem studies, different methods have been developed directed at specific topics. For studying trends in long-term monitoring time series new methods have been developed and tested in the programme Trendspotter.

A GADGET model has been developed to study the hake-blue whiting species complex in the Northeast Atlantic. This model allows for a better understanding of the effect of environmental regimes and species interactions on management reference points. Through this model, a simulation framework is created to test ecosystem based management and reference point estimation in a multispecies context.

### **3.4 Standardisation of techniques, data accessibility and quality control**

Advances were made in to fish ageing of various fish species. Improvements of the quality of fish ageing, such as using a semi-automatic sawing machine and new improved screens for embedding otoliths, have been incorporated. In addition, plans have been developed to further improve quality and efficiency (e.g. image analysis, database adaptations, lab improvements) of fish ageing.

A high number of the WOT monitoring surveys are carried out on-board RV Tridens. Since the refit of the vessel the data streams on-board have been altered and this has effect on the data collection and storage during the WOT surveys. An overview of data streams on board of RV Tridens, including the (efficiency) of data storage is prepared. Also an overview is created of acoustic equipment on-board that might interfere (in collection of data as well as data flows) with each other. Finally, advice is drafted giving possible ways of how to manage the data flows and storage.

Tools have been developed to convert historical data from acoustic surveys carried out by the Netherlands to the ICES database format. Thus increasing accessibility of the Dutch acoustic data. Fish data from regular survey can now be automatically resubmit data from the WMR database Frisbe to the ICES database DATRAS. A communication protocol has been developed that can automatically check data in both databases and correct data in the ICES database if necessary.

Up until 2017 data from the shellfish surveys carried out by the Netherlands were stored in a local database. Reference tables and programming code have been created to allow for upload of the long-term shellfish surveys datasets to the WMR Frisbe database. This allows for better quality control and greater accessibility of this data.

An analysis and plan has been setup for the adaptation of the WMR Frisbe database to allow registration, upload and storage of bycatches from commercial samplings.

Recording bycatches on board commercial vessels is a highly sensitive task. In order to improve communication of WMR (personnel) with crews of the commercial vessels, a plan has been developed to aid the communication on this topic. The plan not only includes how WMR personnel can best communicate with the fisherman, but also includes better understanding of motivation of fisherman in recording bycatch. Within this plan, also a self-sampling scheme of rare fish species has been proposed to the Pelagic Freezer Association (PFA).

The regular herring larvae surveys carried out as part of the statutory tasks have been improved. Larval distributions have been modelled for a better understanding of larval drift and where larvae from the



various spawning grounds in the North Sea drift to. This allows for improving the various larval indices from the specific spawning grounds and management of North Sea herring by spawning stocks. In addition, an impact assessment of removing one of the current herring larvae surveys from the North Sea herring assessment was carried out. The positive outcomes allowed for the development of a new herring larvae survey, while replacing the original January survey, providing recruitment data of the herring larvae spawned in the English Channel. These data are very important for the management of fish stocks.



### 3.5 Recent publications resulting from the KB WOT fisheries programme

One peer reviewed publication resulted in 2017 which was prepared with the aid of funds from the KB WOT Fisheries programme.

Brown, E.J., Vasconcelos, R.P., Wennhage, H., Bergström, U., Støttrup, J.G., Van de Wolfshaar, K., Millisenda, G., Colloca, F., and Le Pape, O. (2018). Conflicts in the coastal zone: human impacts on commercially important fish species utilizing coastal habitat.  
<https://doi.org/10.1093/icesjms/fsx237>

In addition, the following manuscripts are in preparation for submission to (peer-reviewed) journals

2016

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'.

2013

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

Next to the above peer-reviewed manuscripts results of the KB WOT projects were also disseminated in other ways. There were also 19 internal and international reports and 21 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.

Bolle et al. (in prep) Handboek leeftijdsbepalingen

Bolle et al. (in prep) Masterplan leeftijdsbepalingen

ICES (2017) Report of the Working Group on Biological Parameters (WGBIOP), 2-6 October 2017, Sardinia, Italy. ICES CM 2017 /SSGIEON:08

ICES (2017) Report of the Working group on integrating surveys for the ecosystem approach. ICESCM 2017/SSGIEOM:17

ICES (2017) Final Report of the Working Group on Electrical Trawling. ICESCM 2017/SSGIEOM:20

ICES (2017) Interim Report of the Working Group on Integrated Assessments of the North Sea. ICES CM/SSGIEA:06

ICES (2017) Interim Report of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB). ICESCM 2017/SSGIEOM:13

ICES (2017) Interim Report of the Working Group on Fisheries, Acoustics, Science and Technology. ICESCM 2017/SSGIEOM:12

ICES (2017) Report of the Working Group on the Ecosystem Effects of Fishing Activities (WGECO). ICES CM 2017/ACOM:26

ICES (2017) Report of the Benthos Ecology Working Group (BEWG). ICES CM 2017/SSGEPD:03

ICES (2017) Report of the Data and Information Group (DIG). ICESCM 2017/SCICOM:02

ICES (2017) Interim Report of the Working Group on Integrative Physical-Biological and Ecosystem Modelling. ICESCM 2017/SSGIEA:01

ICES (2017) Interim Report of the Working Group on the Value of Coastal Habitats for Exploited Species (WGVHES). ICES CM 2017/SSGEPI:15.

ICES (2017) Interim Report of the Working Group on Maritime Systems. ICESCM 2017/SSGIEA:12

Troost et al (in prep) UAV Remote mussel bed sensing

Troost et al (in prep) Satellite Remote mussel bed sensing

Tulp et al. (in prep) Trendspotter: Long-term trends in the WaddenSea

Van Damme et al (in prep) Improving North Sea herring larvae surveys

Van Hal et al (in prep) Collection and storage of data on board of Tridens II



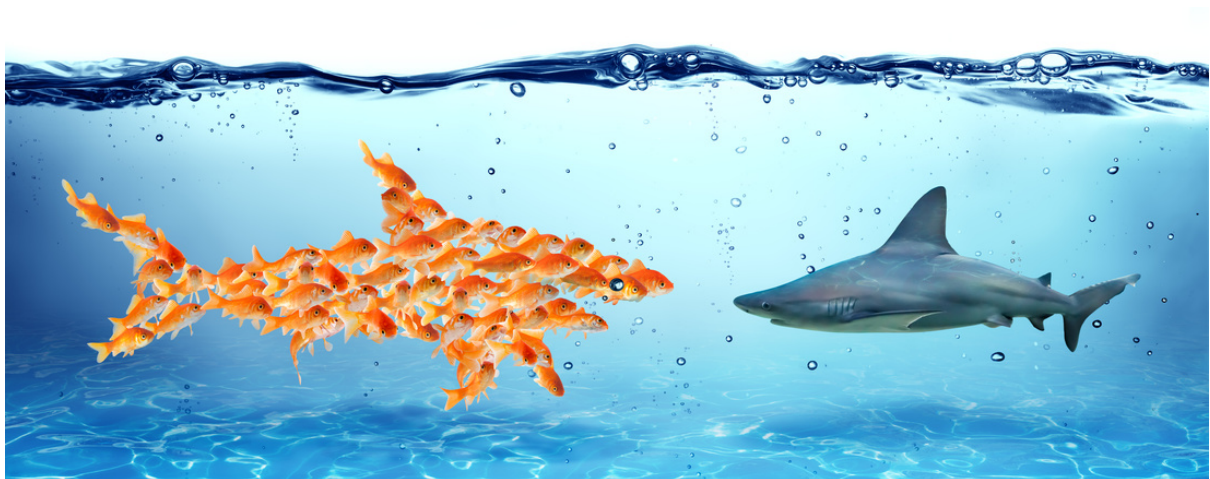
*Newly hatched cod larvae. C. Clemmesen*

#### 4 International partnership and collaboration

Fish do not stick to man-made borders. This makes fish stocks and fisheries management by its nature international. And thus it is set in the European fisheries policies. As a result, many of the statutory tasks are carried out in cooperation with international fisheries science institutes. 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 maintaining and developing the key expertises needed to perform the WOT Fisheries tasks.

Of the 14 projects in 2017, 4 were carried out in collaboration with scientists from international institutes in and outside Europe. As resources and expertise from other countries contribute to the KB WOT Fisheries programme, this is a source of added value. International exchange is a recurring project, which is especially dedicated to exchange of science and scientists. This project made it possible for Wageningen Marine Research colleagues to participate in studies of ecosystem modelling, effects of climate change, fisheries induced evolution, integrated monitoring, improving survey, acoustic and fishing technologies and benthic and ichthyoplankton monitoring.

Over 20 international presentations were given at these working groups and symposia. Through the KB WOT Fisheries programme Wageningen Marine Research scientists joined forces with scientists from institutes from all over the 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 a very creative and pioneering programme in 2017. Unfortunately, one project could only carry out part of the original objectives, because database developments needed for the project were not as quick as expected. However, due to this, one new project could be started, as a follow-up of a KB WOT Fisheries project from 2015. The 14 projects carried out in 2017 were successful and produced interesting and useful results and developments, from maintaining quality in collecting biological samples, fish ageing, shellfish, acoustic and discard sampling, data storage and improving fish stock assessments to more strategic research in fisheries acoustics, electronic monitoring and trend and ecosystem analyses. A trial with the trendy drones showed that such new tools, though they can potentially improve monitoring, need further development before they can be used in the harsh environment that WOT Fisheries monitoring is carried out. Through the considerable international collaboration and participation in international meetings, workshops and symposia, a large amount of added value was also supplemented to the programme in 2017.

The budget of the KB WOT Fisheries programme in 2017 was used to:

- Exchange and developed science and developments and collaborate with (inter)national colleagues.
- Develop new innovative tools and methods to monitor catches and bycatches on board commercial vessels
- Ensure high quality data collection, storage and accessibility
- Maintain and develop expertises essential to perform 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.



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### 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

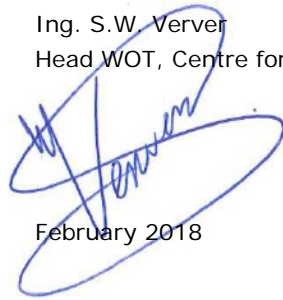
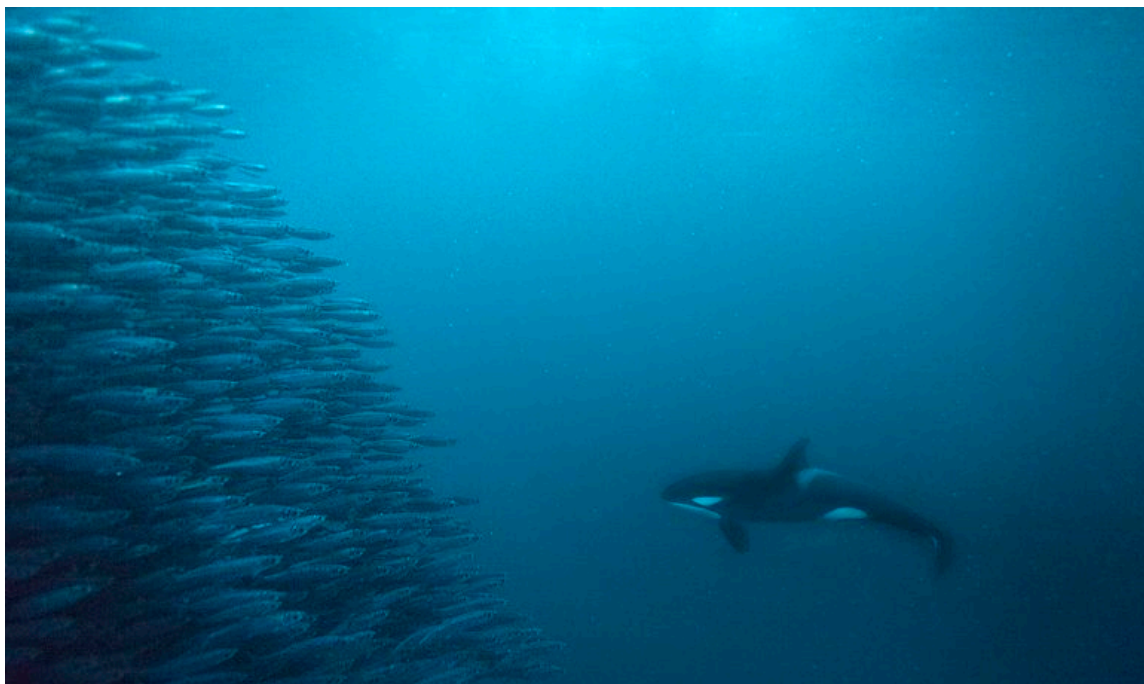
CVO Report: 18.001

Project number: 4311300047

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

Signature:

Date: February 2018

A handwritten signature in blue ink, appearing to be 'S.W. Verver', written over a large, loopy blue oval scribble.

*Mike Korostelev/Moment/Getty Images*

## Annex 1. Annual Reports of KB WOT Fisheries Projects 2017

Title	1. Programme management
Number	4311300034
Project leader	Cindy J.G. van Damme
Other researchers in WUR	Rian Schelvis, Sieto Verver, Johan Craeymeersch and Olvin van Keeken
Researchers outside WUR	None
BAPS number	KB-24-005-001
Budget	€ 28.000,-
Goals of project	Manage and develop the KB WOT Fisheries programme. Participate in the KB theme System Earth Management (SEM).
Target group for research	Ministry of LNV. Close links to the KB programme. The new KB programme is currently under development.

### PROGRESS 2017

Results	<p>Main results: The KB WOT fisheries programme contained 13 different projects in two different themes. The projects were carried out successfully.</p> <p>Products: A report with the results from the 2016 KB WOT Fisheries programme and a report with the planned programme for 2018.</p>
Describe the realisation/ deviations of the work plans (science)	The work was mostly carried out according to plan. However, during the year it became clear that some projects within the KB WOT programme were not able to realise all the planned work and use the requested budget. This led to extra work carried out within 'International exchange' and a change of allocation of tasks with the projects 'Migration of WOT shellfish database' and 'Catch monitoring'.
Describe the realisation/ deviations of the work plans (financial)	Because it was not possible to carry out the originally planned tasks budget was reallocated from the project 'Fish ageing' to 'International exchange'.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	The programme has maintained and developed expertise to underpin the statutory tasks of the Netherlands in fisheries research.
Science publications	A Wageningen Marine Research (WMR) symposium was organised on 17 January 2017 where all projects presented their results of the KB WOT projects carried out in 2016 to other WMR scientists and representatives of the Ministry of LNV.
General publications	Damme and Verver, 2017. The KB WOT Fisheries Programme carried out in 2016. CVO report: 17.007. Damme and Verver, 2017. KB WOT Fisheries 2018 - Maintaining Excellence and Innovation in Fisheries Research. CVO report: 17.019.
Other outputs/products	KB WOT mini-symposium.
Describe links to Wageningen	None

University projects	
What is relevant for LNV fisheries or ecosystem management?	The review by LNV found that the programme was forward looking, viewed high quality innovative science as important and yet maintained the direction considered important by LNV. Thus, the KBWOT programme appears to utilise the expertise available to DLO on fisheries and look to the future research needs of society. See utility of the developed products and expertise.
Describe collaboration with any partners outside WUR (national)	Close links through ICES, the EU STECF, PICES and FAO. In addition, a network of marine researchers in Universities across Europe and North America.

### SUMMARY

Non scientific partners	Fisheries managers and research coordinators in LNV.
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 2016 and a report with the proposed programme for 2018. Within the KB WOT Fisheries, programme 13 projects in two different themes (1. Evaluating, improving and underpinning the WOT Fisheries programme; 2. International Exchange) were granted. Projects are carried out successfully.
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 2016 en het geplande programma voor 2018. Binnen het KB WOT Visserij programma zijn er in 2017 in totaal 13 projecten toegekend in twee verschillende thema's (1. Evaluating, improving and underpinning the WOT Fisheries programme; 2. International Exchange). De projecten zijn succesvol 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 research programmes?	Not in 2017
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	The programme places WMR in a strong position in fisheries and marine science.



Title	2. International exchange
Number	4311300033
Project leader	Cindy J.G. van Damme
Other researchers in WUR	Daniel Benden, Benoit Berges, Loes Bolle, Ingeborg de Boois, Thomas Brunel, Chun Chen, Johan Craeymeersch, Michiel Dammers, Andre Dijkman-Dulkes, Daan Gerla, Ralf van Hal, Edwin van Helmond, Niels Hintzen, Tobias van Kooten, Pieke Molenaar, GerJan Piet, Jan Jaap Poos, Adriaan Rijnsdorp, Christine Röckmann and Karen van de Wolfshaar.
Researchers outside WUR	None
BAPS number	KB-24-005-002
Budget	€ 154.412,-
Goals of project	To participate in meetings and workshops that are considered important for the WOT Fisheries statutory tasks. With this project WMR scientists stay up to date with international developments and participate in the international science developments by presenting WMR research. Value of WOT Fisheries increases by technology or expertise transfer from international partners.
Target group for research	International science networks and ICES

## PROGRESS 2017

Results	<p>Main results:</p> <p>WMR active participation and contribution to 23 international workshops and study groups on fisheries, fish ecology, stakeholder involvement, evolutionary effects of fishing, development of new survey methods, assessment and age reading organised by ICES and WMR. This brought in added value and technology transfer to the Netherlands. WMR personnel participated in the following networks and ICES groups:</p> <p>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 (WGEGBS2), Report of the Working Group on Working Group on Biological Parameters (WGBIOP), Benthos Ecology Working Group (BEWG),</p> <p>Workshop on Stock Identification and allocation of catches of herring to stocks (WKSIDAC), Working Group on North Sea Integrated Assessments (WGINOSE), Workshop on Sexual Maturity staging from histological tools (WKMATTHIS), ICES-ICCAT Methods Working Group (MGWG), Working Group on the Ecosystem Effects of Fishing Activities (WGECO), Working Group on Maritime Systems (WGMARS), Workshop on Sexual Maturity Staging of Herring (<i>Clupea harengus</i>) and Sprat (<i>Sprattus sprattus</i>) (WKMSHS2), Working Group on Methods for Estimating Discard Survival (WGMEDS), Fish measuring board developments, In-house assessment course and Discard ban paper group.</p> <p>Products:</p> <p>Report of the Working group on integrating surveys for the ecosystem approach. ICESCM 2017/SSGIEOM: 17, Report of the Working group on integrating surveys</p>
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	<p>for the ecosystem approach. CVO/1706.366 IdB-bc;  Final Report of the Working Group on Electrical Trawling. ICESCM 2017/SSGIEOM:20, Report of the Working Group on Electrical Trawling. WMR nota; Report on the Electronic Measuring Device meeting, Rostock 31 January 2017. WMR nota; Interim Report of the Working Group on Integrated Assessments of the North Sea. ICES CM/SSGIEA:06. Report of the Working Group on Integrated Assessments of the North Sea. WMR nota 1711475-GJP-lcs; Interim Report of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB). ICESCM 2017/SSGIEOM:13. Report of the Working Group on Fishing Technology and Fish Behaviour (WGFTFB). WMR nota; Interim Report of the Working Group on Fisheries, Acoustics, Science and Technology. ICESCM 2017/SSGIEOM:12. Report of the meeting of the Working Group on Fisheries, Acoustics, Science and Technology. WMR nota; Report of the Working Group on the Ecosystem Effects of Fishing Activities (WGECO). ICES CM 2017/ACOM:26. Report of the Working Group on the Ecosystem Effects of Fishing Activities (WGECO). WMR nota 1716477.TvK.mw; Report of the Benthos Ecology Working Group (BEWG). ICES CM 2017/SSGEPD:03. Report of the meeting of the Benthos Ecology Working Group (BEWG). WMR nota; Report of the Data and Information Group (DIG). ICESCM 2017/SCICOM:02. Report of the meeting of the Data and Information Group (DIG). 1716805.IB.mw; Interim Report of the Working Group on Integrative Physical-Biological and Ecosystem Modelling. ICESCM 2017/SSGIEA:01. Report of the meeting of the Working Group on Integrative Physical-Biological and Ecosystem Modelling (WGIPEM). WMR nota; Interim Report of the Working Group on the Value of Coastal Habitats for Exploited Species (WGVHES). ICES CM 2017/SSGEPI:15. Report of the meeting of the Working Group on the Value of Coastal Habitats for Exploited Species (WGVHES). 1717132 WMR nota WGVHES; Interim Report of the Working Group on Maritime Systems. ICESCM 2017/SSGIEA:12. 1719144-Nota ICES WGMARS and WKINWA 2017 FINAL-CR-LvdV-lcs Final.</p>
Describe the realisation/ deviations of the work plans (science)	<p>For a large part, the project was realised as planned. However, WMR did not participate in the meetings of Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact (WGSPEC) and Working Group on Marine Habitat Mapping (WGMHM) because no WMR expert was available to participate in the meeting. Because of this, finances became available to participate in Working Group on Methods for Estimating Discard Survival (WGMEDS), organise an in-house assessment course and participate in the writing of a manuscript on effects of the discard ban.</p>
Describe the realisation/ deviations of the work plans (financial)	<p>At the end of Q3, it became clear that some KB WOT projects could not carry out all the work originally planned. Part of the budget that fell free was added to International exchange to be able to participate in the meetings described above.</p>
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	<p>The developed expertise underpins WMR research in technical measures, acoustics, effects of the discard ban, fish stock identification, fish ecology, stock assessment methods, maturity determination in fish, pulse trawl, evolutionary effects of fishing, data provision, biodiversity and stock structure.</p>
Science publications	<p>Each group has produced a report which is published on the ICES website: <a href="http://www.ices.dk/community/groups/Pages/default.aspx">http://www.ices.dk/community/groups/Pages/default.aspx</a></p>

General publications	Besides the ICES reports, a WMR nota is published after each meeting with the main findings of the meeting and results that are of importance for WMR and the ministry of LNV.
Other outputs/products	None
Describe links to Wageningen University projects	None
What is relevant for LNV fisheries or ecosystem management?	Products and expertise central to the development and research of fisheries in the Netherlands. Added value by participating in collaborative international projects and groups.
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) and scientists from Australia.

## SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	<p>WMR active participation and contribution to 23 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. WMR personnel participated in the following networks and ICES groups:</p> <p>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), Report of the Working Group on Working Group on Biological Parameters (WGBIOP), Benthos Ecology Working Group (BEWG), Workshop on Stock Identification and allocation of catches of herring to stocks (WKSIDAC), Working Group on North Sea Integrated Assessments (WGINOSE), Workshop on Sexual Maturity staging from histological tools (WKMATHIS), ICES-ICCAT Methods Working Group (MGWG), Working Group on the Ecosystem Effects of Fishing Activities (WGECO), Working Group on Maritime Systems (WGMARS), Workshop on Sexual Maturity Staging of Herring (<i>Clupea harengus</i>) and Sprat (<i>Sprattus sprattus</i>) (WKMSHS2), Working Group on Methods for Estimating Discard Survival (WGMEDS), Fish measuring board developments, In-house assessment course and Discard ban paper group.</p>
Dutch summary and conclusions	<p>WMR actieve deelname en bijdrage aan 23 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 WMR heeft in 2017 deelgenomen aan onderstaande netwerken en ICES groepen:</p> <p>Data and Information Group (DIG), Working Group on Integrative Physical-</p>

	<p>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), Report of the Working Group on Working Group on Biological Parameters (WGBIOP), Benthos Ecology Working Group (BEWG), Workshop on Stock Identification and allocation of catches of herring to stocks (WKSIDAC), Working Group on North Sea Integrated Assessments (WGINOSE), Workshop on Sexual Maturity staging from histological tools (WKMATHIS), ICES-ICCAT Methods Working Group (MGWG), Working Group on the Ecosystem Effects of Fishing Activities (WGECEO), Working Group on Maritime Systems (WGMARS), Workshop on Sexual Maturity Staging of Herring (<i>Clupea harengus</i>) and Sprat (<i>Sprattus sprattus</i>) (WKMSHS2), Working Group on Methods for Estimating Discard Survival (WGMEDS), Fish measuring board developments, In-house assessment course and Discard ban paper group.</p>
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#### 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. In addition, links to FAO fisheries units.
Has the project been associated with international funding sources (EU, DGIS etc.) or research programmes?	No, but underpins the research behind the Data Collection Framework 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?	The project is crucial to maintain WMR at the centre of the European network of fisheries research organisations.

Title	3. Fish ageing
Number	4311300035
Project leader	Loes J. Bolle
Other researchers in WUR	Peter v.d. Kamp, Daniel Benden, Ineke Pennock, Ruben Hoek, André Dijkman, Jan Beintema, Marcel de Vries, Peter Groot, Betty van Os, Thomas Pasterkamp, Erika Koelemij, Maadjieda Tjon-Atsoi, Andrea Sneekes, Norie v.d. Meeren and Tim Huijer
Researchers outside WUR	None
BAPS number	KB-24-005-003
Budget	Original budget: € 81.584,- € 3500,- moved to KBWOT international exchange
Goals of project	A) Maintaining the key expertise of age reading B) Improving the quality and efficiency of the whole process of fish ageing
Target group for research	This is of great relevance for WOT as market, survey and discard data are used for age-based assessments.

#### PROGRESS 2017

Results	<p>Main results (A)</p> <ul style="list-style-type: none"> <li>- International age reading exchanges and workshops</li> <li>- Training of new readers</li> </ul> <p>Main results (B)</p> <ul style="list-style-type: none"> <li>- Improvement of the quality and efficiency of fish ageing (e.g. semi-automatic sawing machine, better screens for embedding otoliths)</li> <li>- Plans on how to further improve quality and efficiency (e.g. image analysis, database adaptations, lab improvements)</li> </ul> <p>Products:</p> <ul style="list-style-type: none"> <li>- ICES or national reports on exchanges and workshops</li> <li>- ICES (2017) Report of the Working Group on Biological Parameters (WGBIOP), 2-6 October 2017, Sardinia, Italy. ICES CM 2017 /SSGIEON:08</li> <li>- Update Handboek leeftijdsbepalingen (in prep)</li> <li>- Masterplan leeftijdsbepalingen (in prep)</li> </ul>
Describe the realisation/ deviations of the work plans (science)	None
Describe the realisation/ deviations of the work plans (financial)	€ 3500,- of the original budget was moved to KBWOT international exchange
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	<p>Part A</p> <p>Maintenance of key expertise fish ageing through international calibration exchanges and workshops and through training of age readers. This is essential to ensure a quality approved WOT programme</p> <p>Part B</p> <p>The whole fish ageing process has been reviewed and potential innovations and changes that will improve quality and efficiency have been documented</p>

	(masterplan leeftijdsbepalingen). Some innovations have already been implemented. This most important developments are: <ul style="list-style-type: none"> <li>- Plans for further development of the image analysis application "Smart Dots"</li> <li>- Plans for development of a WMR image database and for automated data entry of age readings into the WMR database Frisbe.</li> <li>- Plans for improvement of methods and devices for the preparation of otoliths</li> <li>- Implementation of improvements of methods and devices for preparation of otoliths.</li> </ul>
Science publications	None
General publications	See products above
Other outputs/products	Presentation at KB WOT 2017 results mini-symposium.
Describe links to Wageningen University projects	None
What is relevant for LNV fisheries or ecosystem management?	Almost all population dynamic research carried by WMR, whether for scientific publications or for fisheries management advice, is age structured. Hence maintenance and development of the expertise fish ageing is of great importance to WMR.
Describe collaboration with any partners outside WUR (national)	None

## SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	<p>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.</p> <p>This year was the first of 3 years in which the whole process of fish ageing, from the collection of the otoliths or scales up to the databased ages and the storage of the material, will be reviewed and improved. Goals is improve both quality and efficiency through implementation of state of art methodologies.</p>
Dutch summary and conclusions	<p>De kernexpertise leeftijdsbepalingen van vissen is van essentieel belang voor alle leeftijds-gestructureerd populatie dynamisch onderzoek, zoals de toestandsbeoordelingen van visbestanden en daarmee de vangstadviezen. Onderhoud van deze kernexpertise wordt bewerkstelligd door internationale kalibratie, training en kwaliteitsborging.</p> <p>Dit jaar was het eerste jaar van een 3 jaar periode waarin we het hele proces van leeftijdsbepalingen, van het verzamelen van otolieten of schubben t/m de data- en materiaalopslag, gaan bekijken en verbeteren. Doelstelling is verbetering van zowel de kwaliteit als de efficiency door de implementatie van de nieuwste methodologieën.</p>

## INTERNATIONAL

Was the project part of an international network?	No
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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?	Fish ageing performance contributes to the standing of WMR within international (ICES) network. Both the improvement of the national age data as well as international coordination and calibration of fish ageing contribute to the quality of ICES work (e.g. stock assessments).

Title	4. Remote sensing of Intertidal Mussel beds
Number	4311300038
Project leader	Karin Troost
Other researchers in WUR	Sander Glorius, Douwe van den Ende, Sander Mûcher, Henk Kramer and Jappe Franke
Researchers outside WUR	None
BAPS number	KB-24-005-008
Budget	€ 30.640,-
Goals of project	To test, develop and implement remote sensing techniques in the regular WOT stock assessment programme for shellfish.
Target group for research	Ministry (LNV), colleague researchers, fisheries and nature policy makers (Natura 2000).

#### PROGRESS 2017

Results	<p>Main results: We collected a sufficient amount of images, and field experience, with 2 unmanned aerial vehicles (UAV) and found a suitable method for analysis. For analysis of satellite images different methods were tested and we found a method that works and will be taught to the WMR WOT team.</p> <p>Products: Draft report on UAV results, and a draft report outline on satellite results.</p>
Describe the realisation/ deviations of the work plans (science)	<p><b>UAV:</b> scientific goals were reached as planned although later in the year than planned. We acquired enough images on enough occasions and obtained enough material for analyses that are still ongoing.</p> <p><b>Satellite:</b> we planned to have a satellite-based map ready before the field season of 2017 to be able to perform field validations. However, the map was not ready in time so no field validation was performed in 2017. The adjusted goal is to have satellite based maps for the entire Wadden Sea for 2015, 2016 and 2017, classified in ArcGIS Pro, and an analysis of how well these fit to the mapped contours within the WOT shellfish programme. Analysis is still ongoing.</p>
Describe the realisation/ deviations of the work plans (financial)	The WMR part of the budget is realised as planned.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	<p><b>UAV</b> operation and analysis: how to acquire images, preparations needed, automatic classification of obtained images using ArcGIS. UAV operation may already be used as a tool to find new mussel beds in the field in the WOT shellfish programme and will certainly be useful in the TMAP Musselbeds programme within WOT Nature &amp; Environment.</p> <p><b>Satellite:</b> where and how to obtain images, classifications methods and how to perform these in ArcGIS. This will be used as a tool in the WOT 2018 survey to find new beds.</p>
Science publications	None
General publications	Two concept reports by end of December to be finalized in January
Other outputs/products	None
Describe links to Wageningen University projects	WOT Shellfish (Karin Troost), TMAP Musselbeds (Sander Glorius).



What is relevant for LNV fisheries or ecosystem management?	Develop new and innovative scientific expertise within WMR.
Describe collaboration with any partners outside WUR (national)	None

### SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	We explored the potential use of UAV and satellite images in the mapping of intertidal mussel- and oysterbeds. In 2016 and 2017 we collected images acquired by UAV and satellites. Different methods to analyse these images were explored. Both types of images are now classified using ArcGIS software. The project taught us how to use UAV, how to prepare for UAV flights, what is possible with UAV and what not (yet), and how to classify images. Both techniques are very useful, but especially the UAV part needs further technological and legal development.
Dutch summary and conclusions	Mogelijke toepassingen van UAV's en satellietbeelden bij het karteren van mossel- en oesterbanken op droogvallende platen zijn onderzocht. In 2016 en 2017 zijn beelden verzameld met UAV en uit het satellietbeelden dataportaal. Gezocht is naar methoden om deze beelden te analyseren. Uiteindelijk wordt daarvoor een classificatie methode gebruikt in het ArcGIS pakket. Beide technieken blijken zeer goed toe te passen in het onderzoek, waarbij er nog wel ontwikkelingen nodig zijn op technologisch gebied voor wat betreft UAV, en ook op het gebied van wetgeving.

### 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?	It has not yet since the project is not yet finished. The international goal is for WMR to not lag behind in applying innovative techniques. Techniques developed may be used in other countries.

Title	5. Ecosystem acoustics
Number	4311300036
Project leader	Benoit J.P. Berges
Other researchers in WUR	Serdar Sakinan, Daniel Benden and Bram Couperus.
Researchers outside WUR	None
BAPS number	KB-24-005-019
Budget	€ 38.144,-
Goals of project	<p>A few broad areas are worth focussing on and developing further as they have potential for attracting external project work, result in scientific discoveries, and improve our existing WOT programme in line with international developments and monitoring requirements so that WMR does not fall behind:</p> <p>A) Maintaining &amp; developing Ecosystem Acoustic monitoring technologies;  B) Courses, meetings, and data management.</p> <p>Within these topics, the specific objectives for the first year are as follows:</p> <ul style="list-style-type: none"> <li>- Further develop seafloor characterisation and habitat mapping methods from our acoustic survey data to better describe fish habitats.</li> <li>- Improve the collection and automatic processing of video data from the trawl camera system on R/V Tridens (Simrad FX80).</li> <li>- Further develop 3D characterisation of fish schools from multibeam echosounder data.</li> <li>- Develop methods to streamline survey data to the new ICES acoustic database standards.</li> </ul> <p>Attend the Dutch Bioacoustic Day and ICES WKQUAD.</p>
Target group for research	Pelagic ecosystem monitoring scientists.

## PROGRESS 2017

Results	<p>Main results:</p> <ul style="list-style-type: none"> <li>- Extraction of 3D characteristics of fish schools from multi-beam echosounder data (Tridens II, HERAS 2016 data).</li> <li>- Conversion of Dutch HERAS historical data to ICES database format. Submission of subsequent data to ICES data portal.</li> <li>- Detection and extraction of single fish from trawl video data.</li> <li>- Investigation of small data sample for seafloor frequency signature compared to models and multi-beam data.</li> </ul> <p>Products:</p> <ul style="list-style-type: none"> <li>- Method and supporting code (echoview template) for automated extraction of 3D characteristics of fish schools.</li> <li>- Method and supporting python code for fish detection.</li> <li>- Report summary of main results for the different components and guide to the various methods and software.</li> <li>- Tools to convert historical data of acoustic surveys to ICES database format.</li> </ul>
Describe the realisation/ deviations of the work plans (science)	<ul style="list-style-type: none"> <li>- Budget for seafloor characterisation and habitat mapping was partly used to liaise with partners in the DISCLOSE project (<a href="http://discloseweb.webhosting.rug.nl/">http://discloseweb.webhosting.rug.nl/</a>, project aimed at providing maps of the North Sea bottom) in order to spark collaboration in the next years.</li> <li>- The use of Simrad FX80 video data during fishing operation on-board Tridens II</li> </ul>

	(HERAS 2017) was initially planned for the project. However, because of the poor resolution and performances of the system, the project relied on past data that were collected using a custom apparatus that uses GoPro camera.
Describe the realisation/ deviations of the work plans (financial)	None
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	Processing of multi-beam echosounder data and trawl video data (from Tridens II) is relevant to WOT. In addition to traditional single beam echosounders, multi-beam echosounder data and video data during fishing operations can provide additional information for species recognition. In turn, these ancillary data would improve the accuracy of the scrutinizing process that takes place during routine acoustic surveys (e.g. HERAS, BWHTS). As a broader use: expertise in multi-beam echosounder processing can be further used to study fish behaviour (e.g. vessel avoidance); expertise in video data processing for species recognition can be used to investigate potential discrepancies with catch sampling.
Science publications	None
General publications	None
Other outputs/products	Report summary of main results and guide to the various methods and software. Presentation at KB WOT 2017 results mini-symposium.
Describe links to Wageningen University projects	None
What is relevant for LNV fisheries or ecosystem management?	A) Use of the methods during pelagic WOT ecosystem surveys and potential future projects (e.g. WOZEP). As a result, it will further the ecosystem monitoring capability. B) Liaise with international partners, provide data in agreement with international programmes, develop and maintain expertise in the field of active ecosystem acoustics. Acoustic methods are a vital monitoring method. Practical implementation of combined acoustic and auxilliary sampling techniques will make data analyses more efficient.
Describe collaboration with any partners outside WUR (national)	None

## SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	Ecosystem Acoustics is a multiannual project to strategically develop integrated acoustic ecosystem monitoring capabilities at WMR. The project develops new scientific methods, utilises most modern acoustic instruments and sampling platforms, and maintains standards in accordance with international scientific requirements. This year, the project has made developpements for the following: (1) automated processing of multi-beam echosounder data for 3D fish school characterisation; (2) processing of trawl video data; (3) tools to convert historical data of acoustic surveys to the ICES database format.

Dutch summary and conclusions	<p>Ecosystem Acoustics (Ecosysteem Akoestiek) is een meerjarig project om de geïntegreerde akoestische monitoringstechnieken bij Wageningen Marine Research te ontwikkelen. Er worden nieuwe methodieken ontwikkelt waarbij gebruik wordt gemaakt van moderne instrumenten en onderzoekfaciliteiten met het doel om onderzoek te doen dat voldoet aan de internationale wetenschappelijke standaard.</p> <p>Dit jaar zijn vorderingen gemaakt op de volgende onderdelen: (1) automatisering van mult-beam echolood data voor het beschrijven van visscholen in 3d; (2) verwerking van trawl video data; (3) de ontwikkeling van algoritmes voor het omzetten van historische data naar het ICES database format.</p>
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### 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?	The project supported the organisation of the bioacoustic day at WMR's location in Den Helder. This one-day conference had an attendance of 20 experts in the field of acoustics and biology from academia and industry.

6. Migration of WOT shellfish database	
Number	4311300042
Project leader	Margriet van Asch
Other researchers in WUR	Eugene Rurangwa, Ingeborg de Boois, Daniël Benden and Peter van der Kamp.
Researchers outside WUR	None
BAPS number	KB-24-005-020
Budget	€ 26.990,-
Goals of project	A stepwise migration of shellfish data into Frisbe database, and to identify and address potential problems arising from the migration. The focus of this proposal is to guarantee a continued safe storage of and continued accessibility to the shellfish data. New data is collected continuously. For the time being, this data will still be stored in the original access database. Developing procedures to import these directly into Frisbe are specifically not included within this proposal. However, once we have the scripts working to migrate everything, we plan to use these to transfer the new data on specific times (e.g. at the end of each year) into Frisbe. In a next step we could then develop procedures to do this automatically as well (e.g. similarly as import from so called Billie files as in use for fisheries data collection).
Target group for research	LNV, CVO, WMR scientists.

#### PROGRESS 2017

Results	<p>Main results in year 1 of 3: the framework for migration has been set; reference values have been added to the receiving database; first trial import has taken place successfully.</p> <p>Products in year 1 of 3:</p> <ul style="list-style-type: none"> <li>• an inventory of the additional values for the various reference tables for all data in the current Access database;</li> <li>• updated Frisbe reference tables for persons, ships, species, sampling gears;</li> <li>• overview of translation Access variables into Frisbe variables;</li> <li>• Sas script to translate Access database output into Frisbe format (version 1)</li> </ul>
Describe the realisation/ deviations of the work plans (science)	<p>The main deviation is the order of things: instead of focussing on one survey and go through the full process, the migration from the shellfish database has been evaluated from a broader perspective, and so, the follow-up should be smoother than in the original plan.</p> <p>As the mapping of the Access database and Frisbe involved a wider range of data collections than originally planned, the impact on the Frisbe tables is also higher. As a consequence, the adaptation of the database tables has been moved forward to Q1 2018.</p> <p>A trial set has been tested in the test environment of Frisbe, for the variables that could be translated to the current exchange format.</p> <p>A presentation to the current users of the shellfish database was given on 14<sup>th</sup> December 2017, to inform everyone on the progress and the next steps.</p>
Describe the realisation/ deviations of the work plans (financial)	<p>Due to delayed database developments €6.488,- could not be utilised. This budget has been transferred to a project on automated data upload to DATRAS.</p>

Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	<p>The main relevance of this project is not in the development of expertise, but in the possibility to sustainably store the WOT data. The inventory of issues has led to improvement of the data quality and consistency, as in translating the existing format to a new format smaller inconsistencies appeared.</p> <p>In the presentation, participants will be informed on the database the data will be stored in, and as such, the knowledge on the oracle database Frisbe will increase in the institute, leading to potentially a wider use of all data stored in Frisbe.</p>
Science publications	None
General publications	None
Other outputs/products	Presentation at KB WOT 2017 results mini-symposium.
Describe links to Wageningen University projects	None
What is relevant for LNV fisheries or ecosystem management?	Enhanced efficiency of several datasets at once (shellfish and fish) strongly facilitates analyses and modelling by all WMR researchers. Also better/more efficient exchange with dataportals (combinations of for instance various WOT datasets).
Describe collaboration with any partners outside WUR (national)	None

## SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	<p>The first year of the multi-annual project has led to a mapping of all variables and the reference parameters in the current (Access) database to the receiving (Oracle) database at WMR. In the Oracle database, the tables with reference parameters (e.g. vessels, species, persons) have been updated with the values derived from the Access database. A SAS programme code has been developed to translate the existing data format into a new data format, currently only for the variables that can be translated. As this is done for all information in the Access database, it is to be expected that this code needs no update once all variables are taken into account in this programme.</p> <p>In order to inform the current shellfish data end-users, a presentation to data end-users has been given on 14<sup>th</sup> December 2017 in Yerseke.</p>
Dutch summary and conclusions	<p>In het eerste jaar van dit driejarige project is een volledig overzicht gemaakt van de variabelen en de toegestane waarden in de Access database. Dit overzicht is gekoppeld aan de ontvangende Oracle database (Frisbe), waaruit volgde welke referentiewaarden (bijv. schepen, soorten, personen) nog moesten worden toegevoegd aan Frisbe. Deze zijn toegevoegd voor alle onderzoeksprogramma's die op dit moment in de Access schelpdierdatabase zijn opgeslagen.</p> <p>Daarnaast is in SAS een code geprogrammeerd waarmee gegevens van het ene bestandsformaat in het andere kunnen worden omgezet zodat deze in Frisbe kunnen worden opgeslagen. Op dit moment is dat alleen nog gedaan voor variabelen en waarden die toegestaan zijn in Frisbe.</p> <p>Een eerste test is uitgevoerd om te zien of de omzetting correct heeft plaatsgevonden.</p> <p>Op 14 december 2017 zijn eindgebruikers van de schelpdierdatabase in de</p>

	gelegenheid geweest om een presentatie over de voortgang van dit project bij te wonen.
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**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 was not an international project.

Title	7. Trendspotter
Number	4311300037
Project leader	Ingrid Tulp
Other researchers in WUR	Chun Chen, Pepijn de Vries and Daan Gerla
Researchers outside WUR	Leo Soldaat (CBS) and Hans Visser (PBL)
BAPS number	KB-24-005-021
Budget	€ 27.320,-
Goals of project	<p>For trend analyses we commonly use Trendspotter, a program that can detect flexible trends. The input of the program has hitherto been annual indices without taking variation between sites into account. We refined the trend calculations by developing a procedure in which we first calculate year indices taking account of all potential sources of variation and only after this correction use the corrected year indices in Trendspotter. Also we wanted to apply and compare two other methods for trend calculation and compare them.</p> <p>Policy makers often need a qualification of trends: are species increasing or decreasing? In this project we search for a method that takes variation into account while at the same time provide the output that policymakers need.</p>
Target group for research	Policy makers and WMR scientists.

#### PROGRESS 2017

Results	<p>Main results: We carried out a literature study comparing different trend calculation methods. Thereafter we applied different trend calculation methods to the same set of data to compare the outcome.</p> <p>Products: Presentation on 23 January and report to be ready end of January 2018.</p>
Describe the realisation/ deviations of the work plans (science)	The work was carried out according to the plans.
Describe the realisation/ deviations of the work plans (financial)	The project underspent its budget by 2k.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	We propose to use the standardised procedure developed in this project to report trends in fish in different programs.
Science publications	None
General publications	WMR report
Other outputs/products	Presentation at KB WOT 2017 results mini-symposium.
Describe links to	PMR-NCV monitoring



Wageningen University projects	
What is relevant for LNV fisheries or ecosystem management?	Improved estimates of trend developments and a standardised method for any future use.
Describe collaboration with any partners outside WUR (national)	Leo Soldaat (CBS) and Hans Visser (PBL)

### SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	Population trends seldom behave in a linear fashion. More common are flexible trends with alternating periods of increases and decreases. A tool commonly used by WMR to describe such flexible fish trends both in the marine and the fresh water environment is Trendspotter (Soldaat <i>et al.</i> 2007; de Graaf <i>et al.</i> 2015; Tulp <i>et al.</i> 2016). The program is also widely used in the Netwerk Ecological Monitoring (NEM) and provides tools to evaluate developments in populations in terms of increase and decrease, which are perceived as very useful by policy makers. However currently only annual mean values are entered into the models, and the variation caused by different locations, seasons or any other variables is neglected. In this project, we evaluated this method and compared it to other trend calculation methods. We conclude that the best way to make use of variation in trend calculations is to use a GAMM that is able to estimate the year indices with reduced variability and detect statistically significant increasing/decreasing time periods taken into account its variability.
Dutch summary and conclusions	Populatietrends ontwikkelen zich zelden volgens een rechte toe- of afnemende lijn, maar laten vaak een grillig verloop zien. Voor de berekening van trends gebruiken we vaak het programma Trendspotter. Tot nu toe hebben we als input jaarlijkse indexen gebruikt waarbij variatie tussen trekken (veroorzaakt door bv doorzicht, wind, getij) niet in de berekening betrokken werd. In dit project hebben we verschillende mogelijkheden voor trendanalyses vergeleken. Beleidsmakers hebben vaak behoefte aan duiding van trends: neemt een soort toe of af? We concluderen dat de beste keuze voor veel van onze tijdseries een GAMM is waarbij zowel covariaten meegenomen kunnen worden en waarbij ook toe-of afnames geduid kunnen worden.

### 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,	No

DGIS etc.) or research programmes?	
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	This was a national project.

Title	8. Collection and storage of data on board of Tridens II
Number	4311300039
Project leader	Ralf van Hal
Other researchers in WUR	Dirk Burggraaf and Thomas Pasterkamp
Researchers outside WUR	None
BAPS number	KB-24-005-022
Budget	€ 5.500,-
Goals of project	<p>Discuss which data are relevant for each survey and in which format (for example averages over a tow, continues during a tow, or continues during the whole survey) they should be collected.</p> <ul style="list-style-type: none"> <li>- Design software to collect and store the relevant data on board.</li> <li>- Extend the Frisbe database enabling it to store the relevant new data.</li> <li>- Test possible interference of the systems and make a list of systems necessary for each survey. So they can function without interference, or clearly specify limitations if used together.</li> </ul>
Target group for research	Mostly internally, however when the actual data is collected this would be used in various assessments and all kind of other projects. The improved data quality will be beneficial for the international (ICES) community.

#### PROGRESS 2017

Results	<p>Main results:</p> <ul style="list-style-type: none"> <li>- Overview of data streams on board of RV Tridens, including if the data is stored, if it is stored efficiently, and if not storage is preferred with which purpose.</li> <li>- Overview of acoustic equipment on board of RV Tridens, which might interfere with each other.</li> <li>- Advice on how to proceed on the storage of data on board of RV Tridens.</li> </ul> <p>Products: Report and the overviews that are useful on board and will be included in the survey manual.</p>
Describe the realisation/ deviations of the work plans (science)	The design of software and the extensions on the database have not taken place. These were goals of the original project with a bigger budget. For the current budget further development of existing software has occurred.
Describe the realisation/ deviations of the work plans (financial)	No deviations of the workplan.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	The knowledge of the technical WMR persons has increased in relation to what data is available on board of Tridens, limitations of current data storage on board, on using the Labview software, and on acoustic interference. This knowledge is relevant for the WOT as further development of all surveys on the Tridens depend on this knowledge. Next to that also the knowledge of the cruise leader of the IBTS, and by the developed overviews, also for the other cruise leaders, has increased on possibilities around collecting additional data on board of Tridens.
Science publications	None
General publications	Report and the overviews that will be included in the survey manual.
Other outputs/products	Presentation at KB WOT 2017 results mini-symposium.

Describe links to Wageningen University projects	None
What is relevant for LNV fisheries or ecosystem management?	The additional data will improve the understanding of the primary data collected.
Describe collaboration with any partners outside WUR (national)	None

### SUMMARY

Non scientific partners	Work is carried out on board of the Rijkswaterstaat vessel Tridens, assistance was provided by the crew on board and also the technical company which installed and advised on most of the on board equipment.
Summary and Conclusions of Project	<p>The project resulted in an overview of 15 devices producing data, which might be of relevance for scientific use. Along with this overview, the description (details of the produced data strings) is provided making it easier to handle it in storage/display software.</p> <p>The currently used storage software build in Labview is analysed to test its capability to handle the additional data. The conclusion is that the current software is not capable of doing that. The advice is to rebuild the software. As a rebuild is required, it is questioned if this should be done in Labview again, as the available Labview developers knowledge is limited. The expectation is that the software can be built in Python as well, and more developers knowledge for this is available.</p> <p>Some of the new equipment produces sound (acoustic equipment) or noise. An overview is given of these sources of sound and their potential interference, if the devices are not synchronised.</p>
Dutch summary and conclusions	<p>The project heeft geleid tot een overzicht van 15 verschillende apparaten die data produceren, welke mogelijk relevant is voor wetenschappelijk gebruik. Voor sommige van deze apparaten is uitgebreide beschrijving, inclusief de gedetailleerde data string, gegeven. Deze data string moet worden opgepikt door de opslag/display software.</p> <p>De huidige software, gemaakt in Labview, is geanalyseerd op de mogelijkheden om de nieuwe data te kunnen gebruiken. De conclusie is dat dit niet mogelijk is en dat een herstructurering van de huidige software nodig is. Dit gestelde vraag is of dit weer moet in Labview, de beschikbare ontwikkelaarskennis van Labview is beperkt. Het is aannemelijk dat het programma ook gebouwd kan worden in Python waarvoor veel meer ontwikkelaarskennis beschikbaar is.</p>

### INTERNATIONAL

Was the project part of an international network?	No
Who were the international partners?	None
Has the project	No

<p>been associated with international funding sources (EU, DGIS etc.) or research programmes?</p>	
<p>How much funding came from these sources?</p>	
<p>How did the project position Wageningen Marine Research internationally?</p>	<p>The Tridens is used in international projects, enabling the storage of more relevant data, makes the Tridens more interesting to be used as a research vessel, and makes the collected data by WMR more relevant and applicable.</p>

<b>Title</b>	<b>9. Improving herring larvae surveys indices (HERLARS)</b>
Number	4311300040
Project leader	Cindy J.G. van Damme
Other researchers in WUR	Niels Hintzen and Loes Bolle
Researchers outside WUR	Frank Kleissen (DELTAARES), Richard Nash (IMR, Norway) and Matthias Kloppmann (TI, Germany)
BAPS number	KB-24-005-023
Budget	€ 62.224,-
Goals of project	<p>The study has 5 objectives</p> <ol style="list-style-type: none"> <li>1. Predict, on a yearly basis, the area where autumn spawned herring larvae can be found during the timing of the IBTS-MIK survey (hereby providing a flexible boundary to exclude the English channel (Down's) herring larvae that cannot be sampled appropriately [Down's larvae are too small at the timing of the IBTS-MIK survey to provide information for a recruitment index], but does add noise to the current practice in generating the MIK recruitment index used in the assessment)</li> <li>2. Predict the area where Down's larvae may appear as late larvae (indicator of recruitment) in the southern North Sea along the coastline</li> <li>3. Estimating the impact of reducing the survey effort in the IHLS survey on the assessment outcomes (anticipating a displacement of IHLS survey effort to a Down's recruitment survey)</li> <li>4. Trial a survey dedicated to monitor Down's recruits</li> <li>5. Evaluate usability of small IBTS-MIK larvae (currently unused) as a supplement to the IHLS survey data to improve the newly hatched survey time-series</li> </ol>
Target group for research	Audience is managers (for efficient WOT programme and effective management), industry (for higher reliability on predicted fisheries opportunities), NGOs (for more effective management being at target) and science (to illustrate how larval survey data can be used in assessments), in the order of importance.

## PROGRESS 2017

Results	<p>Main results:</p> <p>The project focussed on objectives 1, 2, 3 and 5 in 2017. DELTAARES ran their hydrodynamic model showing herring larvae distributions from 2004 until 2011. The model includes larval behaviour in three development stages based on length. The first stage the larvae drift from the bottom, where they hatched from the demersal eggs, to the surface. In stage two the larvae start to develop their daily migration pattern and in stage three the daily migration pattern is fully developed at its maximum magnitude. This daily migration pattern is important because the drift is depending on the place in the water column. Mortality is not included in the drift model.</p> <p>The model ran from 15 December until 1 July each year. Total numbers and numbers at length of the herring larvae per ICES rectangle for each 14-day period resulted from the model.</p> <p>The model provides information on the amount of Down's larvae that need to be removed from the IBTS-MIK recruitment index (objective 1). It also provides the 'Downs' larvae distribution at the late development stage (objective 2).</p> <p>For objective 3 the assessment model was run removing one of the three herring larvae surveys carried out in December and January each year. The impact of this</p>
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	<p>was a maximum of 2% on the SSB estimate. From this it was concluded that the herring larvae survey carried out by the Netherlands in January can be dropped in favour of developing a recruitment survey for 'Downs' larvae (objective 4). Despite the low effect the herring larvae surveys have on the assessment, it is important to keep carrying them out, as this is the only index to provide information on the different spawning components in the North Sea.</p> <p>In 2014 comparative trials on the catchability of herring larvae between the MIK-net and Gulf VII plankton sampler were carried out in the KB WOT project HERCATCH. The Gulf VII is used during the herring larvae surveys and the MIK-net during the IBTS-MIK survey. From HERCATCH a conversion factor, to convert the newly hatched larvae from the MIK-sampling to the Gulf VII sampling, was gained. With this it was possible to create a new Larval Abundance Index (LAI) for use in the assessment (objective 5).</p> <p>Results were presented at the Larval Fish Conference (LFC) and at the ICES Data Collection workshop for the herring benchmark.</p> <p>Products:</p> <p>Larval distributions from 2004 until 2011 per 14 days period from 15 December until 1 July.</p> <p>Impact assessment of removing one of the herring larvae surveys from the North Sea herring assessment.</p> <p>Input for a new 'Downs' recruitment survey in spring.</p> <p>Modified Larval Abundance Index including newly hatched larvae from the MIK-samplings.</p> <p>Presentations at the LFC, ICES and WMR. A CVO report will be published with the results beginning 2018.</p>
Describe the realisation/ deviations of the work plans (science)	The work was carried out according to the original plan.
Describe the realisation/ deviations of the work plans (financial)	There were no financial deviations from the work plan.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	<p>The herring larvae surveys carried out by the Netherlands are part of the statutory tasks. With the results of this project the current indices derived from these surveys can be modified and improved, thus improving the North Sea herring assessment. With these results it is possible to develop a new extra 'Downs' recruitment survey within the same budget currently available for the herring larvae surveys. Currently no information is available on 'Downs' recruitment to the North Sea herring stock.</p> <p>The larval drift modelling is also important for other species in the North Sea, but is also an important example for larval drift in other areas around the world.</p>
Science publications	Presentations at the LFC, ICES and WMR. The CVO report will form the basis of a peer-review manuscript.
General publications	CVO report with results of the project to be published beginning of 2018.
Other outputs/products	<p>Herring larval distributions in the southern North Sea per 14-day period from 15 December until 1 July.</p> <p>Presentation at KB WOT 2017 results mini-symposium.</p>
Describe links to	None

Wageningen University projects	
What is relevant for LNV fisheries or ecosystem management?	Improved understanding on how variability in larvae distribution can be treated more scientifically robust for assessment purposes.
Describe collaboration with any partners outside WUR (national)	DELTAIRES carried out the hydrodynamic modelling providing the herring larvae distributions.

## SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	<p>DELTAIRES ran their hydrodynamic model showing herring larvae distributions from 2004 until 2011. The model includes larval behaviour in three development stages based on length. Total numbers and numbers at length of the herring larvae per ICES rectangle for each 14-day period resulted from the model. The model provides information on the amount of Down's larvae that need to be removed from the IBTS-MIK recruitment index (objective 1). It also provides the 'Downs' larvae distribution at the late development stage (objective 2). For objective 3 the North Sea herring assessment model was run removing one of the three herring larvae surveys carried out in December and January each year. The impact of this was a maximum of 2% on the SSB estimate. From this it was concluded that the herring larvae survey carried out by the Netherlands in January can be dropped in favour of developing a recruitment survey for 'Downs' larvae (objective 4). Despite the low effect the herring larvae surveys have on the assessment, it is important to keep carrying them out, as this is the only index to provide information on the different spawning components in the North Sea. In 2014 comparative trials on the catchability of herring larvae between the MIK-net and Gulf VII plankton sampler were carried out in the KB WOT project HERCATCH. From this a conversion factor, to convert the newly hatched larvae from the MIK-sampling to the Gulf VII sampling, was gained. With this it was possible to create a new Larval Abundance Index (LAI) for use in the herring assessment (objective 5).</p>
Dutch summary and conclusions	<p>DELTAIRES heeft haar hydrodynamisch model laten lopen voor de modellering van haring larven distributie vanaf 2004 tot 2011. In het model was het haring larven gedrag gebaseerd op lengte ingevoegd. The resultaat van het model is het totaal aantal larven en larven per lengteklasse per 14-daagse periode, van 15 december tot 1 juli per jaar.</p> <p>Dit levert informatie over het aantal 'Downs' larven die verwijderd moeten worden uit de IBTS-MIK recruitment index (doel 1). Het levert ook de informatie over de distributie van ontwikkelde 'Downs' haringlarven in het voorjaar (doel 2). Het huidige Noordzee haring assessment model was gerund terwijl er een van de huidige haringlarven surveys weggelaten werd als input data. Dit bleek slechts een effect van maximaal 2% te hebben op de SSB berekening (doel 3). Hieruit is geconcludeerd dat het mogelijk is om de haringlarvensurvey, die Nederland uitvoert in januari, om te zetten in een nieuwe extra 'Downs' recruitment survey (doel 4). Ondanks het lage effect dat de haringlarven surveys hebben op de SSB schatting, is het van groot belang deze surveys wel uit te blijven voeren omdat ze</p>



	<p>de enige bron van informatie zijn over de ontwikkeling van de afzonderlijke paaicomponenten.</p> <p>In 2014 is er in het KB WOT project HERCATCH een vergelijkend vissen experiment uitgevoerd tussen onder andere het MIK-net en het Gulf VII planktontuig. De conversie factor die hieruit voort kwam is gebruikt om de net gepaarde haringlarven uit de MIK-monsters om te zetten naar een Gulf VII bemonstering. Hiermee was het mogelijk om de Larval Abundance Index (LAI) welke gebruikt wordt in het assessment van de Noordzee haring aan te passen (doel 5).</p>
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### INTERNATIONAL

Was the project part of an international network?	Yes, ICES.
Who were the international partners?	Richard Nash (IMR, Norway) and Matthias Kloppmann (TI, Germany) provided advice for the project.
Has the project been associated with international funding sources (EU, DGIS etc.) or research programmes?	None
How much funding came from these sources?	
How did the project position Wageningen Marine Research internationally?	<p>This project resulted in improved understanding on how variability in larvae distribution can be treated more scientifically robust for assessment purposes.</p> <p>This is an important example for other areas. The results of this project have led to improved indices used in the North Sea herring assessment. With the new 'Downs' recruitment survey WMR will be the only one able to provide direct information on the recruitment of the 'Downs' component.</p>

Title	10. Density-dependent individual growth reduction of North Sea plaice
Number	4311300041
Project leader	Tobias van Kooten
Other researchers in WUR	Karen van de Wolfshaar and Ralf van Hal
Researchers outside WUR	André de Roos
BAPS number	KB-24-005-024
Budget	€ 43.280,-
Goals of project	Make the above risk concrete based on available data, translate to advice for the assessment group, publish findings in scientific literature.
Target group for research	ICES advice groups, in particular WGNSSK, policymakers and fisheries scientists.

### PROGRESS 2017

Results	Main results: EU-funded PhD student; subject on the agenda at ICES WGECO. Products: partial publication, to be finished in the first quarter of 2018.
Describe the realisation/ deviations of the work plans (science)	Analysis of data has been conducted largely as planned (add market data, analyse more species). We have done additional analysis on plaice to better understand the patterns observed. We have written part of the scientific manuscript. The advice to WGNSSK will be realized through incorporation of this subject in the terms of reference of WGECO for the next 3 years. Furthermore, the preliminary analysis has allowed us to successfully participate in an EU proposal, which will fund a PhD student who will further develop this research line.
Describe the realisation/ deviations of the work plans (financial)	Not all budget has been spent, mostly due to illness of one of the researchers involved at the end of the year.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	The expertise developed is important to understand changes in fish stocks that recover from overfishing. Such understanding is necessary for the appropriate management of recovered stocks in the future.
Science publications	Manuscript in preparation.
General publications	None
Other outputs/products	Presentation at KB WOT 2017 results mini-symposium.
Describe links to Wageningen University projects	None
What is relevant for LNV fisheries or ecosystem management?	The expertise developed is important to understand changes in fish stocks that recover from overfishing. Such understanding is necessary for the appropriate management of recovered stocks in the future.
Describe collaboration with	Collaboration with prof Andre de Roos (University of Amsterdam) for his expertise on population dynamics

any partners outside WUR (national)	
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## SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	We studied the occurrence of reduced individual growth and physical condition rate in several North Sea flatfish species, which have strongly increased in abundance in the last decade. We have found evidence of these effects in fisheries-independent survey data but also in market samples. This latter finding indicates that while quota are high, catches consist mostly of small and skinny fish, which have relatively low market value. The implication of this is that even though quota are high, the small size of the fish makes exploitation economically difficult and also more wasteful, as skinny fish have a relatively high proportion of inedible biomass (bones, skin, etc.).
Dutch summary and conclusions	In dit werk bestuderen we het voorkomen van groeivertraging en verslechterde conditie in een aantal platvissoorten waarvan de bestanden de laatste 10 jaar enorm zijn gegroeid. We vonden deze effecten in visserij-onafhankelijke bemonsteringsgegevens, maar ook in de marktmonitoring. Dat laatste betekent dat, ondanks ruime quota, de vangsten vooral uit kleine en magere vis bestaan, met een zeer geringe marktwaarde. Dat betekent dat ondanks de gunstige omvang van de bestanden, een rendabele visserij wordt bemoeilijkt. Daarnaast is de visserij meer verkwistend, omdat magere vissen relatief veel niet-eetbare biomassa (botten, huid, enz.) bevatten.

## INTERNATIONAL

Was the project part of an international network?	Not originally planned, but yes.
Who were the international partners?	Ken Andersen (DTU aqua, Denmark)
Has the project been associated with international funding sources (EU, DGIS etc.) or research programmes?	There is a future association: The work in this project has directly allowed us to participate successfully in an EU H2020 application.
How much funding came from these sources?	None
How did the project position Wageningen Marine Research internationally?	As an international authority on the dynamics of size structured fish populations and effects of fishing on such populations.

Title	11. Incidental Bycatch
Number	4311300043
Project leader	Edwin T.M. van Helmond
Other researchers in WUR	Bram Couperus and Marloes Kraan
Researchers outside WUR	Ince Iksan Kaimuddin (student Environmental Policy Group) and Martin Pastoors (PFA)
BAPS number	KB-24-005-025
Budget	€ 23.660,-
Goals of project	Improve recording of bycatch of protected or rare species and alter/improve data handling systems to ensure that bycatch records are stored and accessible for ICES and EU related reporting. Without good communication with crews and acceptance of monitoring of incidental bycatch recording would not take place, therefore the focus of this project is to improve communications and explain importance of incidental bycatch monitoring to fishermen.
Target group for research	Presentation of sampling approach for ICES WGCATCH and WGBYC.

## PROGRESS 2017

Results	<p>Main results:</p> <ol style="list-style-type: none"> <li>1. Internal guidance and education on on-board sampling within the WOT discard sampling, resulting in integration of sampling of rare species: An impact analyses has been made for the adaptation of the Frisbe database. A temporal solution for the registration has been created for the collection of data in Billie in order to be able to store the data in the database.</li> <li>2. In order to improve communication with crews, a plan has been developed amongst the team members to investigate the communication on the topic. A master student of ENPanalyse the social practice of fishing in the pelagic fishery with focus on the perceptions and practices of incidental bycatch. He will board a pelagic trawler for participant observation in December and interview crew on board and afterwards.</li> <li>3. A self-sampling scheme of rare fish species proposed to the Pelagic Freezer Association (PFA); it was agreed with the PFA that it will fund a photo guide of meso pelagic fish in the catch of pelagic trawlers. A student currently prepares photo fact sheets as basis for this guide</li> </ol> <p>Products:</p> <p>An impact analyses has been made for the adaptation of the Frisbe database. A temporal solution for the registration has been created for the collection of data in Billie in order to be able to store the data in the database.</p> <p>In order to improve communication with crews, a plan has been developed amongst the team members to investigate the communication on the topic.</p> <p>A self-sampling scheme of rare fish species proposed to the Pelagic Freezer Association (PFA).</p>
Describe the realisation/ deviations of the work plans (science)	<p>After meetings with the PFA, it appears that the topic of incidental bycatches is even more sensitive than expected. The planned outputs of an article in Visserijnieuws and interviews with skippers have been postponed to next year.</p> <p>Instead, effort has been put in understanding and describing the perspectives and practices of crew on pelagic trawlers towards incidental bycatch.</p> <p>Regarding the development of new methods to increase coverage of bycatch of</p>

	<p>rare species, we initiated a self-sampling program on board trawlers. The plan has been accepted and will start in 2018.</p> <p>The guidance of WMR observers and the adaption of the database is in progress.</p>
Describe the realisation/ deviations of the work plans (financial)	According to plan.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	Design a new data storage and- handling system for incidental bycatch. Understanding motivations of fishers in recording by-catch. Implementation of innovative sampling designs, technology and methods (e.g. comprehensive protocols on bycatch monitoring).
Science publications	Not yet.
General publications	Not yet.
Other outputs/products	<p>A social sciences student will investigate the practices and perceptions of crew towards incidental bycatch a/b trawler. This was not a planned activity in the proposal of last year. However, the topic of incidental bycatch appears so sensitive in the pelagic fleet that we have decided to first describe the considerations and motivations of crewmembers in the context of the social practice of fishing, before starting to inform and educate.</p> <p>Presentation at KB WOT 2017 results mini-symposium.</p>
Describe links to Wageningen University projects	The social sciences student studies at the Environmental Policy Group at Wageningen University.
What is relevant for LNV fisheries or ecosystem management?	Increased insight in incidental bycatch of protected species. The implementation of sampling of protected species is a requirement in the new EU MAP
Describe collaboration with any partners outside WUR (national)	None

## SUMMARY

Non scientific partners	Pelagic Freezer Trawler Association
Summary and Conclusions of Project	<p>In the new EU MAP it is mandatory to monitor protected and rare species. However, the current WMR sampling programme for protected species needs improvement. The aim of this study is to improve and innovate recording, data handling and storage systems of bycatch of protected and rare species. This includes the removal of the current taboo on the registration of protected species bycatch and to work towards a more open, transparent attitude in crews of fishery vessels and by on board observers. The original objective was to inform crews by means of articles in Visserijnieuws and to address skippers in port. After meeting with the PFA, it appeared that the subject was too sensitive for this direct approach. Instead the perceptions and practices of the crew are now investigated. Internal at WMR, observers are guided to integrate the monitoring of incidental bycatch in EU MAP sampling.</p>

	The adaptation of the database is in progress: an impact analysis has been prepared. Meanwhile a temporary solution has been made to collect and store the data in Frisbe.
Dutch summary and conclusions	In de nieuwe EU MAP is de monitoring van incidentele bijvangst van beschermde soorten opgenomen. De bemonstering binnen WMR moet hiervoor worden aangepast. Het doel van deze studie is om de registratie, databeheer- en opslag van de bijvangst van beschermde soorten te verbeteren. Hierbij is een belangrijk onderdeel het wegnemen van het taboe van registratie van beschermde diersoorten en het bereiken van een transparante grondhouding, zowel bij bemanningen van visserijvaartuigen als bij waarnemers aan boord. Het oorspronkelijk plan om bemanningen te benaderen en te informeren door middel van artikels in Visserijnieuws is bijgesteld, omdat - na overleg met de PFA – dit issue te gevoelig ligt. In plaats daarvan wordt nu de visserijpraktijk en de percepties van de bemanning ten opzichte van dit onderwerp bestudeerd. Intern (bij WMR) worden waarnemers begeleid bij de integratie van de bemonstering van incidentele bijvangsten in de EU MAP bemonstering. De aanpassing van de database vindt plaats. Er is een impact analyse gemaakt. Er is een voorlopige oplossing bedacht voor het verzamelen van de data in Billie en de opslag van de data in Frisbe.

#### 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?	In the ICES community, representatives of EU member states are looking at WMR, as the leading institute of how to start to implement the monitoring of protected species in the new EU-MAP.

<b>Title</b>	<b>12. Developing tools to incorporate ecosystem considerations into management</b>
Number	4311300044
Project leader	Thomas Brunel
Other researchers in WUR	Alfonso Perez Rodriguez
Researchers outside WUR	Mark Payne (DTU Aqua)
BAPS number	KB-24-005-026
Budget	€ 32.000,-
Goals of project	Define and develop methods to incorporate knowledge on ecosystem into the management process, by proposing management targets that respond to environmental changes as well as changes in other components of the ecosystem. Using the case study proposed (blue whiting-hake), the potential gain of such an ecosystem based management can be illustrated for different scenario of management goals (e.g. maximising the yield of blue whiting, maximising the yield of hake, maximising the combined yield). The project is distributed over two years, with the first year being devoted to review previous work and design of the simulation model. The final definition of environmental and management scenarios, testing the simulation performance and key dissemination activities will be conducted in the second year. The main reasons for this division is to link with on-going work in the EU (linking to H2020 which are not active yet, but will become so in 1-year time) and time needed to accurately deal with the complexity of this project.
Target group for research	National government, EU commission and scientific community.

## PROGRESS 2017

Results	<p>Main results:</p> <p>In the particular case of the blue whiting/hake complex taken as case study in this work, little benefit was found in a management strategy in which management targets change over time to adapt to environmental changes and to take account of species interactions, compared to the current management based on the MSY approach.</p> <p>When using a hockey-stick SSB-Recruitment relationship, despite the maximum yield differ between recruitment regime scenarios, the <math>F_{msy}</math> was very similar in the high and medium recruitment regimes. In the low recruitment scenario <math>F_{msy}</math> was lower due to the restrictions in the maximum <math>F_{bar}</math> allowed by the 5% limit of risk of being bellow <math>B_{lim}</math> in the long term simulations.</p> <table border="1"> <thead> <tr> <th colspan="8">Low recruitment</th> </tr> <tr> <th>speci</th> <th>scale_eff</th> <th>Fbar</th> <th>SSB</th> <th>Blim</th> <th>Yield</th> <th>MSY</th> <th>Relat_M</th> </tr> </thead> <tbody> <tr> <td>hake</td> <td>4.2</td> <td><b>0.1932</b></td> <td>34617</td> <td>32000</td> <td>65478</td> <td>67647</td> <td>0.96793</td> </tr> <tr> <td>blue</td> <td>0.9</td> <td><b>0.1021</b></td> <td>29092</td> <td>13663</td> <td>48476</td> <td>62989</td> <td>0.76959</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="8">All data</th> </tr> <tr> <th>speci</th> <th>scale_eff</th> <th>Fbar</th> <th>SSB</th> <th>Blim</th> <th>Yield</th> <th>MSY</th> <th>Relat_M</th> </tr> </thead> <tbody> <tr> <td>hake</td> <td>4.8</td> <td><b>0.2446</b></td> <td>34909</td> <td>32000</td> <td>79331</td> <td>82776</td> <td>0.95838</td> </tr> <tr> <td>blue</td> <td>0.9</td> <td><b>0.1035</b></td> <td>80591</td> <td>13663</td> <td>13464</td> <td>16052</td> <td>0.83879</td> </tr> </tbody> </table> <p><b>High</b></p>	Low recruitment								speci	scale_eff	Fbar	SSB	Blim	Yield	MSY	Relat_M	hake	4.2	<b>0.1932</b>	34617	32000	65478	67647	0.96793	blue	0.9	<b>0.1021</b>	29092	13663	48476	62989	0.76959	All data								speci	scale_eff	Fbar	SSB	Blim	Yield	MSY	Relat_M	hake	4.8	<b>0.2446</b>	34909	32000	79331	82776	0.95838	blue	0.9	<b>0.1035</b>	80591	13663	13464	16052	0.83879
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specie	scale_eff	<b>Fbar</b>	SSB	Blim	Yield	MSY	Relat_M
hake	5.1	<b>0.2746</b>	35032	32000	86673	93012	0.93184
blue	0.9	<b>0.1032</b>	1.2E+	13663	20555	23873	0.86101

When running a high number of long term simulations with different combinations of recruitment regime periods, no important benefits were obtained by switching the management reference points (adaptive strategy) in adaptation to the changes in recruitment or maintaining constant values of  $F_{msy}$  (constant strategy). Very similar yield was obtained. The risk was slightly lower in the adaptive strategy, although it was also very low in the constant strategy. The most important differences of an adaptive management strategy were observed in the SSB and the interannual yield variability, although these differences were still reduced.

As a sensitivity test, different Ricker SSB-Recruitment curves were fit to the three group of SSB-Recruitment periods (high recruitment period, all years (as medium recruitment regime) and low recruitment period). The obtained Ricker SSB-Recruitment curves were modified to ensure that three different curves in magnitude and shape were obtained for the three recruitment regime periods. Unlike with the hockey stick model, different  $F_{msy}$  values were obtained for all the three recruitment regimes.

Low recruitment							
specie	scale_effo	<b>Fbar</b>	SSB	Blim	Yield	MSY	Relat_M
hake	4.2	<b>0.1925</b>	34196	32000	64783	65259	0.99270
blue	1.2	<b>0.1318</b>	22603	13663	47894	61336	0.78084

All data							
specie	scale_effo	<b>Fbar</b>	SSB	Blim	Yield	MSY	Relat_M
hake	4.8	<b>0.2371</b>	32041	32000	73508	73846	0.99542
blue	1.5	<b>0.1626</b>	38909	13663	99038	11597	0.85396

High recruitment							
specie	scale_effo	<b>Fbar</b>	SSB	Blim	Yield	MSY	Relat_M
hake	4.8	<b>0.2541</b>	38056	32000	85694	86932	0.98575
blue	2.4	<b>0.2439</b>	53597	13663	19598	22190	0.88316

However, despite the difference in the recruitment regime, the same results were obtained when running long term simulations with variable recruitment regime periods over time. The adaptive and the constant management strategies produced very similar outputs in terms of total yield, SSB, risk of being bellow Blim and inter annual catch variability.

The absence of marked difference in the benefits of an adaptive versus a constant management strategy, even if different  $F_{msy}$  values were obtained for the three recruitment regimes was due to the low difference in total catch (and hence removals from the blue whiting population) that these different  $F_{msy}$  values actually implied (See yield/ $F_{bar}$  curves in the figure below).



	<p>Products:</p> <p>An implementation of the GADGET model for the hake/blue whiting species complex.</p>
Describe the realisation/ deviations of the work plans (science)	The project had to be run in 1 year instead of 2, as funding was not granted for the second year. The work planned for 2018 had therefore to be partially covered in 2017. Work realisation involved: literature review / recruitment modelling / setting up gadget /estimating reference points / simulation based on different management scenarios.
Describe the realisation/ deviations of the work plans (financial)	According to planning for the first year, 2017.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	<p>Development of a conceptual framework for Fmsy estimation in a multispecific context.</p> <p>Better understanding of the effect of environmental regimes and species interactions on management reference points.</p> <p>Development of a simulation framework to test ecosystem based management.</p>
Science publications	None
General publications	None
Other outputs/products	Presentation at KB WOT 2017 results mini-symposium.
Describe links to Wageningen University projects	None
What is relevant for LNV fisheries or ecosystem management?	Bringing the current knowledge on trophic interactions and environmental effects on fish stocks into the advice framework.
Describe collaboration with any partners outside WUR (national)	None

**SUMMARY**

Non scientific partners	None
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<p>Summary and Conclusions of Project</p>	<p>The project aimed at developing management rules for an “ecosystem approach to fisheries management”. We focused on two ecosystem effects influencing the dynamics of fish stocks: environmental regimes and trophic interaction. The blue whiting / hake complex was taken as case study. The study was based on a multispecies model, GADGET, in which the recruitment dynamics of blue whiting was varying between low productivity and high productivity regimes. Management targets (Fmsy) were derived in three different ways: 1) assuming constant productivity and no interaction between the stocks, 2) assuming 2 recruitment regimes (productivity) for blue whiting and no interaction, 3) assuming 2 recruitment regimes for blue whiting and trophic interactions with hake.</p> <p>Managing the 2 stocks using an adaptive strategy (changing the management target for blue whiting depending on the environmental regime) did not improve management. The only minor benefit was a reduction of the risk for the stocks to fall below Blim (which was already low). There was no clear benefit either in using the multispecies Fmsy values as management targets.</p> <p>For this specific case study, the lack of benefit in implementing an ecosystem based management approach is explained by the very flat shape of the equilibrium catch vs. fishing mortality curves, and the large overlap in the fishing mortality corresponding to pretty high yields in the different scenarios.</p>
<p>Dutch summary and conclusions</p>	<p>Het project was gericht op het ontwikkelen van beheersregels voor een "ecosysteembenadering van visserijbeheer". We hebben ons gericht op twee ecosysteemeffecten die van invloed zijn op de dynamiek van visbestanden: milieusystemen en trofische interactie. Het blauwe wijting/ heekcomplex werd als casus genomen. De studie was gebaseerd op een meer-soorten-model, GADGET, waarin de rekruteringsdynamiek van blauwe wijting varieerde tussen lage productiviteit en hoge productiviteitsregimes.</p> <p>Managementdoelen (Fmsy) zijn op drie verschillende manieren afgeleid: 1) uitgaande van constante productiviteit en geen interactie tussen de bestanden, 2) uitgaande van 2 wervingsregimes (productiviteit) voor blauwe wijting en geen interactie, 3) ervan uitgaande dat er 2 wervingsregimes voor blauwe wijting zijn en trofische interacties met heek.</p> <p>Het beheren van de 2 bestanden met behulp van een adaptieve strategie (het wijzigen van het managementdoel voor blauwe wijting afhankelijk van het milieuregime) heeft het management niet verbeterd. Het enige kleine voordeel was een vermindering van het risico dat de bestanden daalden onder Blim (die al laag was). Er was ook geen duidelijk voordeel bij het gebruik van de Fmsy-waarden voor meerdere speerpunten als managementdoelen.</p> <p>Voor deze specifieke casus wordt het gebrek aan voordeel bij de implementatie van een ecosysteemgerichte managementaanpak verklaard door de zeer vlakke vorm van de vangst- versus visserijsterftecurven, en de grote overlap in de visserijsterfte overeenkomend met behoorlijk hoge opbrengsten in de verschillende scenario's.</p>

**INTERNATIONAL**

<p>Was the project part of an international network?</p>	<p>No</p>
<p>Who were the international</p>	<p>None</p>

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?	Not applicable.

Title	13. Catch monitoring
Number	4311300045
Project leader	Edwin T.M. van Helmond
Other researchers in WUR	Ruben Verkempynck, Daniel Benden and Dirk Burggraaf
Researchers outside WUR	None
BAPS number	KB-24-005-027
Budget	€ 33.849,-
Goals of project	<p>Case study 1:</p> <p>The aim of this study is to develop an electronic monitoring system that helps observers to improve catch recording on pelagic trawlers. This system enables observers to take pictures from the unsorted catch during transport over the conveyer belt to the sorting machine. These pictures provide a digital 'snap-shot' of catch compositions. A series of pictures, e.g. 50 – 100 snap shots, during the total duration of catch processing, will provide an accurate estimate of the catch composition. Compared to the current protocol, where observers sample only one or two baskets of fish from the total catch, digital snap shots provide a higher sampling density, and therefore, a more representative sample of the catch. In addition, the risks of taking digital pictures with a camera that can be controlled by a laptop from a distance will be considerably less, than taking a physical catch samples from a fast running conveyor belt.</p> <p>Case study 2:</p> <p>The aim of this study is to compare on-board and onshore sampling of BMS and to develop an alternative method to sample the BMS fraction of catches in the demersal fleet. So that the time series of catches used in the assessments of several commercial species is safeguarded.</p> <p>Common objective:</p> <p>From both case studies best practices will be learned so that both methodologies being developed in the pelagic and demersal fleet can be used in the other fleet as well.</p>
Target group for research	Ministry, fishing industry and research institutes.

### PROGRESS 2017

Results	<p>Main results:</p> <p>Prototype of CatchCam system. Image-recordings during trial runs on surveys.</p> <p>Products:</p> <p>Proto type and GUI.</p>
Describe the realisation/ deviations of the work plans (science)	<p>Case study 1:</p> <p>The basis of the system (prototype) and Graphical User Interface (GUI) were developed in the initial year. Test runs on survey vessels exposed several technical issues. The most critical issue is the storage process of the system. The storage process has a negative impact on control function of the system, this results in limitations of the storage capacity and processing time of the system, in other words, the more storage used more time is needed to take a picture. Minor issues are incorrect time registration and the inability to unpack storage files on board (data need to be downloaded first on external computer). Hardware failures include corrupted hard drives and limited power supply. Dealing with these</p>

	<p>issues consumed a considerable amount of resources during the second year. To compensate for this loss resources from case study 2 were made available (case study see below). Nevertheless, the data recorded during the trials are of sufficient quality and giving us the confidence that we can meet the aims of the project. Currently, preparations are ongoing to trial the system on a commercial fishing vessel. For the time being less images per time unit are recorded until the storage issue is solved.</p> <p>Case study 2:  In 2017 the next step in the phasing of the landing obligation was realised. This means that in 2017 again different species that are caught in several different meters were added to the list of species of which all catch is obliged to land (part of the catch are landings, the other part is BMS landings). However, to cope with the landing obligation several exemptions are granted. This adds to the complexity of this management tool. The project was setup to engage in exploratory field sampling of these BMS landings at the Dutch fish auctions. In practice, only a small amount of BMS (compared to what was expected to be landed from previous project (KBWOT 2016)) is landed in Dutch harbours. This meant that the works from the project in this year could not be performed because almost no BMS was being landed. Several reasons can be thought of why only a small amount of BMS is being landed:</p> <ul style="list-style-type: none"> <li>- The complexity of the management measure (fishermen may not know they are obliged to land BMS).</li> <li>- Poor enforcement of the management measure.</li> <li>- There are less discards.</li> </ul> <p>For the project in 2018, works will deal with the above situations.</p>
Describe the realisation/ deviations of the work plans (financial)	<p>Budget for 2017 is expended in case study 1. During the second year loss of resources were compensated with available budget from case study 2 (see previous section).</p> <p>Budget of case study 2 is not expended.</p>
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	<p>Development of technical expertise, software development, monitoring knowledge. A transportable electronic monitoring device in combination with computer vision software is of relevance in any situation where species recorded and/ or measured. Therefore, we see also potential outside the scope of monitoring commercial vessels, for example to take samples on scientific survey vessels and port/market sampling programmes. Just by "flashing" individual fish under the camera system, species and length will be recorded in a fraction of a second, making manual or electronic measuring boards redundant.</p>
Science publications	Not so far.
General publications	None
Other outputs/products	Prototype system.
Describe links to Wageningen University projects	Potential link with Plant Sciences Group (PSG) specialised in robotics and computer vision technology.
What is relevant for LNV fisheries or ecosystem management?	Good cost effective catch monitoring programmes provide good data and eventually better fisheries management.

Describe collaboration with any partners outside WUR (national)	Not within the scope of this project, but potential links with fishing industry (Fishers Union, VisNed and PFA).
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## SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	<p>Existing observer monitoring programmes of commercial fisheries at sea is time consuming and expensive and numbers of samples taken is limited, which may result in biased catch estimates. To support scientific observers to monitor the catch on board commercial fishing vessels WMR is developing an electronic monitoring system. This automated takes a series of digital pictures from the catch. These pictures provide a representative sample of the catch compositions. Based on this sample catch composition can be calculated. So far prototype of the system and supporting software (GUI) were built. First test runs on survey vessels were conducted. Currently, preparations are ongoing for test runs on commercial vessels.</p> <p>Work in progress. So far, the results are promising. Nevertheless, several technical issues have to be dealt with. There is also potential to extend the use of the system to other monitoring programmes, e.g. length measurements and automated species recognition for fish on markets, laboratories and surveys.</p>
Dutch summary and conclusions	<p>Bestaande monitoringmethoden van de commerciële visserij kosten veel tijd (en geld) en zijn inefficiënt in het bemonsteren van vangsten op zee. Om het monitoren aan boord te verbeteren ontwikkeld WMR een systeem waarbij cameratechnologie wordt gebruikt om de vangstsamenstelling op commerciële schepen te kunnen bepalen. D.m.v. deze technologie kan gemakkelijker en veiliger een representatief monster van de vangst genomen worden. Tot nu toe is een prototype van het systeem gereed en is het besturingssysteem via user interface ontwikkeld. Eerste tests zijn uitgevoerd op onderzoeksschepen, momenteel wordt er aan gewerkt een eerste test uit te voeren op een commercieel schip.</p>

## 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?	

<p>How did the project position Wageningen Marine Research internationally?</p>	<p>Case study 1: Electronic Monitoring and computer vision technology will have a significant impact on data collection in the future. WMR should be a key player in this process. Development and research on this topic are important to be able to play this role; this project contributes to this process.</p> <p>Case study 2: Understanding and investigating monitoring under the landing obligation is an important topic in context with the European Data Collection Framework.</p>
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Title	14. Development of automated data upload to DATRAS
Number	4311300042 (partly)
Project leader	Ingeborg J. de Boois
Other researchers in WUR	Peter van der Kamp and Daniël Benden (WMR)
Researchers outside WUR	None
BAPS number	KB-24-005-020a
Budget	€ 6.488,-
Goals of project	Finalise the automated data upload to DATRAS.
Target group for research	International fisheries biologists,

### PROGRESS 2017

Results	<p>Main results: It is possible to automatically resubmit data from the WMR oracle database Frisbe to ICES database DATRAS</p> <p>Products: Description of dataflow, software to extract data from Frisbe, software to let both databases communicate</p>
Describe the realisation/ deviations of the work plans (science)	None
Describe the realisation/ deviations of the work plans (financial)	This project was initiated during 2017. The budget has been fully used.
Describe developed expertise, include direct and indirect relevance for WOT as well as (potential) broader use	<p>The knowledge developed on database-to-database communication goes together with broader use in other data harvesting projects, such as WOZEP, Informatiehuis Marien.</p> <p>Within the EU Data Collection Framework for Fisheries (DCF) data upload to international (agreed) databases is mandatory, and automated resubmission will lead to a more frequent update of the data.</p>
Science publications	None
General publications	None
Other outputs/products	Presentation at KB WOT 2017 results mini-symposium.
Describe links to Wageningen University projects	None
What is relevant for LNV fisheries or ecosystem management?	<p>By creating the possibility to let both database communicate automatically, the most recent information in the WMR database is frequently transmitted to DATRAS, leading to more accurate information for e.g. stock assessments at ICES, calculation of indices relevant for the Marine Strategy Framework Directive.</p> <p>Within the EU Data Collection Framework for Fisheries (DCF) data upload to international (agreed) databases is mandatory, and automated resubmission will lead to a more frequent update of the data.</p>



Describe collaboration with any partners outside WUR (national)	The project was in collaboration with the International Council for Exploration of the Sea (ICES). One of its Data Centre employees joined in a 3-day workshop in October 2017 to finalise the project, which started in 2014 and was funded by KB WOT Fisheries in 2015.
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## SUMMARY

Non scientific partners	None
Summary and Conclusions of Project	Under the EU Data Collection Framework, submission of data to an international database is mandatory. Until now only manual submission to the database of trawl surveys was possible, leading to a delay in the upload of revised data. By creating the possibility to let both database communicate automatically, the most recent information in the WMR database is frequently transmitted to DATRAS, leading to more accurate information for e.g. stock assessments at ICES, calculation of indices relevant for the Marine Strategy Framework Directive.
Dutch summary and conclusions	Ten behoeve van de EU dataverzameling voor visserij (DCF) worden gegevens van visonderzoek op zee ten behoeve van bestandsschattingen opgeslagen in een internationale database (DATRAS). Tot nog toe was het alleen mogelijk om deze gegevens handmatig aan te bieden aan de database. Dat leidde tot serieuze vertragingen in de update van de internationale database. Door de WMR database zelf te laten detecteren of er wijzigingen zijn aangebracht in de database na de datum van de laatste toevoeging in DATRAS, kan nu een automatische transmissie van gegevens plaatsvinden voor gegevens die al in DATRAS zijn opgeslagen. Hiermee is er geen achterstand in de update van de internationale databases en zijn de gegevens op beide plekken gelijk.

## INTERNATIONAL

Was the project part of an international network?	Yes
Who were the international partners?	International Council for Exploration of the Sea (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?	For ICES, WMR was again one of the national institutes that initiated the development of a new feature in data management. At ICES the software has been developed as such that other countries can easily make use of the facility as well in future.