022615

CEDER

Catch, Effort and Discard Estimates in Real time

Specific targeted research or innovation project

Research for Policy Support

Final Activity Report

JRC: Joint Research Centre

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Use of sensitive data accumulated during CEDER

The contracting parties, including DG MARE, must be aware that any use of data accumulated during CEDER requires the explicit consent of data providers, who in turn may need to ask permission from data owners. The data providers were IMARES (Dutch North Sea data), FRI and DIS (both for Icelandic Redfish), FRS (Northern Shelf Angler, Scottish pelagic), CEFAS (English North Sea Roundfish), GINR and GFLK (Greenland Shrimp), and IRD (French Tuna).

1 EXECUTIVE SUMMARY

Uncertainties in human activities contribute significantly to the overall uncertainty in the assessment of fish stocks and in the estimated impact of fishery management advice.

However the current widespread deployment of modern technologies has the potential not only to improve the accuracy of such data but also increase its spatial precision and to reduce the time it takes to arrive at the desktops of fisheries stakeholders (ship owners, producer organizations, authorities, scientists) thus opening up a new set of possibilities for a more responsive fisheries management.

According to the work programme of task 7 of "Priority 1.3 Modernisation and sustainability of fisheries, including aquaculture-based production systems"

> *"The objective of the task is to develop operational (near) real time catch estimation from VMS (Vessel Monitoring System) data and observer reports, which also can be used for short-term forecasts of the catches in order to obtain reliable prognoses on the degree of TAC fulfilment. The task is also to investigate if combinations of VMS data, observers' reports and other information can be used to improve estimates of discards.*

The precise objectives of the CEDER project are:

- to harness new technologies to provide more accurate and more timely information on catches, effort, landings, discards and quota uptake;
- to assess the benefits of this information for fisheries management.

<u>Objectives quoted from the technical annex</u>

It is the primary objective of this project to harness these technologies [such as the Vessel Monitoring System and electronic logbooks] to provide more accurate and timelier information on catches, effort, landings, discards and quota and TAC uptake and to assess the benefits of this information for fisheries management.

(A) In the first "analysis" phase all available data from the fishery from traditional sources such as observers and landing notes as well as from new sources such as VMS will be collected and analysed in order to determine relationships between the different measurements – VMS and declared effort or landings and log-book entries for instance – and to convert these measurements into the information required by the stakeholders.

(B) The second "testing" phase will involve carrying a series of pilot studies under real conditions to show the feasibility of obtaining real-time information on fisheries, to identify bottlenecks and to measure the performance of the technology used in terms of accuracy of information, timeliness and cost.

(C) The third "implementation" phase involves determining how the system could be moved from pilot scale to full-scale EU implementation and identifying the benefits for stakeholders in doing so.

The measurable objectives are:

(1). the production of a harmonized database for fisheries data of six different fisheries;
(2). the construction of relationships between these data and national catches, landings;
(3). an assessment of the accuracy of such relationships;
(4). the production and testing of a near-real-time system that can monitor catch, effort, discards and landings of these fisheries;
(5). the delivery of an outline design for introducing such a system into operation;

(6). an assessment of the benefits to industry, authorities and to the sustainability of stock and the fishery.

Summary of work performed and results achieved (pertinence to objectives):

- Collation of existing information – development of database. Participants FRS, CEFAS, IMARES, IRD, NEAFC, FRI, and DIS collected data for selected fisheries. Data included landings declarations, vessel logbooks, observer reports, VMS reports, and fleet reference data, at different levels of granularity. OLRAC collated the data into the harmonized database. Participants GINR and GFLK forwarded their data to Sirius instead. (A, 1)
- Data harmonisation. Olrac produced a database viewer, which can be freely distributed. It has a CSV export feature and the possibility to reduce the dataset. The latter was added because of concerns over legal bindings with some of the dataset. (A, 1)
- Data Quality. JRC delivered the Data Quality Report, deliverable 1.1.2. The data quality was sufficient for the project. However, first in some cases quality can and should be improved; second different levels of aggregation meant effort needed to be deployed to navigate around these various levels, and third, legal bindings exist on parts of the data that make it difficult to work with it. (A, 1, 2, 3)
- Information flow in fisheries. Avanti and Navigs have produced the deliverable 1.3, a summary of the regulatory and scientific data provided to national and European authorities. This document has relevance beyond CEDER, as the implementers of the ERS directive will also need to assess the present situation. The document identifies standard fisheries reporting chains for regulatory and scientific information on catches and discards, describes the communications infrastructure and the timeliness of information in the fisheries of this project, and outlines the regulations and use of new technologies. (A, 2)
- Discards and by-catch in Greenland Shrimp. GINR and GFLK gathered and evaluated data on the level of discarded by-catch of fish in the Greenlandic shrimp fishery within the Greenlandic Exclusive Economic Zone in 2006 and 2007. Preliminary findings indicated an "observer under-estimation" effect, in addition to a "skipper under-estimation" effect, pointing to social interactions between the skipper and the observer. However, the level of discard from the entire study period in 2006 and 2007 on 332 hauls from 12 commercial trips on 9 different vessels in the shrimp fishery with an average discard percentage on 2.2% must be considered low. (A, 2, 3)
- Scottish pelagic fisheries data analysis. In 2006, FRS encountered issues with VMS data, which was restricted due to Data Protection Legislation in the UK. However, VMS data was made available to FRS at the end of 2007. An interpretation of vessel speed was used to analyse individual recordings for a given vessel. The result is that by using VMS based analysis on a numbers of vessels, it is possible to quantify fishing activity and days absent to characterize the spatial and temporal pattern of fishing in this fishery. (A, 2)

Work in the design, testing, and pilot phases focused on

- The EU fisheries prototype systems ("ReelCatch", Correlation). Correlation wrote a prototype, called "ReelCatch", and fed it with data from some Scottish demersal boats during the pilot phase. The prototype can classify behaviour of fishing vessels for demersal and pelagic with accuracy, if it is provided with GPS positional data for each boat at least every 15 minutes. This is useful e.g. for cross-checks with the ERS logbook and for assessing the spatio-temporal fishing load of given areas. The prototype can also guess landings, given recent effort, historical landings, observer figures, and historical logbook contents. FRS provided the pilot's data. Obtaining the pilot data proved to be challenging. (B, 2, 3, 4)
- The Icelandic Redfish prototype system ("CARFI", FRI). In collaboration with the DIS, FRI have developed a system that identifies and categorises vessel activity in this fishery through analysis of positional data (VMS). Because in this fishery, there is a relatively

strong relation between effort while fishing and catch, which becomes clearer with higher levels of aggregation, catches for a vessel can be predicted using effort. The system can also alert the user to abnormal situations with respect to the expected catches, missing landing reports, or suspected refuelling and/or transhipment at sea. The system was tested with data from the DIS. The real-time capability of the prototype system CARFI was tested with VMS data coming from the DIS. (B, 2, 3, 4)

- The Greenland prototype system (Sirius). In collaboration with GFLK and GINR, Sirius have developed a system that is able to combine information from VMS, hail messages (logbook substitute), transcribed logbooks, and sales notes, in order to calculate a more accurate amount of catch on any given trip. Quota uptake inaccuracies are dominated by input errors such as omitting or adding a zero in a catch report. Once typical errors are eliminated, quota uptake can be calculated more reliably, and it is easier to identify other reporting irregularities. (B, 2, 3, 4)
- The time series analysis of quota uptake (JRC). JRC developed a prototype that uses a set of time series models to predict quota uptake (or landings) using past quota uptake (or landings). If the quota uptake exhibits some form of regularity, then the predictions prove fairly accurate (quota consumption prediction errs by up to 5%). Tests were conducted with fisheries data from the FIDES CRONT v2 system of DG MARE. Note that if the time series exhibits a broken trend, then large inaccuracies in predictions may occur. Research into trend breakers revealed that some of the popular and widely used methods do not identify quota overshoots quickly enough. (B, 2, 3, 4)
- Execution of the pilot: (B, 4)
  - EU fisheries pilot: Despite the challenges encountered, CEDER was able to successfully conduct a pilot phase in the Scottish demersal sector. First and foremost, the system demonstrated its real-time ability to infer fishing behaviour from 15 minute VMS messages. Second, when the system crossed effort figures with historical landings, it came to the conclusion that UK Cod, Whiting, Haddock, and Anglerfish quota in area VIa should all have been exhausted in April 2008; later reports from the UK to DG MARE will either confirm or invalidate these findings. Finally, since the pilot project was a smaller-scale pre-ERS attempt at rolling out e-logbook solutions, there are lessons to be learned for ERS. These are summarized in chapter 2.2.1.2.
  - Icelandic Redfish pilot: the real-time capability of FRI's CARFI prototype system was tested with VMS data coming from the DIS.
  - Greenland pilot: Currently, the Sirius prototype is running as a production pilot. It includes hail messages, sales notes, and VMS.
  - Time series analysis pilot: JRC has conducted tests of its prototype with fisheries data from the FIDES CRONT v2 system of DG MARE.

The 3rd phase determines how the system could be moved from pilot scale to full-scale EU implementation and identifying the benefits for stakeholders in doing so. Work regarding the implementation and benefits focused on:

- Operational system design: Firstly, partners analyzed the required changes in communications pathways between shareholders. Then, confidentiality, data protection and freedom of information are also discussed. More so, we took special provisions to integrate the impact of the "electronic recording and reporting system" (the ERS) and the Court of Auditors Special Report No 7/2007 on the Common Fisheries Policy (the CoA report). Finally, any common system for gathering near-real-time data requires a common language and common definitions. A common vocabulary and an approach to overcoming definition problems are presented. (C, 5)
- Benefits of better information: Within the benefits for authorities section, the range of potential management frameworks within which the CEDER systems might operate is presented. Each prototype is evaluated in terms of the management frameworks. The benefits to industry section highlights that what Industry may deem as beneficial may not be comparable to that considered beneficial by government agencies and scientists.

However, by providing a complete and accurate story on the fishing activities of a fishing fleet, industry would provide a complete picture of all fishing activity on which the TAC is based upon. By doing so, industry can provide science with a far more accurate view of the current status of stock, leading to more adapted TACs. Fishermen and authorities mostly find themselves stuck in a "poacher versus gamekeeper" mindset that must be overcome; recent collaboration has led to improvements. Finally, the benefits to sustainability section reports on the potential improvements in the sustainability of European fisheries management. We present the results of computer simulations that examine two separate aspects of the benefits for sustainability. (C, 6)

- Project Implementation Plan: Formally part of the "benefits of better information" deliverable, the PIP summarises the results achieved within CEDER. It details how CEDER project outputs can be applied at the fishery policy management level to ensure envisioned benefits from implementation of project findings can be achieved. (C, 5, 6)

Intentions for use and impact

Please consult the Project Implementation Plan in Deliverable 3.2.

Summary of publishable results

Dissemination of project results will be through the CEDER web-site and is also planned through CORDIS.

Some of the project's scientific results will also be published in peer-reviewed scientific journals. Please consult the dissemination plan at the end of this document.

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2 APPENDIX 1: MAJOR ACHIEVEMENTS

2.1 Data collection

2.1.1 Summary of Data

Detailed results in D 1.1.2 Data Quality Report, Annex 1 fisheries description.

Data has been collected on the following fisheries:

Northern Shelf Angler Fish.	FRS
Scottish pelagic fisheries.	FRS
North Sea roundfish fisheries.	CEFAS, FRS
North Sea flatfish	RIVO
Greenland shrimp	GINR, GFLK
French and Spanish Tropical Tuna	IRD
Peruvian Anchovy	IRD
North Atlantic Redfish	FRI, DIS, NEAFC

IMARES collected a description of each fishery, OLRAC described the data availability and GINR summarised how the data was stored. A document has been prepared by OLRAC[1] summarising all the available information.

Northern Shelf Angler Fish.	20 all-year trawlers, 20 seasonal, 100 nephrops trawlers
Scottish pelagic fisheries.	26 pelagic vessels
North Sea roundfish fisheries.	64 demersal trawlers, 47 nephrops trawlers
North Sea flatfish	400 beam trawlers
Greenland shrimp	28 shrimp trawlers
French Tropical Tuna	12 purse seiners
Peruvian Anchovy	1300 purse seiners
North Atlantic Redfish	18 pelagic trawlers

2.1.2 Data Harmonisation

Detailed results in D 1.1.1 Database Design Document.

2.1.2.1 Preliminary Remarks

During initial development of the prototypes it became apparent that data provided by some fisheries were not at the required resolution for the development of the mathematical models. Therefore, CEDER followed two approaches.

Firstly, for the purposes of developing and testing models, confidential data at the right resolution were provided directly to the model developers by those CEDER members with access to it. Secondly, CEDER progressed in the development of the harmonized database, which is capable of combining data from different sources and fisheries regardless of their format or resolution.

[1] Description of fisheries; common description of data; and information descriptions for the Ceder project

Legal notice: The contracting parties, including DG MARE, must be aware that any use of such data requires the explicit consent of data providers, who in turn may need to ask permission from data owners. The data providers were IMARES (Dutch North Sea data), FRI and DIS (both for Icelandic Redfish), FRS (Northern Shelf Angler, Scottish pelagic), CEFAS (English North Sea Roundfish), GINR and GFLK (Greenland Shrimp), and IRD (French Tuna).

Most of the confidential VMS high resolution data used in the modelling were not incorporated in the harmonized database in order to maintain data confidentiality and because it wasn't necessary for the development of the modelling approaches. However, the harmonized database was developed to accommodate such data, if necessary and when permitted, and demonstration datasets in the same format as those used for the modelling were imported successfully.

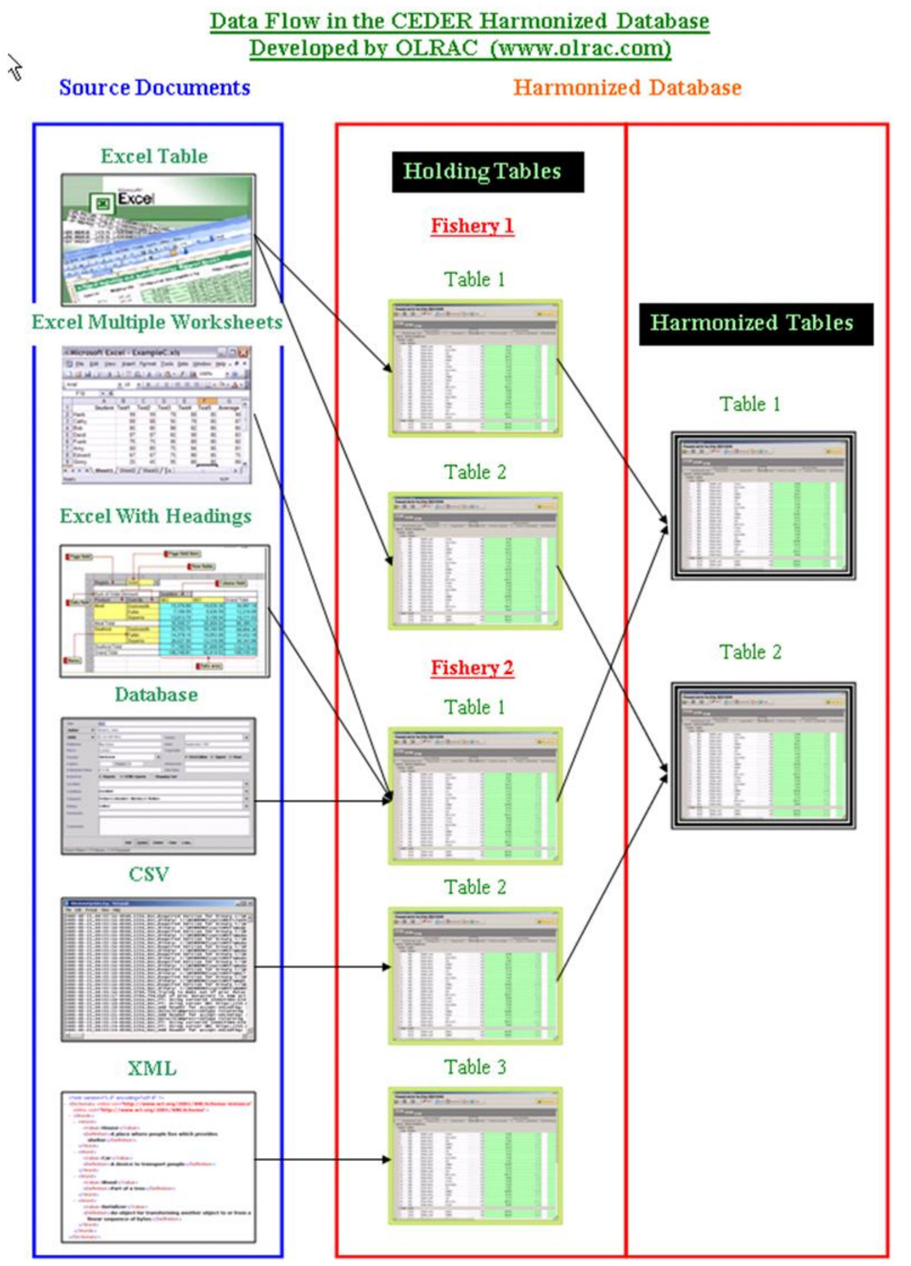
The result of these combined approaches is firstly the development of different models using high resolution VMS data, and secondly a demonstration that such data can be incorporated into one database for more efficient linking to modelling approaches, if the data and the resources to implement the system become available in future.

CEDER did not use existing database systems, such as the ones of TECTAC, because much of the information contained therein was at vessel level (CEDER), as opposed to metier level (TECTAC, DCR). However, it should be possible to relate the CEDER harmonized database to some provided matching metier level information.

The various formats of data made it difficult for the developers of algorithms to test them on the full spectrum of data from all the fisheries.

OLRAC have therefore developed a software tool to import data in the native format (CSV, Excel or database) and convert it to a form that is common to all fisheries. A document describing the tool and its capabilities has been prepared[2]

[2] Technical Overview: A Tool for the Creation and Maintenance of a Harmonized Database
Progress Report January-December 2006(OLRAC)



Most of the data can be input automatically – so the database can accept new data that is similar to previously-processed data. However some manual manipulation was necessary – particularly for excel files where a description of the data was included within the columns of data rather than as a heading.

2.1.3 Data quality summary

Detailed results in D 1.1.2 Data Quality Report, Annex 1 fisheries description.

2.1.3.1 VMS data

VMS data can be obtained, but for legal reasons, that is possible only if the party that receives it agrees to the utmost confidentiality. The VMS data quality is usually acceptable, but could be improved. Very occasionally one observes artefacts in calculated speed between positions. While it is possible for scientists to circumvent these artefacts by ignoring them, the same artefacts create false alarms for assessing VMS frauds.

2.1.3.2 Monthly landings

Because it is aggregated, monthly landings data does not nearly come with the same legal bindings as VMS data. For CEDER fisheries, all landings data can be sourced from the FIDES CRONT database, except for Icelandic Redfish, Greenland Shrimp, and French Indian Ocean tuna. Data quality is usually acceptable, but could be improved. Sometimes negative landings are reported, or data is missing. Another difficulty is that data from FIDES CRONT is presented by the conventions behind EC reporting areas. Also, when reporting given landings, the area can be changed from one year to the next.

2.1.3.3 Logbook data

Concerning logbook data, it was imported into the Harmonized Database at different levels of aggregation. It contains haul-based, trip-based, and aggregated data at higher levels, and there is some coverage between logbook data and VMS data in the harmonized database. In turn, the high-resolution data received permitted to have additional coverage between the logbooks and the VMS.

2.1.3.4 Observer data

We did not really need discard data for developing the models and algorithms. For the pilot, we gathered discard data at an aggregate level from the Scottish pelagic fleet. Estimating discards from aggregates is a common approach in fisheries management.

2.2 Prototype Systems

Detailed results:

- Construction of relationships in D 1.2.1 Report on the relationships developed
- Assessment of accuracy in D 1.2.3 Model Performance
- The production of a near-real-time system lead to system designs; D 2.1 Design Report
- Testing of a near-real-time system in D 2.2 Testing of Pilot Systems
- Results of the pilot project in D 2.3 Pilot Study
- Policy implementation plan in D 3.2 Benefits Report, Annex 1 Policy Implementation Plan

2.2.1 EU Fisheries, ReelCatch prototype by Correlation Systems

2.2.1.1 System Presentation

The system developed by Correlation Systems

- Classifies fishing activity using 15-minute GPS, and hence estimates effort while fishing
- Estimates landings from effort, past landings, observer reports, and/or historical e-logbooks.

Correlation systems design is based on a database, including permanent historical data and data incoming from real-time observation.

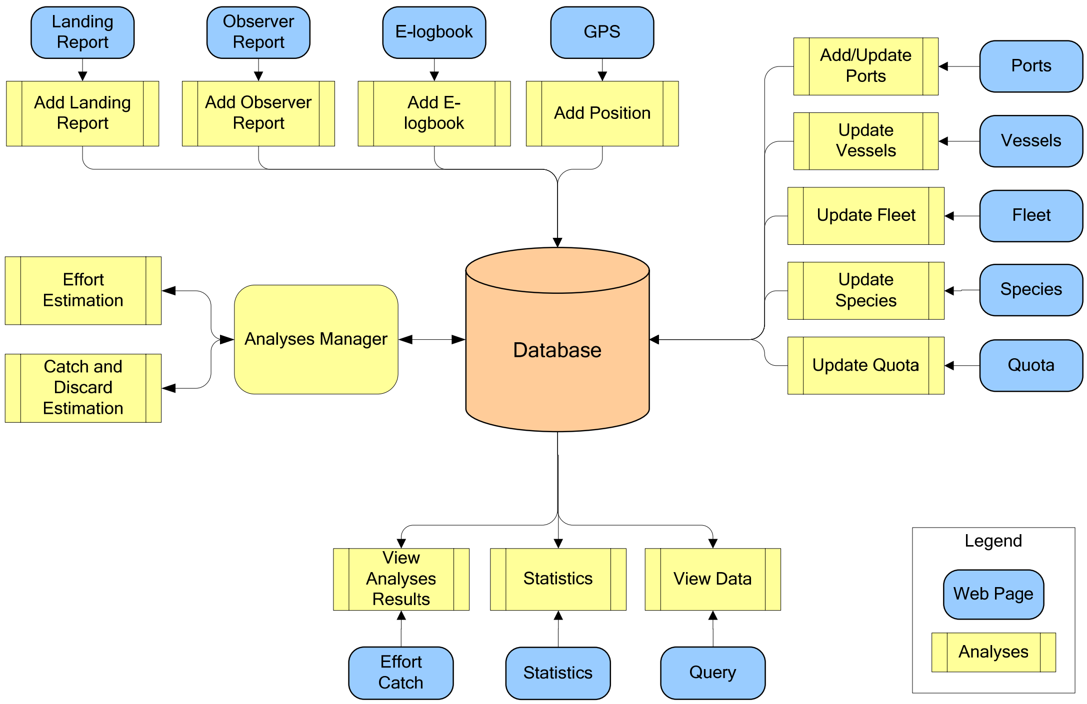


Figure 1 The Correlation Systems Design.

The system supports 4 input data types:
1. GPS data
2. E-logbooks
3. Observer Reports
4. Landing Reports

The observer reports are usually aggregated, and contain Catch per unit effort as well as discard rates.

The user can also update port., vessel, fleet, species, and quota reference data, which are also maintained in the database. At any point, the user can view the data stored in the database.

The user can then ask the system to perform analyses on the stored data, such as:
1. **Effort Estimation** – the analysis is performed on VMS data of a single vessel, and determines for each record whether the vessel was fishing, cruising or at the port. The records are collected into tracks, which are displayed on a map along with the Effort estimation for each point.
2. **Catch and Discard Estimation** – the analysis is performed on all data types which are stored in the database. The analysis estimates for a specified area/ species and country the weight of catch and discard, and the catch/quota ratio. The output is displayed as a data table and on charts on the web pages.

Note: Correlation performed further research into the direction of predicting "effort while fishing" from 2 hour VMS. For that, Correlation modified the algorithm for 15-minute data accordingly. However, Correlation found that such VMS data is too coarse to reliably achieve that goal. As a reminder, ReelCatch is a "fishery agnostic" approach; fishery-specific analysis may achieve that goal with VMS data.

2.2.1.2 Pilot: FRS, Correlation, IMARES, CEFAS, OLRAC, JRC, TraceAll

The prototype system developed by Correlation was tested using FRS data on landings, discards, métiers and vessel movements plus e-logbook data from TraceAll and FRS.

The pilot phase was a challenge. However, despite the difficulties, we were able to get results.

Firstly, a number of fisheries could not participate, and secondly, the pilot did not start until 2008. As mentioned in the Contract Change notice 007:

- For the Netherlands, Olrac and IMARES progressed the installation of the Olfish e-logbook solution on Dutch beam trawl vessels. Despite considerable effort, and due to various complications[3], this e-logbook solution was only installed mid- May 2008, too late for the pilot. IMARES supported OLRAC in contacting Dutch fishermen.
- For England, CEFAS reported the following: Much of the English fleet (including round and flatfish) operating off the NE coast consists of vessels less than 15m, due to lower costs and regulatory controls, and there is an ongoing trend towards smaller vessels. These vessels then regularly change their fishing gear and target species. A report on this is available at www.cefas.co.uk/publications/techrep/tech134.pdf . The current diversity of vessels and irregularity of fishing by many of them implies that any real time monitoring system would have to be deployed on large numbers of small vessels to have any value as a source of information relevant for management of the overall fishery.
- For Scotland, FRS was performing activities. There are number of vessels that have the TraceAll system installed.
  Mentioned in the CCN, there were:
  - 2 demersal boats that target Anglerfish[4], but also catch some other demersal round and flatfish. Here, the trips occur in Q4 and Q1, as mentioned in the CCN.
  - 3 pelagic boats, which cannot catch due to quota restrictions, and will be active starting in 2008.

  Beyond the CCN:
  - 2 demersal boats that target prawns, but also catch some other demersal round and flatfish. These boats are operational and gathering data.
  - 1 boat that targets demersal fish (as opposed to prawns). This boat participated. Two more such boats were due to be fitted with the e-logbook solution.

After the CCN was published, it proved impossible to place E-logbooks on vessels in the Scottish pelagic fleet, which elected to withdraw from the pilot. Fortunately however, it did prove possible to place E-logbooks on six vessels in the Scottish demersal fleet, which target mixed demersals including angler fish. On this new basis, FRS, TraceAll, and Correlation have successfully conducted a pilot, complete with per-trip landings and fine-grained VMS data from six vessels. The findings are part of D 2.3.

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[3] OLRAC met with some problems with the fishing company which had responsibility of carrying out the complete installation on the boats. Multiple mails were sent out and phone calls made but mostly ignored. The unfortunate death of the team lead in the company was also a major setback. Subsequently, CEDER worked around the issue by IMARES trying to contact the vessels directly to get an idea of the equipment on board the boats (GO58 and GO22). Again there was a long period of trying to get the required data from the boats but not with great success. It was eventually decided to attempt to install a "stand alone" solution which meant that two laptops loaded with the OLRAC CEDER software and a mobile GPS was delivered to IMARES. The skippers at that point could not guarantee their whereabouts at any given time making a trip to Holland to install and train on board the actual vessels nigh impossible. Olrac decided that the best that could be done was to deliver the equipment directly to IMARES who would then arrange to meet the skippers as and when allowed by their fishing schedules. The laptops were delivered in March of this year. One skipper decided not to return to the Netherlands during April, and the other skipper's GPS receiver proved to be defective.

[4] Northern Shelf Anglerfish: Anglerfish is not caught by a separate fleet, but rather as a by-catch. Mostly it is caught in demersal fisheries, such as the Scottish demersal fishery

To sum up the result of the situations elaborated above, the CEDER EU pilot could only use data from the Scottish demersal sector.

Th Scottish demersal data were used to define the relationships between landings, discards and effort for the six pilot vessels. The pilot itself was carried out using VMS data collected for a two month period (March and April 2008) at 15 minute resolution, and the data from the E-logbooks. In addition FRS collated and provided landings information (landed catch by species and individual trip and day information) for the target vessels. FRS also contributed metier level catches and discards for 2007, as well as boat level VMS data.

Concerning collection of e-logbook data, TraceAll has continued to work on the data collection from 2 Scottish Vessels from the Traceall Vessel Management System. This data includes not only Catch Details but also Operational and Crew Data. Traceall system has been installed a number of new vessels on the request of the project leader and the data from additional vessels has been provided. This included providing the hardware, software and on-site installations.

The other 4 boats did not have automated data transfer, so data pickup had to be manual. Several data pickup attempts were organized for the logbooks of the other boats. Unfortunately, they were either not in Scottish ports during May and early June 2008, or missed their pickup dates. As stated above, CEDER worked around this difficulty by using the boats' landings as a proxy; these data were provided by FRS.

With the data in place, Correlation performed final preparations, ran the pilot data with their system, and produced a summary. On their side, the actual execution of the pilot (originally estimated as 1 person month) required additional effort due to preparations made for entering aggregated discard data, and because of the aforementioned switch from logbook to landings data. This additional effort also caused additional management overhead.

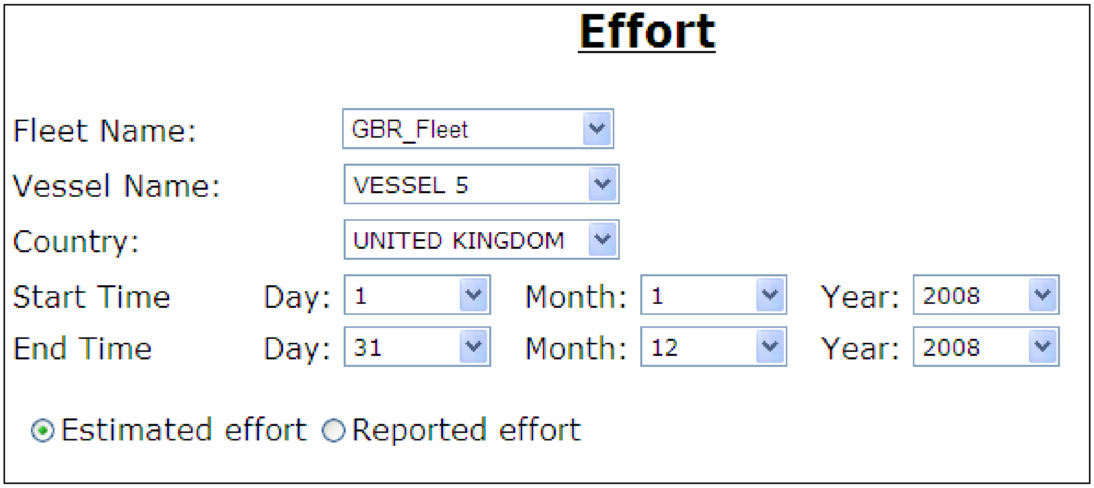
In conclusion, CEDER's pilot project was a smaller-scale pre-ERS attempt at rolling out e-logbook solutions. Results obtained suggest the following.

- First, any roll-out of the ERS must be backed by prior enactment of national laws implementing the ERS directive. One particular goal in that aspect should be to regulate any lack of support.
- Second, even though this is foreseen in the ERS, it is important to insist on the following point. Any e-logbook system installed should always be set up so as to transmit data in an automated fashion, precluding any routine manual data transmission, and one should be wary of any exceptions to the above rule. This is needed to exclude complications linked to pick-up of data at landing time, which otherwise are to be expected.
- Third, manufacturers rolling out their e-logbook systems must pay attention to logistical aspects. These would include installation scheduling, user training, and adequate stockpile of e-logbook related hardware. The latter designates embedded systems, GPS devices, and transmission antennas. Indeed, fishermen are often unreachable, and this factor compounds standard logistics issues.

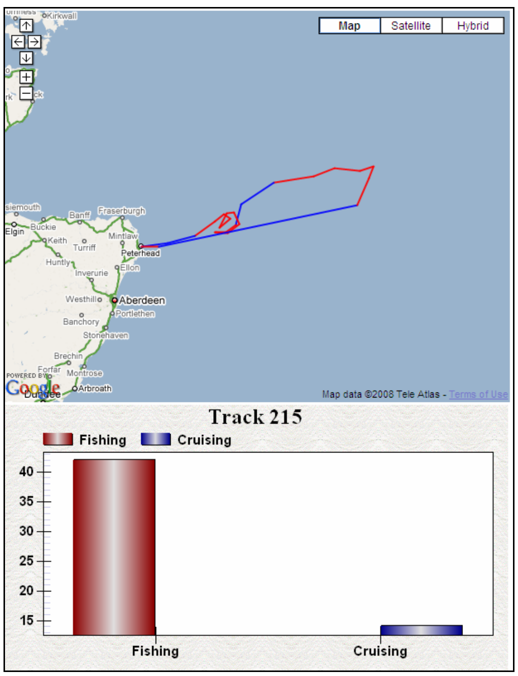
2.2.1.3 Effort estimation results

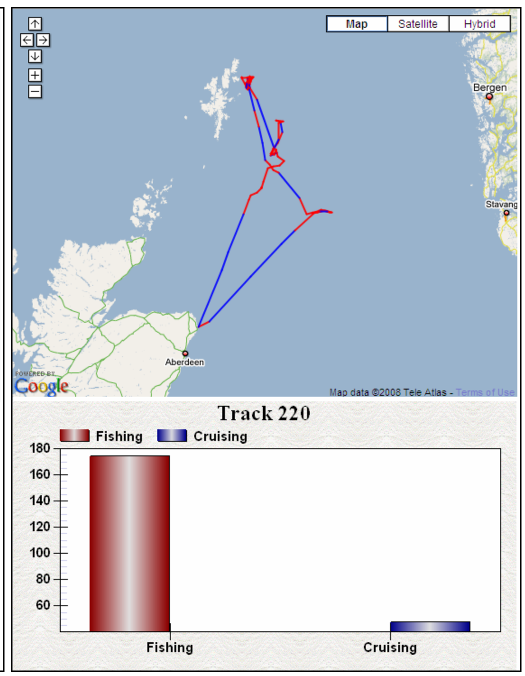
After having been fed the GPS data, the software is then able to identify fishing and cruising behaviour with less than 20% type I and II errors. The calibrated amounts of false positive and false negative errors can be seen in the deliverable 1.2.

The user selects the vessel for which he wants to identify vessel tracks, using the user interface:



The software will then list a number of tracks that the vessel has made, according to its own analysis. The user then clicks on a vessel track, and view it using an interface that is an extension of Google Maps.





More vessel tracks can be seen in the deliverable 2.3.

The software also has the capacity to view fishing versus cruising effort, aggregated by ICES areas.

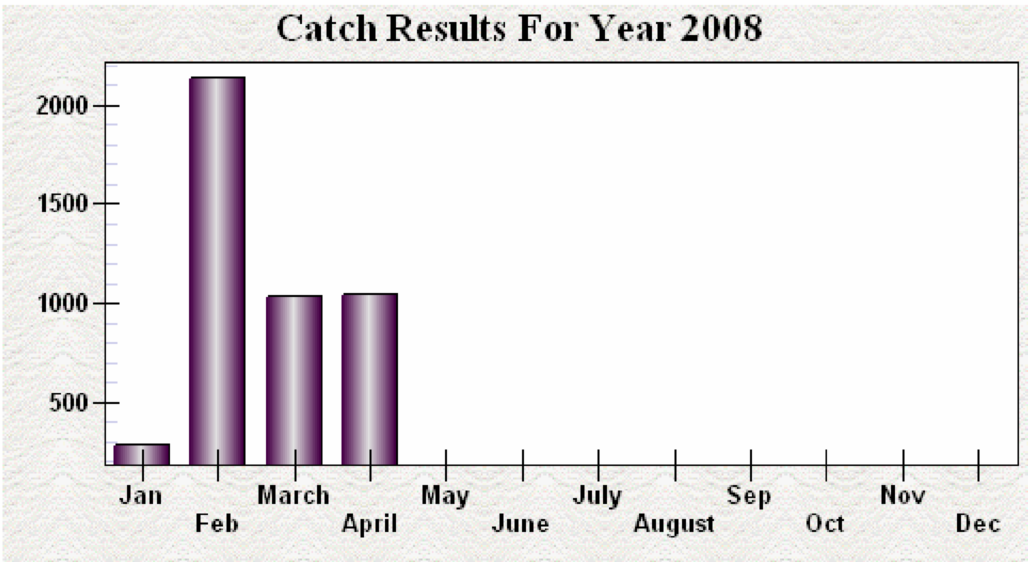
2.2.1.4 Landings estimation results

Apart from performing effort estimation, the ReelCatch prototype can also perform landings estimations. (Note: These are called “catch estimations” below).

The result of the catch estimation will be presented according to area. One such estimation is presented below:

Catch Estimation for Area IVa, Species: COD

Year	Month	Catch	Effort Days	CPUE	Quota	Catch/Quota	Estimated catch
2008	1	280.8	17.4885	16.0562	8628	3.2545	Yes
2008	2	2129.4	22.1532	153.9548	8628	24.6801	Yes
2008	3	1029.6	25.1219	52.1614	8628	11.9332	Yes
2008	4	1041.3	23.7105	43.9172	8628	12.0688	Yes
2008		**4481.1**	**88.4741**		**8628**	**51.9367**	



As a word of caution, the algorithm developed is of a general nature, not taking the specifics of each fishery into account.

The pilot system demonstrates CEDER's capability to estimate accurate effort activities as well as expected catch for a specific fleet in near real time.

Additionally, the pilot demonstrates that after a short setup time it is possible to integrate VMS data with E-Logbook data with minimal effort in order to have an integrated reporting and prediction system for fleet management.

The pilot had detected unusual activity at area IVa, indication that can reflect massively overshoot quota at this area. This information matches external reports from industry regarding massive discarding of commercial sized cod. Even though this prototype is not fishery specific, these two observations coincide, confirming that the approach is of value.

2.2.2 Icelandic Redfish fisheries, CARFI prototype by FRI

CARFI calculates effort, catches, and landings from VMS.

Icelandic authorities already publish landings in Icelandic ports and quota uptake daily through the internet. The prototype provides near-real-time information on effort and catch from electronic logbooks, from vessels still at sea. This is of more benefit to scientists than authorities because the current system already provides an efficient tool for quota management.

Note the peculiarity of the North-Atlantic Redfish fisheries that there is no discard, except in cases of clearly damaged or sick fish. This is likely largely due to the simple fact that the fleet has not been able to finish the allocated quota for the past several years, along with minimal by-catch, and thus there is no incentive to discard catch.

The data sources for the data collection module are CSV-formatted files delivered from the Icelandic Fisheries directorate, either to an FTP-site or by e-mail. In either case, the system regularly checks for the presence of new files to process in specific file locations. These files are then imported into the database. The processes can be run manually or as regular scheduled tasks to update the effort, catch and quota take-up.

The three system modules (data collection, analysis and presentation) each interact with the database.

The analysis module:

1. Contains an algorithm capable of identifying and categorizing vessel activity through analysis of positional data (VMS) - particularly to differentiate between fishing and non-fishing activities with the aim of estimating total time spent fishing. The result is an estimate of effort.
2. Contains a model capable of predicting the total catch of a vessel, based on the analysis of the positional data, vessel catch logbooks and official catch reports.
3. Verifies the accuracy of the model predictions and establish confidence intervals

First, one run classifications algorithms on the VMS-data to determine when a vessel is trawling (gear deployed) and when it is cruising.

Second, the user can predict individual vessel and total fleet catch based on effort, by selecting and running an appropriate statistical model from its model library. The prototype system includes one prediction model for demonstration purposes.

The VMS data points are ordered in chronological order, and the distance between them calculated, using Vincenty's formula[5]. This distance is termed a single *leg* of the track. FRI classified each leg as either a *cruising leg* or a *trawling leg*, depending on the calculated leg speed. Any speed results above 50 km/hr are assumed to be erroneous and ignored. A speed of or above 8 km/hr indicates a cruising leg, and a speed below 8 km/hr indicates a trawling leg. (This simple speed rule is the result of the rather homogeneous nature and behaviour of the Icelandic Redfish fleet.)

To calculate the total effort of each, we now simply add together the durations of each 2 hour leg classified as trawling, resulting in *effort (time trawling)*.

2.2.2.1 Vessel Tracks and Catch Module

Users have several options to view the underlying datasets, e.g. from a "trip" perspective and "catch" perspective. Example of this is illustrated in *Figure 2: Vessel track*. It illustrates a complete trip, with catch entries marked as blue triangles and starting and endpoints of the trip as green and red points respectively.

[5] The Vincenty algorithm computes the distance between two points using the WGS-84 Earth ellipsoid, to within a few millimetres of accuracy. Original algorithm source: T. Vincenty, "Direct and Inverse Solutions of Geodesics on the Ellipsoid with Application of Nested Equations", Survey Review, vol. 23, no. 176, April 1975, pp 88-93. Available at: http://www.ngs.noaa.gov/PUBS_LIB/inverse.pdf

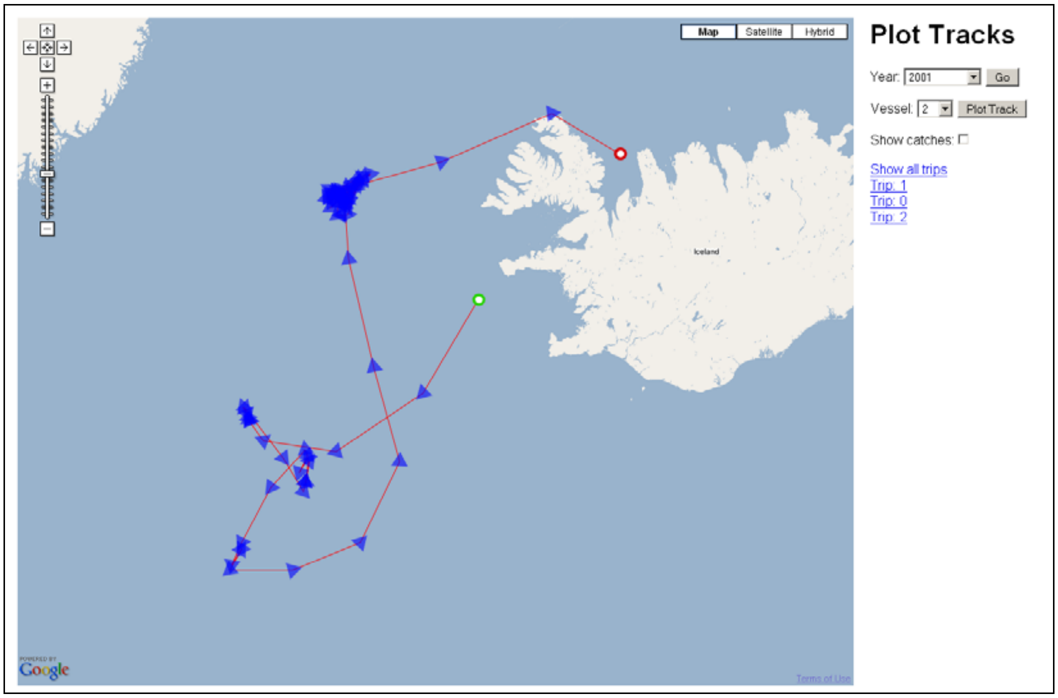


Figure 2: Vessel track

A similar view can be used to show which track legs belong to a specific catch report, i.e. where the haul started and ended for that catch.

From the catch logbook data we can now find *estimated catch* per day, from which it is now straightforward to calculate the *catch per unit effort* (CPUE).

Using the prediction model shown in *Figure 3: Prediction model*, the user can see how much a vessel is expected to catch, given a certain behaviour profile imported into the database.

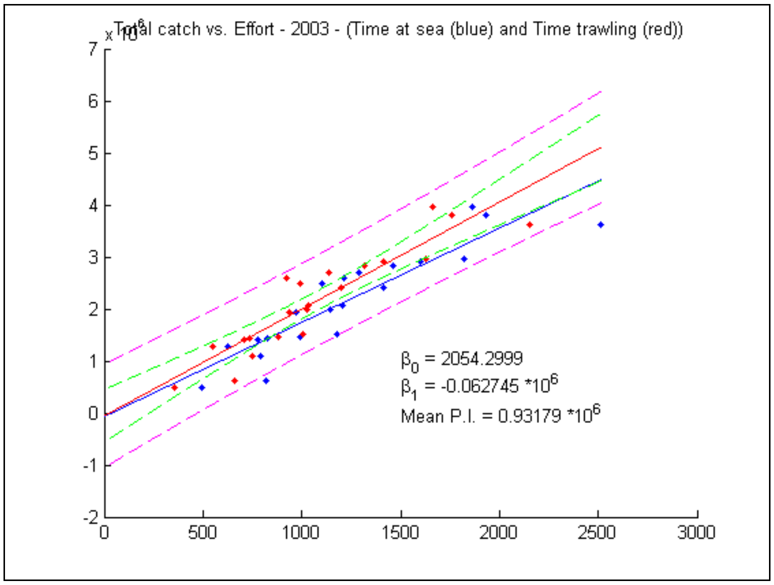


Figure 3: Prediction model. Each dot represents a boat's total catch, for all of 2003, versus total effort. Blue dots are total effort as measured by time spent at sea, red dots represent total effort as measured by time spent trawling.

In *Figure 3: Prediction model*, points represent individual boats' catches versus effort aggregated over a year, for redfish, in zone Va. There may be up to 2 points per boat, a blue one for time at sea (standard measure of effort), and a red one for time spent fishing (new measure of effort)

The prediction model now assumes a simple linear relationship between effort and catch, and using the method of the *sum of least squares* errors.

Finally, a special alert module automatically checks for certain events in the datasets, and alerts the user. These events include when a vessel under- or over-reports catch compared to the prediction model, when a vessel comes to port without submitting a landing report, and when a vessel may have refuelled or transhipped at sea.

2.2.2.2 Icelandic pilot: FRI and DIS

FRI reports that the real-time capability of the prototype system CARFI was tested with VMS data coming from DIS.

2.2.3 Detecting Anomalies in Fisheries Data by Sirius IT

Sirius have developed a data mining tool, currently in use in a production pilot setting, in Greenland Shrimp.

2.2.3.1 Greenland Prototype System and Assessment

The system developed by Sirius is able to combine information from VMS, hail messages (logbook substitute), transcribed logbooks, and sales notes, in order to calculate a more accurate amount of catch on any given trip.

Note: Sirius attempted to predict "effort while fishing" from VMS, but found that 2-hour VMS data is too coarse to reliably achieve that goal.

We will first present the system in general, and then several of its data mining aspects in particular.

Due to the fact that amounts in sales notes are more accurate than amounts from logbooks, we are calculating the quota uptake primarily based on the combination of logbooks and sales notes.

The basic strength of the pilot system is the automatic match of the different sources of information as soon as it becomes available. Sources currently are VMS, logbooks, hail messages, and sales notes. The overwhelming amount of information received by the enforcement authorities makes it impossible to review all the detailed information manually. It is especially difficult to cross check information from different sources which were not originally developed with automatic integration in mind from a technical or legislative point of view.

The system offers a number of features which in real time (i.e. as the information comes in) can provide the inspector with a good quota uptake overview, improve data quality, direct attention to suspicious behaviour and provide case management features.

- An easily accessible graphical overview of the quota uptake of TAC and individual quotas with strong drilling possibilities to quickly get detailed information down to haul level information.
- An extrapolation of ongoing quota uptake to calculate the expected time of exhaustion of the quota based on the quota uptake the previous five years.
- Direct graphical crosscheck with VMS data to validate logbook positions, relate effort to catch and check for suspicious behaviour in general
- Alarm based rule engine which may direct attention to erroneous information. A major uncertainty in the usability of logbook information can be attributed to a range of errors including poor or inadequate professional conduct of the master of the vessel in filling in the logbooks, misprinting, fraud and typing errors of the authorities when entering the logbook information into the database.

A major benefit to enforcement authorities is the integration of the different sources of information which allows for a number of cross checks which makes it possible to quickly correct obvious mistakes in the logbooks, e.g. misprinting of a latitude or longitude, or an extra digit in the catch amount.

These kinds of checks are important because actual automatic detection of suspicious behaviour will be dominated by the aforementioned obvious mistakes. Once the bulk of the most trivial errors are corrected a number of alarms can be set up aimed at detecting suspicious behaviour.

In the present version of the quota analysis system the alarms are hard coded and thus not flexible. The system however is extensible. Here are few examples:

- A maximum vessel speed compared to a calculated speed for the vessel in order to sail from the reported end of the haul time and position to the nearest VMS position.
- Maximum (and possible minimum) catch per unit effort, CPUE.
- A range of accepted ratios between hail and logbook catch amounts.
- A range of accepted ratios between logbook and sales notes.
- Warnings of close to exhausted quotas – global and individual.

The effectiveness of the alarm features are based on knowledge of the behaviour and characteristics in the specific fisheries, by the inspector who sets up the algorithms and on the scores the different types of alarms are allocated.

The need for specific alarms indicates that the effective implementation of an alarm based system will require a great deal of data analysis to be effective; otherwise the inspectors may get flooded in alarms.

Finally the pilot system includes a useful management tool to control the processing of the generated alarms. A feature, which attributes each alarm with a status, so that the inspectors can always determine if a given alarm is unhandled, under investigation or closed and the data deemed reliable despite the alarm.

In conclusion the pilot system offers a variety of strong features which is expected to produce higher quality quota uptake reports, to make quota uptake available in real time, strengthen the enforcement effort substantially and provide an appealing graphical user interface for easy overview with strong data drilling properties.

2.2.3.2 Greenlandic sales notes to logbook matching algorithm

Due to the fact that amounts in sales notes are more accurate than amounts from logbooks, we are calculating the quota uptake primarily based on the combination of logbooks and sales notes.

In order to match logbook and sales notes we have made an algorithm that uses a scoring and weighing system.

First, the system restricts the scope for matches, by pre-matching information on Vessel ID and Species. If a trip number is available both in the logbook and sales note, the algorithm ends by finding an exact match, and exits.

If no matching trip number is found, the algorithm continues by using a weighted scoring system. Higher scores signify higher probability of a match.

The logbook has catch dates, and the sales notes landing dates. The system calculates the sales notes date minus logbook landing date, and attributes a first score.

Difference in days	Score
-1	75
0	100
0	95
1	90
2	85
3	80
4-9	10
Other	0 (No match)

Let this first score be the “difference in days score”.

Next, the system divides the weight in the logbook by the weight of the sales notes. Commonly, skippers have a slight tendency to under-declare weights in their logbooks, so the ratio tends to be less than 100%[6].

A score is attributed according to the following table:

Sales note in relation to logbook	Score
> 120%	1
100% - 120%	60
80% - 100%	100
70% - 80%	90
0 – 70%	80

Let this second score be the "weight ratio score".

The final score of each possible match is given by the formula

Final score = "difference in days score" * 60% + "weight ratio score" * 40%

This formula is based on empirical research in the Greenland Shrimp fishery.

The possible combinations between sales notes and logbooks are given by a matrix. The matrix is then reduced by successive iterations. In each step, the entries into the matrix with highest final scores are "paired off" and removed from the matrix.

A possible borderline case is that a logbook achieves the same "high score" with 2 or more different sales notes (or conversely, a sales note has the same "high score" with 2 or more logbooks, or possibly both apply). This is unlikely, as it would mean that the same vessel sold catches of the same species at dates so close to each other, that the algorithm would be confused. Such oddities would require operator intervention to manually pair off the equally likely sales note to logbook combination.

If there are any residues in the matrix (i.e. unmatched sales notes or logbooks), then these are mostly due to the newest or oldest entries in terms of catch or sales date. An unmatched logbook entry or sales note with a date of more than 9 days in the past warrants an investigation; most likely the matching sales note or logbook was not entered into the system.

2.2.3.3 Drill-down facilities to address data quality problems

This subsection describes how quota take-up is calculated in Greenland at GFLK in near real time using the quota management module developed during this project.

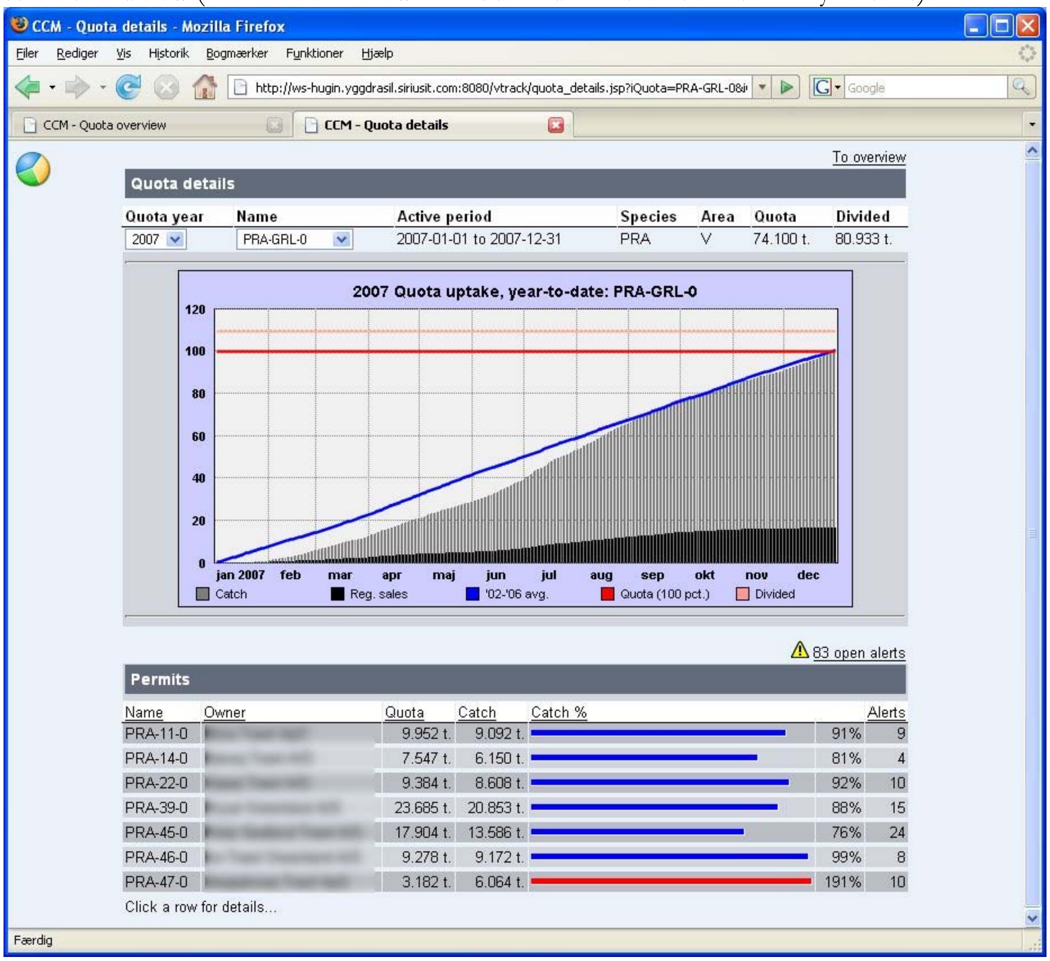
At the moment Hail messages, with catch information, are received by fax/telex or e-mail on a weekly basis for ocean going vessels, logbook's are received by GFLK by ordinary mail after a fishing trip has ended. For landings in Greenland, GFLK receives sales notes electronically after the fish has been sold.

As soon as the hail message is entered in the system the reported catch will be deducted from the quota. When the fishing trip has ended and the logbook data has been entered in the database, the logbook data will replace the catch data from the previous received hail messages. When the

[6] Ratios of up to 0.92 are commonly tolerated by inspectors. But the matching algorithm continues regardless of this enforcement-related tolerance.

fish has been sold and the sales-note[7] data has been entered in the database the sales-note data replaces the matching logbook data except for discards which is retained from the logbook.

In the user interface of the system, the user can drill down in a particular quota by clicking on the quota-name. Then he is able to see the actual quota take-up for each license as seen in the screenshot below (the name of the owner has been blurred for confidentiality reasons).



In the above picture, the last boat would be of particular interest, since it allegedly caught about twice its allocated catch. The user can drill down further to inspect this boat's catches.

The deliverable 2.3 provides more information on the subject of the drill-down facility.

2.2.3.4 Rule-based alert system

The following alert types are available at the moment:

Logbook-VMS compared (>40 knots)	a position in logbook is compared with the nearest in time position from the VMS, if the vessel has to have a speed of more than 40 knots in order to be at both positions at the specified times, an alert is raised.

[7] Sales note data is only received for fish landed in Greenland.

Unrealistic catch per hour	If the catch rate per exceeds a predefined limit an alert is raised.
Haul speed (>20 knots)	If the speed of the vessel has to be over 20 knots, calculated from the position of the start of the haul to the position of the end of the haul, an alert is raised.

The alert system enables the inspector to find errors early in the process. Most of the errors found during the development phase of the module proved to be typing errors, but never the less, the quota analysis system, draws attention to these errors, so that they can be corrected as soon as possible, in order to ensure that the quota take-up is calculated as accurate as possible.

Further the errors can be visualized by showing the catches in a geographical manner

2.2.3.5 Greenland pilot: GINR, GFLK, Sirius

Currently, the Sirius prototype is running as a production pilot. It includes hail messages, sales notes, and VMS. The Greenland pilot benefited from close collaboration between GINR, GFLK, and Sirius.
The prototype system was made available for inspectors to work on the Greenlandic production database. The result of the online trials show that the system integrates flawlessly with the existing system from a technically point of view in real time (as the data becomes available in the database) and provides the inspectors with an intuitively understandable system which allows them easy overview and drill down possibilities, can direct attention to suspicious data and has an incorporated tool for management of suspicious cases.

2.2.4 Time-series analysis on quota uptake by JRC

JRC wrote a prototype system that uses time series predictions, and explored trend breakers in reported landings.

2.2.4.1 Prediction of the coming months

JRC developed a prototype that uses a set of time series models to predict quota uptake (or landings) using past quota uptake (or landings). The prediction algorithm exploits any seasonality and/or trend it can find. The prototype will then perform a forecast with those models that performed the best forecasts in the past.

If the quota uptake exhibits some form of regularity, then the predictions prove fairly accurate (quota consumption prediction errs by up to 5%).

A representative case would be the prediction of 2 months of Dutch NS Cod uptake for August and September 2007.

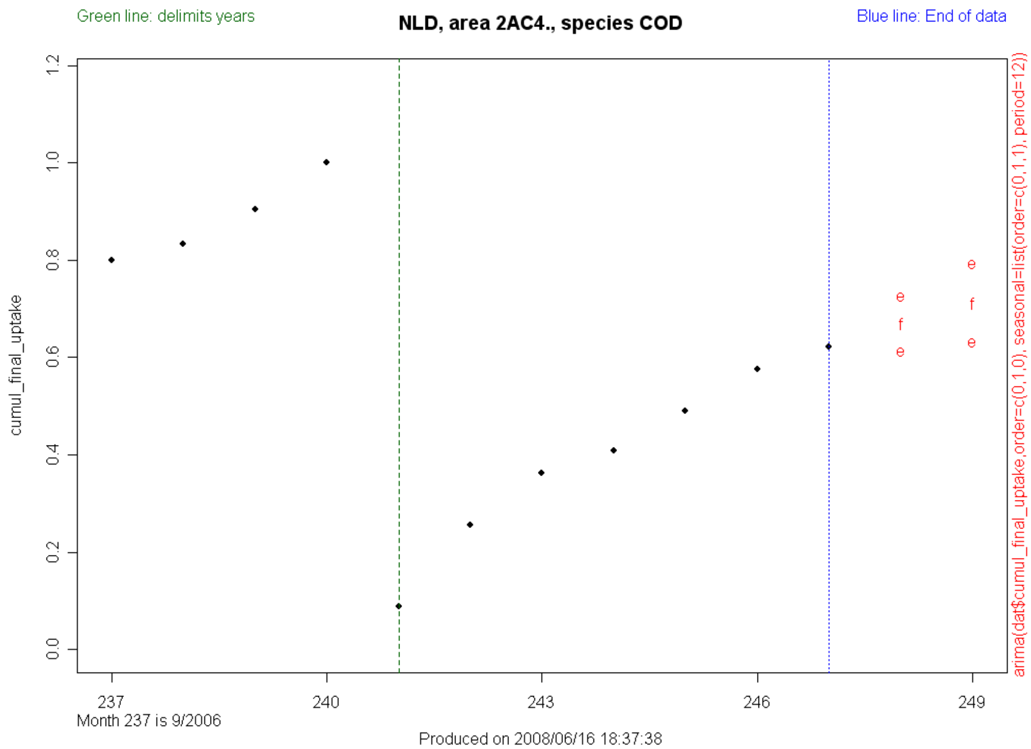


Figure 4: Dutch NS Cod quota uptake and prediction using a S-ARIMA (0,1,0) 12 (0,0,1) model. The red "f" stands for "fitted value", while the "e" indicates the standard error margins. The estimation for August and September 2007 was 67% and 71% respectively, with standard error of 5% and 8%. Actual figures for the 2 predicted months were 70 and 76%.

If there are big irregularities in the time series, such as a broken trend, then the predictions were quite inaccurate (quota consumption prediction errs by 8-20%). If one wants to induce the prediction algorithm into error, one simply chooses a fishery where a broken trend existed, such as the Dutch NS Whiting in late 2004.

Such breaks in trends do occur, to a degree that varies within each fishery. However, when faced with a sophisticated array of statistical models, it is not that frequent to have a truly broken trend. In conclusion, quota uptake predictions can be used as an indicator, but must always be interpreted with caution.

2.2.4.2 Detecting unusual uptakes

JRC attempted a complementary measure to time series analysis, by tracking such changes in trends. For that purpose, we defined a "simple" trend as one in which the quota consumption depends on the month only, and fitted the data using the least squares method. Arguably, with such a simple model, more fisheries will seem to have broken trends. But when researching trend breakers, the goal is more to track irregularities in the consumption of quota, than to predict the uptake of the next months.

Research into trend breakers revealed that some current approaches yield results, but cannot be used because they detect breaks in trends too late. Specifically, CUSUM and related tests developed by Brown, Durbin, and Evans, are able to detect a break in trend in French eastern Atlantic bluefin tuna for 2007, but only by September.

2.2.4.3 Quota uptake time series pilot

JRC has conducted tests of its prototype with fisheries data from the FIDES CRONT v2 system of DG MARE. Real-time capability of the prototype system was therefore tested.

2.3 Additional Studies

A number of participants elected to design studies rather than to devise prototypes. Collectively, these contribute to achieve the following end results:

2. the construction of relationships between these data and national catches, landings;
3. an assessment of the accuracy of such relationships;

Detailed results have been, or are to be published in peer-reviewed journals.

2.3.1 Discards and by-catch in Greenland Shrimp by GINR and GFLK

This is a summary of the following published papers:

Sünksen, K., 2008.

Discarded by-catch in shrimp fisheries in Greenlandic offshore waters 2006-2007. Working Document for ICES NWWG, 21. – 29. april, 12 pp. (Also published as NAFO SCR Doc. 07/88, 12 pp.)

Sünksen, K., 2007.

By-catch in the Greenlandic off shore shrimp fisheries 2006-2007, -preliminary results. Working Document for ICES NWWG, 24. april - 3. maj, 10 pp.

By-catches of fish in the Greenland Shrimp fishery obey the following simple rules:

- All fish caught must be discarded due to hygiene measures.
- If by-catch rates are above 10 % fishing ground should be changed by at least 5 nautical miles.

Observers are deployed on approximately half of the Greenland Shrimp fishing vessels.

Normally the captain or onboard observer, representing the authorities, reports the discard based on visual estimates. In 171 hauls on 6 commercial catch trips on 4 different vessels, from January 2007 to June 2008, collected all fish in baskets and weighed by scientific observers.

Captain and the authorities' observer often agreed on the same amount of by-catch however not necessary at the right level. The average discard of fish ranged by area from 1.6 % of the shrimp catch in NAFO 1B to 5.8 % in ICES XIVb. On the same hauls the captain's estimates ranged from 4.4 % to 1.2% for the same areas. This is somewhat higher than what has been reported in the later years where the discard level on average has remained well below 1% for several years. This suggests that the reporting of the by-catch has been affected by the presence of the scientific assistant.

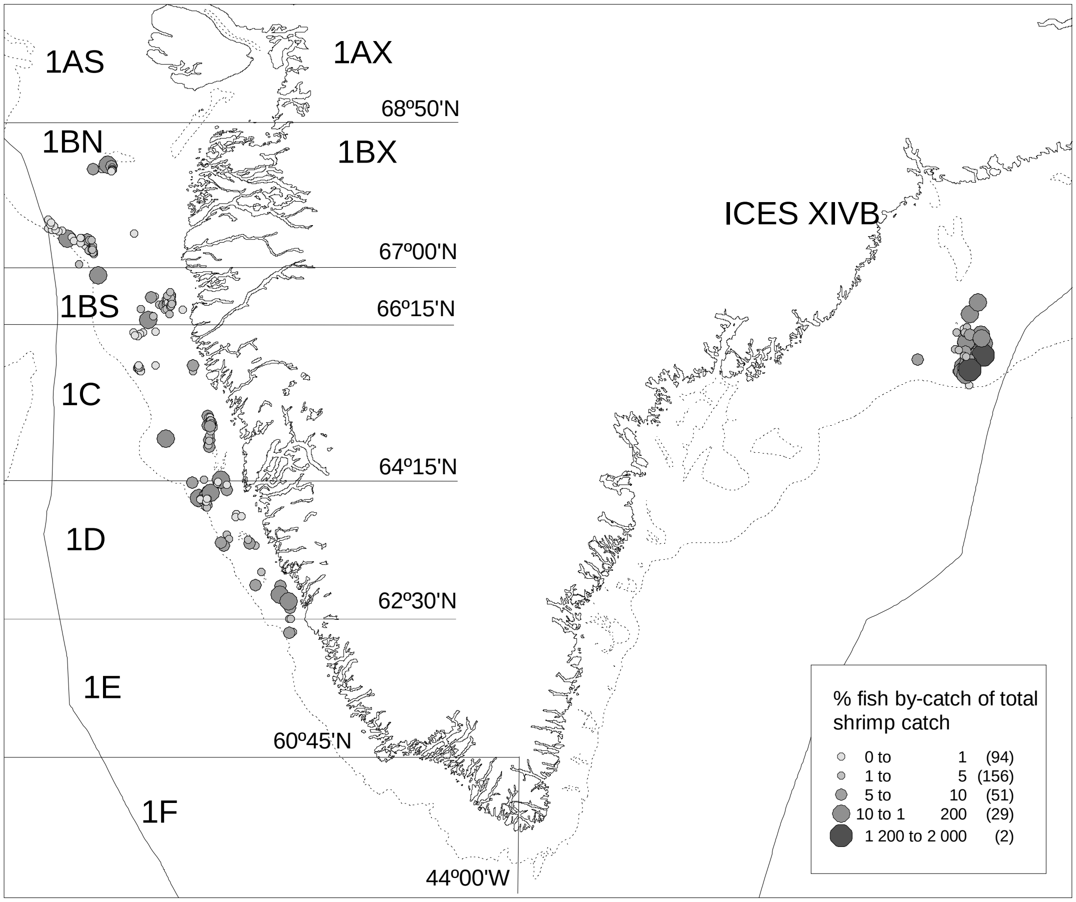


Figure. Distribution of hauls (n=332). Dots varies in size equal to the percentage fish by-catch of the total catch of shrimps. Dotted line: 500 m depth line, Solid line: The 200 nm EEC line. The two hauls with very high percentages were due to few kilo's of shrimp caught in these hauls.

Still the level of discard from the entire study period in 2006 and 2007 on 332 hauls from 12 commercial trips on 9 different vessels in the shrimp fishery with an average discard percentage on 2.2% must be considered low, therefore no conversion of reported levels of by-catch are considered necessary in future systems, see figure below.

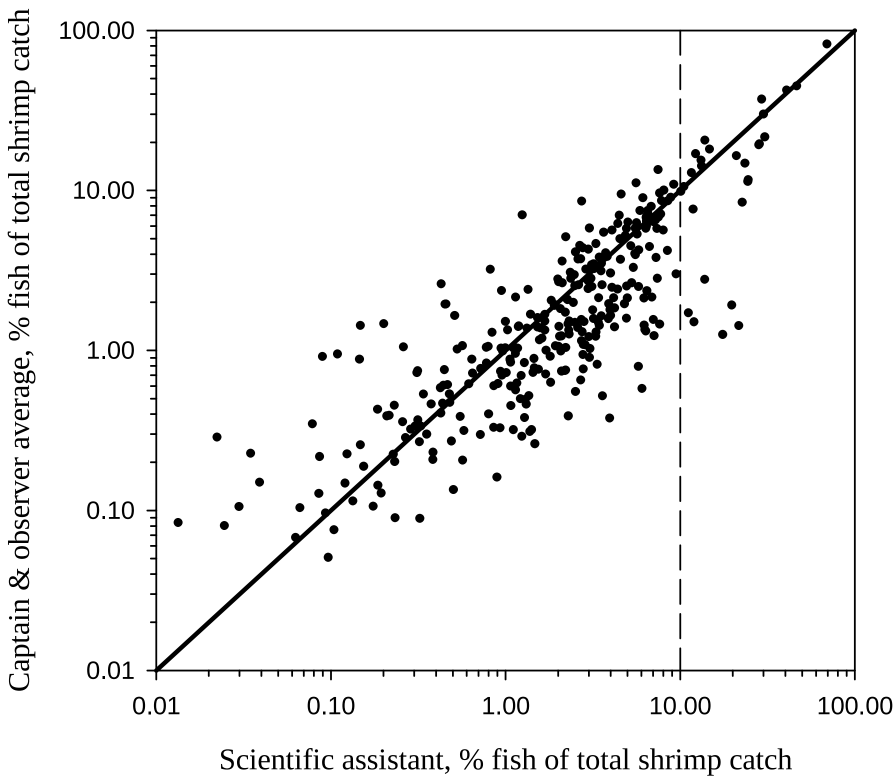


Figure. Percentage fish by-catch of total shrimp catch found by scientific assistant plotted against an average of the same percentage estimated by captain and GFLK observer. Dotted line: 10 % of total shrimp catch. If by-catch rates are above 10 % fishing ground should be changed by at least 5 nautical miles. Solid line: 1:1 accordance between logbook value and scientific assistant. Note the logarithmic scale.

The confirmation on the relatively low discard levels of fish were reported both in ICES North Western Working Group and at NAFO's scientific Council Meeting and the study were cited in the final summary reports in both 2007 and presumably also in 2008.

2.3.2 Scottish pelagic VMS-based effort estimation by FRS

This is a summary of an upcoming draft paper. Draft papers represent preliminary findings and are not to be cited outside of this document.

As reported in the first interim report FRS encountered issues with VMS data, which was restricted due to Data Protection Legislation in the UK. Four vessels from the pelagic fleet provided data releases, and these data were been processed for fishing activity and effort allocation.

VMS data was made available to FRS at the end of 2007. Current access provides all Scottish vessels and all foreign vessels in Scottish waters. The data are available on line for the last 12 months, and off line back to 2004. Within the new agreement, FRS were able to obtain for the pilot study, 15 minute polling data for the six demersal vessels carrying trial elogbooks. This was for a trial period of two months February to April 2008.

As detailed in the last interim report, FRS have obtained data from on board loggers on seven vessels from the pelagic fleet. These data are collected at approximately 2 second resolution. Example datasets were passed to Correlations for analysis – initial conclusions suggested that fishing activity could be resolved from data with a minimum of 15 minute resolution. No validation data were available from the commercial vessels to back up this analysis.

Initial analysis involved the use of speed frequency histograms.

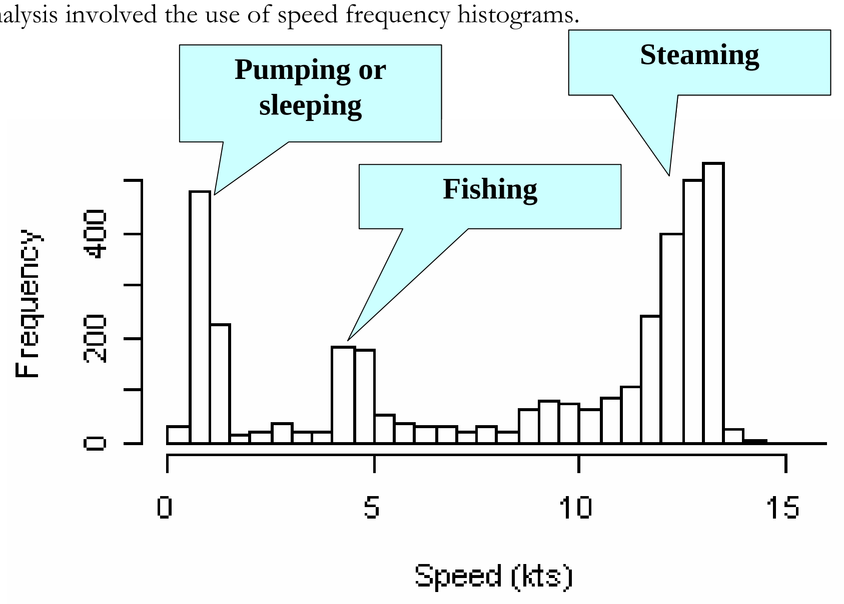


Figure 5: Speed frequency histogram for an individual vessel in the Scottish pelagic fleet

Speeds were based on averages over 30 records, or one minute. While speeds were recorded between 0 and 15 knots the bulk of the activity fell into three categories; between 0 and 1.5 knots – pumping or drifting; between 4 & 5 knots – fishing; and greater than 11 knots – steaming. While no direct validation data was available, the interpretation was confirmed by some of the skippers involved.

We are able to partition the entire trip into four categories. While the speeds for "sleeping" and "pumping" are similar, pumping always follows a shot, and can thus be differentiated. The same information can then be presented on a map to illustrate the spatial patterns of the activity, see figure below:

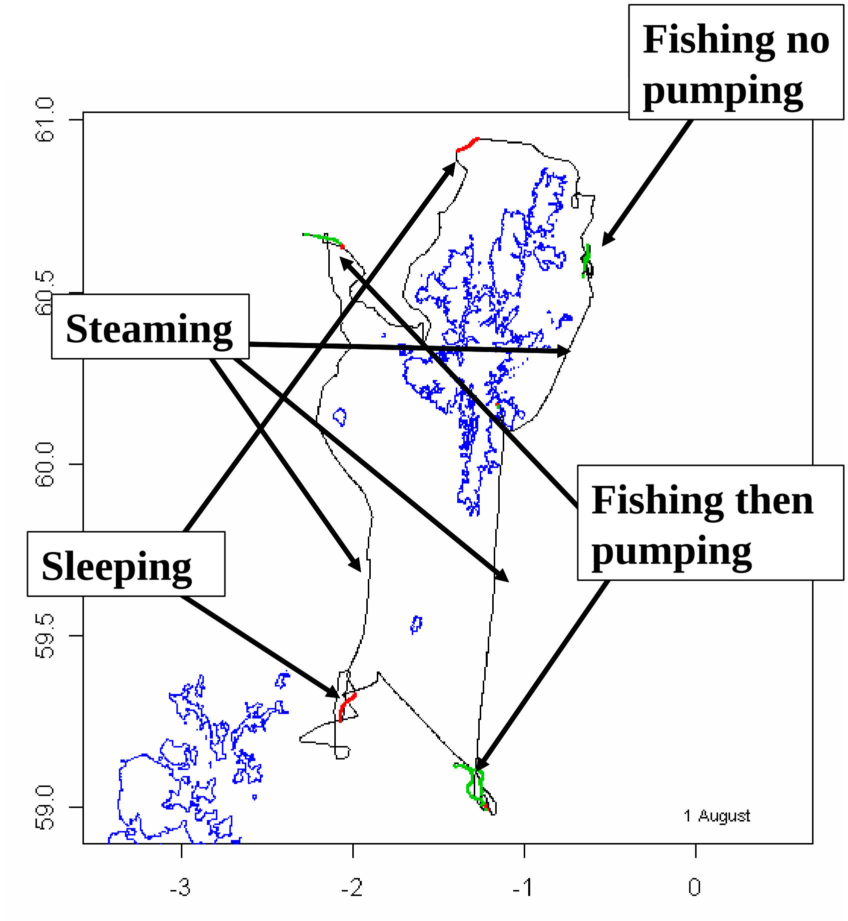


Figure 6: Map showing the vessel trajectory and activities during the period shown in Figure 7

Finally, this information can also be applied more widely to the VMS data available in this fishery. Using VMS for numbers of vessels it is possible to quantify fishing activity and days absent to characterize the spatial and temporal pattern of fishing in this fishery, see the last figure.

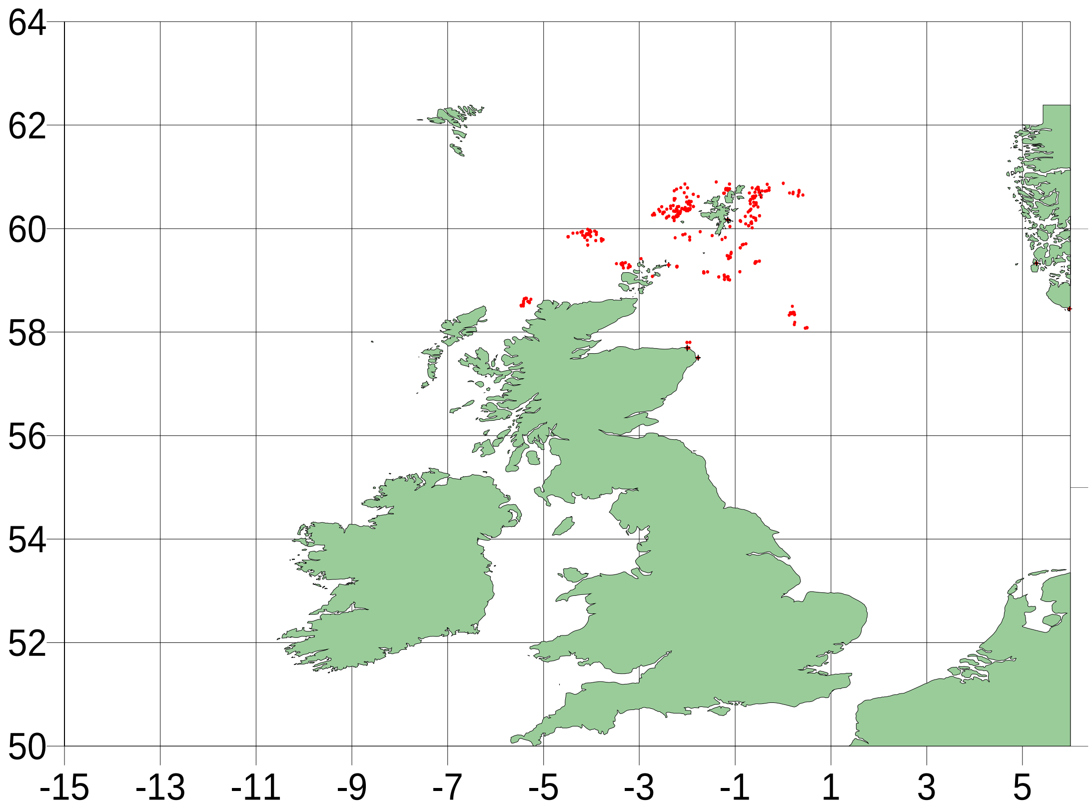


Figure 7: VMS records coded for fishing only for number of vessels in the 2007 herring fishery.

2.3.3 Catch-at-length model for catches and discards by CEFAS

This is a summary of the following draft paper:

A.J.R. Cotter and A. South

"A model based on observer data for forecasting numbers-at-length and –at-age of cod (Gadus morhua) caught per trip by North Sea trawlers"

Draft papers represent preliminary findings and are not to be cited outside of this document.

The modelling of trip catches by small commercial trawlers (pair, otter, and Nephrops trawlers) is difficult because of the well-known extreme variability of fishing success from haul to haul and trip to trip, the correlations in the data and among parameter estimates, and because the numbers of trips observed are often low, causing high sampling variation.

CEFAS developed methods to describe the spatial and temporal distribution of fishing activity using VMS data. Two hourly VMS positions, those which are collected routinely for enforcement purposes in the UK, were joined to discard observer data which defined whether a vessel was actually fishing or steaming at the time the VMS information was sent. From this rules were developed to define whether each 2 hour location corresponded to fishing or steaming. These rules were defined using data from the North Sea and southwest UK, for beam trawl, otter trawl and dredge fleets using observer data collected between 2000 and 2005. Rules based upon vessel speed alone were able to correctly estimate fishing and non-fishing activity from VMS positions in over 90% of cases, when applied to the relatively limited discard observer data. Further testing of whether two hourly VMS data can provide useful estimates of fishing activity is limited by lack of higher resolution data against which to test it.

A model to predict commercial catch rates for North Sea cod was developed using trip-by-trip observer information for fisheries based along the northeast coast of England. The approach taken allowed the incorporation of additional information collected over time, to improve the potential precision of results.

The model successfully mimicked observed patterns in cod recruitment in the test data set, while the approach allowed the catch rate of cod retained for landing and discarded to be predicted a year in advance. It also achieved estimation of average cod catchabilities of three types of trawler, fishing mortality and gear selectivity, as well as other biological characteristics, which have relevance for managing fish and the structure of fishing fleets.

However, not surprisingly precision was not high. This depends upon the number of observed trips in a year and whether they represent a random sample by each type of trawler, and on the inherent variability of catches on different fishing trips. Shortages of trained observers, bad weather, and lack of fishing opportunities all, at times, constrained sampling rates. The least accurately estimable was the quantity of discards which are mostly one-year olds for which there is little or no prior information at the start of each year.

Examining the residual factors that could better predict the number of fish caught, CEFAS concluded that: Firstly, the size of a trawler within the length and power ranges observed off the NE coast of England has little influence on catching power within a trawl type. Secondly, catching and discarding rates are not related to the locality of trawling, but can increase seasonally in summer and autumn. Finally, towing time does not affect numbers caught or discarded per hour. In summary, these mostly negative findings tend to support advice heard from observers that catches and discarding on a trip are strongly influenced by the skipper, the weather, and practical problems with the vessel or the trawl gear.

Preliminary tests were performed to merge the results of the effort estimation approach using VMS data and the catch estimation model. Predicted landings were somewhat higher than reported in all months except January and February. Model predictions based on international bottom trawl survey recruitment estimates were encouragingly of a similar magnitude to reported landings.

2.3.4 VMS-based effort model by CEFAS

This is a summary of an upcoming draft paper. Draft papers represent preliminary findings and are not to be cited outside of this document.

The Cefas approach to analyzing VMS data followed that described in Mills *et al.* (2007) (a paper based on work conducted prior to the CEDER project). In Mills *et al.* (2007) VMS data for beam trawlers were linked to data from 10 discard monitoring trips (332 hauls) in the North Sea between 2002 & 2003. Using speed alone they were able to correctly classify VMS records as fishing 99% of the time and steaming 94% of the time. Using a combined speed and directionality rule, correct classification rates of 99% and 95% were obtained. Thus adding the directionality rules achieved no benefit in terms of classifying fishing and only a 1% improvement in classifying steaming. To extend the analysis presented in Mills *et. al.* (2007) we applied similar methods to data from the North Sea and SW, beam trawl, otter trawl and dredge fleets, using observer data collected between 2000 & 2005.

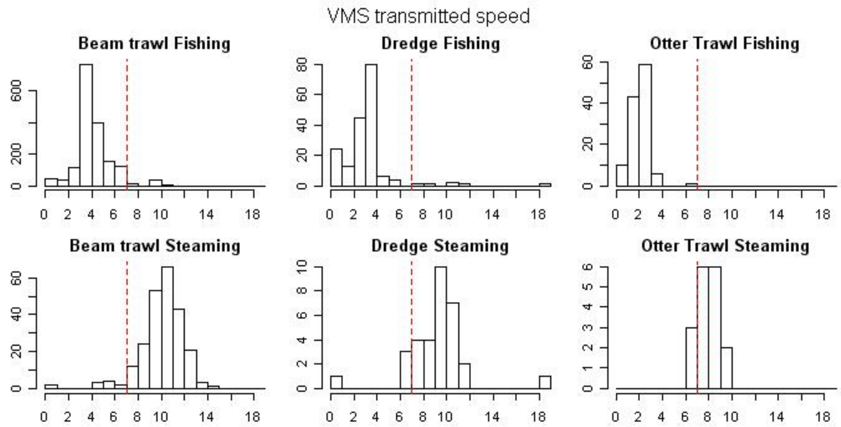


Figure: Vessel speed by gear & activity for UK vessels in North Sea and SW sampled in the Observer Discard monitoring program between 2000 and 2005. The vertical dashed line is at 7 knots which the data suggest is a good cut-off to distinguish between fishing & steaming for Beam trawlers; ; the data suggest that 6 knots would be a better cut-off to distinguish between fishing and steaming for Dredge & Otter trawlers.

		Predicted Numbers		**Proportion of observed**		**Accuracy index**
	Observed	Fishing	Not Fishing	Fishing	Not Fishing	(TP+TN)/total
Beam Trawl						
Speed 7	Fish	2856	100	**0.97**	0.03	**0.96**
	Not	18	205	0.08	**0.92**	
Speed 6	Fish	2666	290	**0.90**	0.10	**0.90**
	Not	13	210	0.06	**0.94**	
Dredge						
Speed 7	Fish	456	11	**0.98**	0.02	**0.97**
	Not	2	23	0.08	**0.92**	
Speed 6	Fish	456	11	**0.98**	0.02	**0.98**
	Not	0	25	0	**1.00**	
Otter Trawl						
Speed 7	Fish	139	0	**1**	0	**0.97**
	Not	4	8	0.33	**0.67**	
Speed 6	Fish	136	3	**0.98**	0.02	**0.97**
	Not	1	11	0.08	**0.92**	

Table: Differentiating between fishing & steaming in VMS data based on speed alone. Fishing/Not fishing from observer data. *Accuracy index = (true+ve + true-ve) / total

Once individual VMS locations have been assigned to either fishing or steaming, there is still the issue of converting these one-dimensional sample locations to a two dimensional estimate of fishing effort. The simplest method is to superimpose a spatial grid, and count the number of fishing locations in each grid cell, assuming that each location represents an amount of time fishing equivalent to the time interval between locations (2 hours in most cases). We also looked at developing algorithms for estimating fishing tracks between VMS locations, and using these to estimate the distribution of effort (as described in Mills *et al.* 2007), however with little independent data on the finer scale paths of fishing vessels it is still uncertain which of these methods might be better.

2.3.5 Spatio-temporal distribution of fishing by IMARES

This is a summary of the following draft paper:

G.J. Piet and F.J. Quirijns

"Spatial and temporal scale determine the impact of fishing"

Draft papers represent preliminary findings and are not to be cited outside of this document.

The impact of a bottom trawl fishery on fish or benthos is often determined by multiplying the frequency of the passing of the trawl with a factor for the effect (i.e. % mortality) of the singular passing of the gear. As fishing intensity in an area is not homogeneously distributed it is necessary to determine the proportions of the area that are fished with different trawling frequencies as these sub-areas together make up the overall species' mortality.

IMARES shows that the proportion of the area fished with a specific trawling frequency is determined by the spatial and temporal scale used. A smaller spatial scale results in an increased perceived patchiness of the fishing intensity.

While the database based on individual fishers' EC-logbooks uses a spatial scale of ICES rectangles to express fishing intensity, the data that are currently being collected using VMS allow a much higher spatial resolution. The fishing intensity of the Dutch beam trawl fleet in the South-eastern North Sea shows distinct spatial patterns that determine how this fishery impacts the ecosystem. However, based on these data our perception may change considerably depending on the spatial scale used.

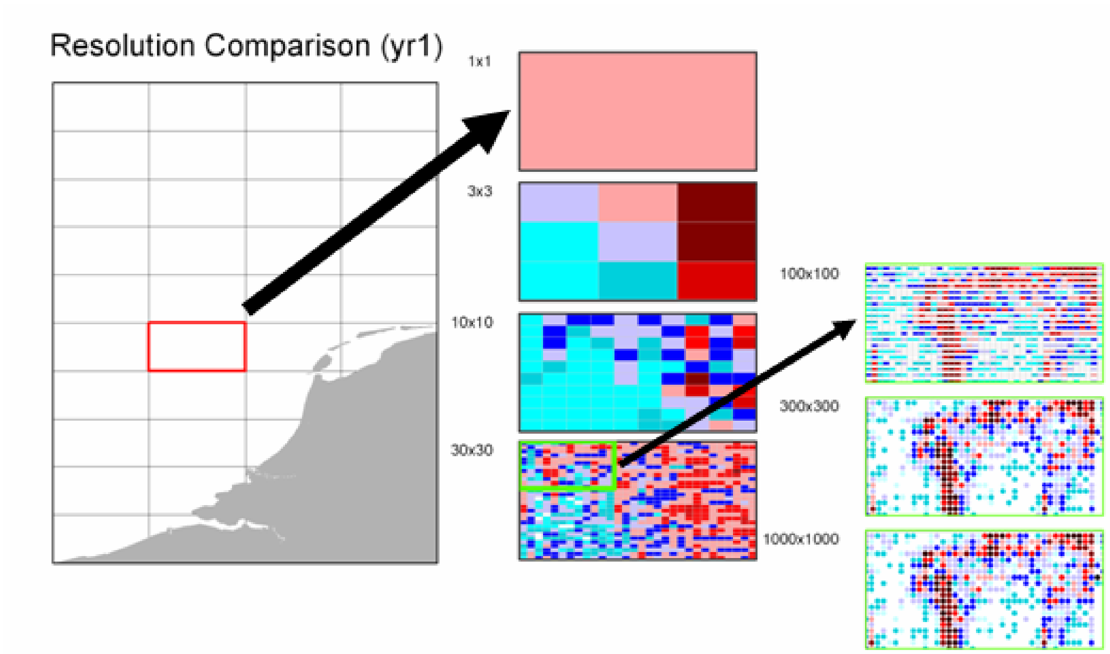


Figure: Spatial distribution of Dutch beam trawl fleet at different spatial scales.

The results show that at the smallest spatial scale (1000x1000 spatial units per rectangle, surface area of approximately 56x56 m) the rectangle gets divided into a large area that is not trawled (and hence 0% mortality) and a smaller area that is trawled heavily with close to 100% annual mortality for all species that remain inside the spatial unit and are, even marginally, affected by the gear. For such sedentary species the vulnerability to the gear hardly makes any difference because in those spatial units where fishing occurs the trawling intensity is so high that even very modest single-event mortalities of 5-10% or higher result in an overall annual mortality of close to 100% in that spatial unit. Thus for sedentary species that are vulnerable for the impact of a particular bottom trawl the overall annual mortality in an ICES rectangle (or larger) is almost entirely determined by the proportions of trawled versus un-trawled areas.

The main problem with this analysis, however, is that it is based on VMS data that provide information of the location of a vessel at certain interval but negates the fact that the position registrations represent actual tracks. The amount of fishing effort is essentially condensed in these positions thereby incorrectly increasing the patchiness of the fishing activity and hence underestimating the estimated fishing impact.

In order to mitigate this effect, enough VMS positions need to be available, for a correct estimate of fishing mortality at the appropriate spatio-temporal scale. In practice this may be achieved by decreasing the interval between registrations. Currently this is approximately 2 hours and therefore a ten-minute interval would provide 12 times as many registrations.

Alternatively the actual trawl track could be reconstructed. If the costs of transmitting this VMS-based information become limiting, the use of electronic logbooks could be considered. These can record all this information at low cost but only make this available on a trip-by-trip basis which is not a problem for the suggested use of this type of information.

If the number of registrations is limiting the use of appropriate spatio-temporal scales, than this reinforces the statement of Hiddink et al., 2006[8] that the constraints on compiling and accessing basic fishery data are an ongoing impediment to operationalizing an EAF in the North Sea and other EU waters.

2.4 Information flow in fisheries

Detailed results in D 1.3 Analysis of Information Flow in Fisheries.

Deliverable 1.3 addresses the following objective:
2. the construction of relationships between these data and national catches, landings;
The prototypes address this objective from an algorithm point of view. This deliverable, by opposition, addresses point 2 from a data flow point of view.

The deliverable
1. identifies standard fisheries reporting chains for regulatory and scientific information on catches and discards
2. describes the communications infrastructure and the timeliness of information in the fisheries of this project.
3. outlines the regulations and use of new technologies

[8] Hiddink, J. G., Hutton, T., Jennings, S. and Kaiser, M. J. 2006. Predicting the effects of area closures and fishing effort restrictions on the production, biomass, and species richness of benthic invertebrate communities. Ices Journal Of Marine Science, 63(5): 822-830.

2.4.1 On reporting chains

The amount that is removed from a stock by a fishery is estimated on basis of the nominal landings, and more seldom based on the logbooks, as in the Greenlandic shrimp fishery and partly the Tropical tuna fisheries. The credibility of the precision of these estimates of catches varies however a lot in between the different fisheries due to several reasons.

In general it seems that the tendency towards miss-/under reporting of the landings is most prominent for the high value species as the Anglerfish for example. This is especially experienced in countries with ITQ (Individual Transferable Quotas) where, as in a "stop and go" fishery, the incitement to hide your catches is not as prominent, however that is "as long as the TAC is large enough". For low valuable species as Greenlandic shrimp and Herring, for instance, where the quality (in most cases size) is important to the value, there will be a tendency towards high grading where, if possible, some of the less valuable part of the catch may be discarded.

Apart from more precise estimates of yearly catch and discard, some of the assessments would benefit from a faster reporting of the catch which may be achieved when the electronic logbooks becomes implemented in the different fisheries. This would probably also increase the percentage of catch reports that actually are delivered to the assessment groups. However most of the assessments are not affected by a slow deliverance of data. The largest benefit from an electronic logbook would (hopefully) be more reliable information on spatial and temporal distribution (when, where and how much).

2.4.2 On communications infrastructure

Six different satellite constellations and their respective provided services are able to support network maintenance with global or semi-global coverage in real or near-real time. A wide range of options as telephony, messaging, email, Voice over IP, file transfers, monitoring and so on are available. A selection of these will likely be used for timely transmission of fisheries data, such as foreseen for the future e-logbook. When such a roll-out happens, it will enable timely transmission of such data. However, before this roll-out, many boats may not be equipped for timely logbook transmission.

Concerning VMS, the report examines standard requirements and current security concerns. In particular, it summarizes several current security issues:

- Blocking Transmission at the Antenna
- Disruption of power supply
- Physical Removal of on-board VMS
- Duplication (cloning) of on-board VMS
- Transmission of False Position

Each issue is laid out, and the authority's possible defences are examined. The subchapters on duplication of VMS boxes, and transmission of false positions, are examined in the light of current GPS and future Galileo satellite systems. The report briefly mentions progress made by the Navigs and JRC during the MARUSE project.

2.4.3 On new technology

This chapter examines the ERS directive, the FP6 project "Sheel" that pioneered some of the concepts related to ERS, and e-logbook systems as developed by Olrac and TraceAll.

2.5 Operational Reporting System Design

Detailed results can be found in D 3.1 Real-Time TAC evaluation and better estimates of effort and discarding.

Deliverable 3.1 addresses the following objective:
5. the delivery of an outline design for introducing such a system into operation

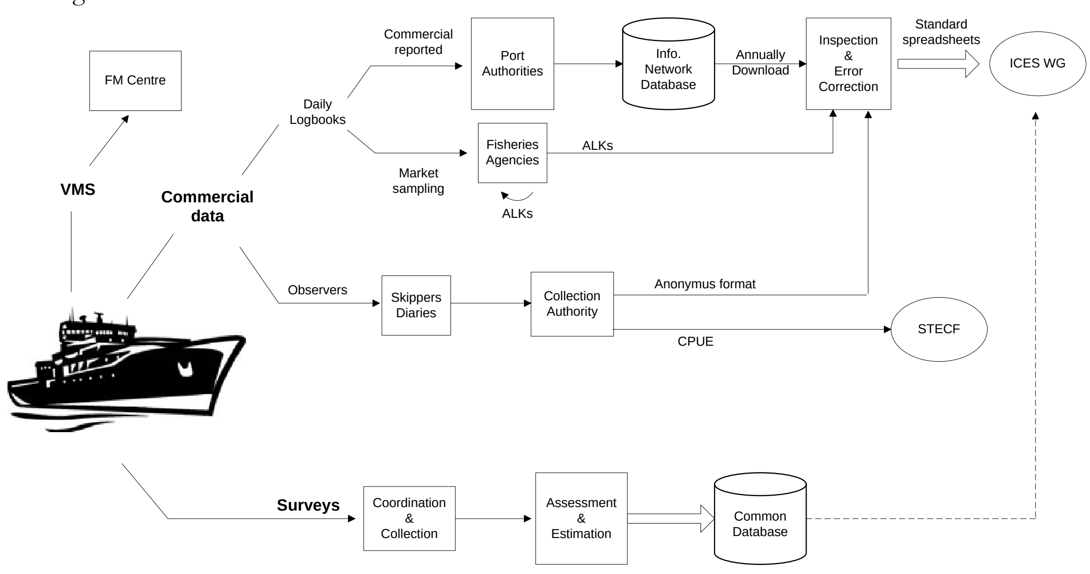
This chapter summarizes some of the findings of deliverable 3.1.

2.5.1 Existing constraints and limitations

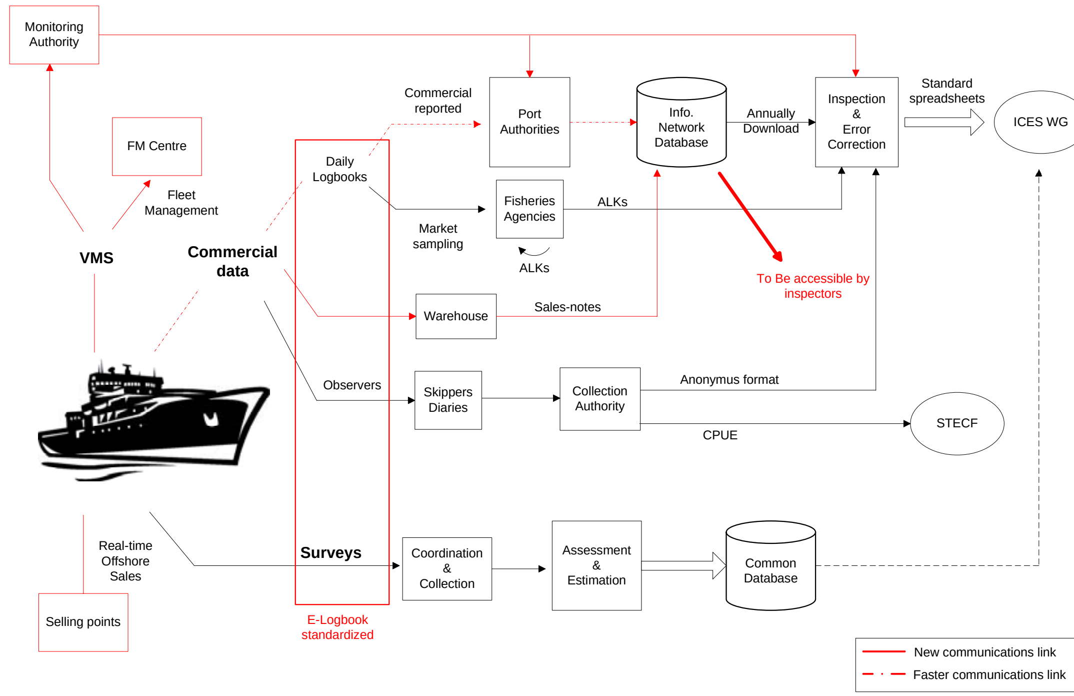
The CoA report provides an excellent analysis of the present situation. During our analysis, as detailed in Deliverable 1.3, we found an almost identical situation. Consequently, Avanti summarized the aspects of the CoA report that impact fisheries.

2.5.2 Fisheries' current status and possible enhancements

The following figure shows a general schematic view of the communications flow between the different stakeholders. Chapter 3 in *D1.3 Analysis of Information Flow in Fisheries* gave a particular analysis of each fishery where the type, age and quality of data and the communication technologies used were described.

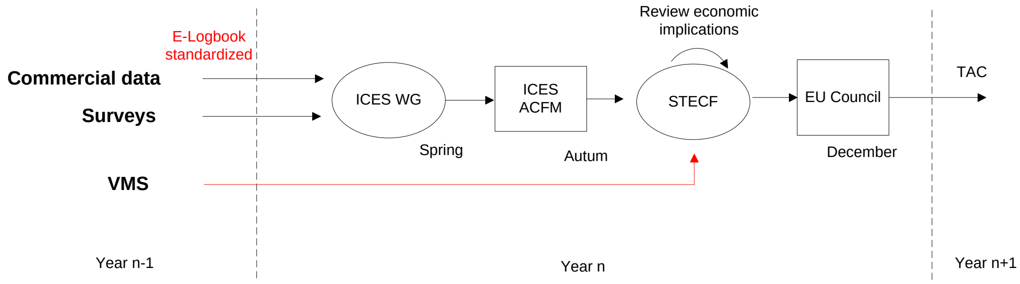


The next figure shows shows the communications data flow for a vessel provided with satellite communications to different onshore monitoring and managing centres. The differences with the existing architecture are plotted in red.



Although the completion process of the TAC assessment cannot be speeded up as it is designed now, its outputs can be improved by providing more accurate and reliable inputs (surveys, landings and more e-logbook data). VMS information can be used in order to cross-check logbook information, as demonstrated in deliverable 1.2.3.. Periodic position information with higher frequency can be used to perform statistical effort analysis, also as demonstrated in the aforementioned deliverable. Such higher-frequency position information could be fitted into the logbooks.

The figure below shows the generalised assessment timeliness for the contemplated fisheries. The time difference between the produced TAC and the input data is still two years as most of the ICES working groups meetings are held in spring, followed by the ACFM in autumn[9]. However, it could be possible to use more recent data by delaying these meetings to a closer date to the final assessment in December. The deployment of these satellite communications and the existence of the standardised e-logbook would allow a simpler, faster and more reliable compilation of data to be reported to the respective working groups, facilitating the work performed at the respective meetings. In this way, almost all the data from year *n* can be used for the assessment in *n+1*.



2.5.3 Data protection, confidentiality and freedom of information

The deliverable 3.1 summarizes ICES data management, as well as data management by different CEDER project partners (FRS, CEFAS, IRD, GINR, GFLK, FRI, DIS). The ICES data management serves to emphasize the balance of data protection versus freedom of information in an international setting.

The International Bottom Trawl Working Group (IBTSWG) is developing the accessibility and quality of their data by storing these in a common database at ICES headquarters, i.e. DATRAS (Database for TRAwl Surveys). The IBTSWG aims to have all their surveys stored in this database, in order that all data are stored in the same format, and can be easily supplied to different users. Furthermore, it facilitates the detection and correction of errors in the historic data, and the prevention of storage of future errors, eventually resulting in one large, high quality database.

[9] TAC assessment data chain and schedule have been recently modified in 2008. ICES delivers full advice in spring, in an attempt to leave more time for STECF and the EU council to deliberate. However, "future evolution is to be expected", as 2009 requirements may well be different. One bottleneck in ICES and STECF assessments are the surveys. These in turn need fish age structure analysis, by gathering otholiths. However, the North Sea surveys are at present done as fast as possible: Trawls are conducted in February/March, and by April, results are already available.

Because of confidentiality requirements, access is grouped into the following categories:

Type of data	User Category			
	National Fisheries Institutes (data suppliers)	**ICES Assessment WGs**	**Other ICES WGs**	**Public and other parties**
Standard maps and graphs (9 commercial species)	Free access	Free access	Free access	Free access
Aggregated data (by ICES rectangle)	Free access	Free access	Free access	Free access
Aggregated data (by ICES rectangle) for other species and times	Password protected **(1)**	Password protected **(3)**	Receive data after request to ICES	If request granted by ICES
Raw data	Password protected **(1)**	Password protected **(3)**	Receive data after request to ICES **(2,3)**	After request granted by national contact person **(2)**

Notes:

1 For those survey/area combinations that the laboratory contributes to, otherwise by request

2 If access to raw data is given, ICES (IBTSWG) and the national fisheries laboratories supplying the data retain "intellectual property", hence if data are to be used for publications, authors must liase with IBTS members to ensure that both data analysis and interpretation are appropriate

3 ICES Assessment WGs that use IBTS data should provide IBTSWG with feedback regarding the utility of the survey data for the species/stock in question, so that IBTS know which data are performing well

ICES WGs will have access to data from only those survey/area combinations that are relevant for their Terms of Reference (TORs) and as such should be specified in them. Data suppliers will only have access to data of those survey/area combinations to which the institute has provided data. Per survey/area combination, the members can decide whether "public and other parties" will have free access to aggregated data or only after request. If a request is granted, an extraction of the data will be made available.

2.5.4 Common terminology and data standardisation

In order to understand why we are making the recommendations on data standardization, we explore the situation as encountered during the Ceder project, with a sidenote on the complexity of data in fisheries in general.

There are virtually infinite numbers and types of fishery data that can be potentially relevant to the Ceder objectives. The reality is that vessel fishing performance and movement patterns are affected by many variables, physical and environmental and there is no point in trying to list all possible data types.

Following an examination of data in the possession of national authorities, scientific laboratories and the European Commission, the partners felt that, despite the detailed differences between the fisheries, there are a number of common features. The partners decided that in order to achieve concrete results within the lifetime of the project, the data description should aim to cover the needs of the fisheries of this project rather than to develop a scheme that is valid for all fisheries everywhere.

Olrac then suggested some common terminology and a schematic chart of a Fishing Operation, based on its own experience, on the Sheel project experience, and based on the recent discussions surrounding the ERS. The deliverable 3.1 details their proposal.

2.5.5 Accuracy and timeliness of data

In the appendix of Deliverable 3.1, there is a section on the accuracy and timeliness of data.

The data comes from: Paper logbooks, Electronic logbooks, Landing declarations, Harbour arrivals, Hail messages, VMS positions, Sales notes and more.

One of CEDER's key results is that sampling GPS position data at least every 15 minutes permits us to distinguish fishing and steaming activities with high accuracy. Here is how we arrived at that conclusion.

Because fishing activities and patterns vary significantly, optimal sampling intervals for VMS data can likewise vary. So that catch estimation can be optimized, it is essential to calibrate these intervals for each fishery and fishing activity. According to the "Nyquist Shannon sampling Theorem"[10] when one samples a frequency, one needs the sampling frequency to be strictly more than twice that frequency (Nyquist rate). Applied to fishing phenomena, in order to be certain to detect a behaviour of N minutes, one needs to sample the vessel's position every n minutes, with $n < N / 2$.

Most fishing vessel activity can be broken down into phases that include steaming, fishing, hauling (the interval between releasing nets from the bottom and their arrival on deck), emptying nets, setting nets (the interval between being placed in the water and touching bottom), and floating (e.g. repairing nets, waiting for improved weather, etc). The optimal VMS sampling time can be determined using the typical duration of these events in addition to the speed at which the vessel is moving whilst they occur. Those parameters for the fisheries covered in CEDER are as follow:

Activity – Beam Trawling (British vessels)	**Estimated Speed**	**Estimated Duration**
Steaming	> 8	Variable
Trawling (Fishing)	4-8	~0.5-2.5 hours
Hauling (from the moment where the nets are released from the bottom up to the moment where nets are on deck)	0	5-15 minutes
Emptying nets and preparing them for setting	0	~10-15 minutes
Setting (from moment where nets are put in the water until the moment where nets touch the bottom)	5-10	5-10 minutes
Floating (repairing nets, waiting for better weather etc)	~ 0-3	Variable

Activity – Otter Trawling	**Estimated Speed**	**Estimated Duration**
Steaming	~ 6-8	Variable
Trawling (Fishing)	2.5-4.5	Usually 4-6 hours but maybe greater on occasions
Hauling (from the moment where the nets are released from the bottom up to the moment where nets are on deck)	0	~15 minutes
Emptying nets and preparing them for setting	0	~15 minutes
Setting (from moment where nets are put in the water until the moment where nets touch the bottom)	4-8	5-10 minutes
Floating (repairing nets, waiting for better weather etc)	~ 0-3	Variable

Activity –Beam Trawling (Dutch vessels)	**Estimated Speed**	**Estimated Duration**
Steaming	> 8	Variable
Trawling (Fishing)	5-8	~1.5 hours
Hauling (from the moment where the nets are released from the	5-8	5-10 minutes

[10] Claude Shannon "Communication in the presence of noise", Proc. Institute of Radio Engineers, vol. 37, no.1, pp. 10-21, Jan. 1949, http://en.wikipedia.org/wiki/Nyquist%E2%80%93Shannon_sampling_theorem

bottom up to the moment where nets are on deck)		
Emptying nets and preparing them for setting	< 5	~15 minutes
Setting (from moment where nets are put in the water until the moment where nets touch the bottom)	5-8	5-10 minutes
Floating (repairing nets, waiting for better weather etc)	~ 0	Variable

Activity Pelagic Trawling (Scotland)	**Estimated Speed**	**Estimated Duration**
Steaming	> 10	Variable <12
Trawling (Fishing)	4-5	15 mins- 4 hr
Hauling (from the moment where the nets are released from the bottom up to the moment where nets are on deck)	0	5-15 minutes
Emptying nets and preparing them for setting	0	1-2 hrs
Setting (from moment where nets are put in the water until the moment where nets touch the bottom)	5-10	5-10 minutes
Floating (repairing nets, waiting for better weather etc)	0	5-8 hrs

Activity – Otter Trawling (Scotland)	**Estimated Speed**	**Estimated Duration**
Steaming	~ 6-8	Variable <10
Trawling (Fishing)	2.5-4	4-6 hours
Hauling (from the moment where the nets are released from the bottom up to the moment where nets are on deck)	2	~15 minutes
Emptying nets and preparing them for setting	0	~15 minutes
Setting (from moment where nets are put in the water until the moment where nets touch the bottom)	4-6	5-10 minutes
Floating (repairing nets, waiting for better weather etc)	~ 0-3	Not common

Activity - Shrimp fishing (Greenland)	**Estimated Speed (knots)**	**Estimated Duration**
Steaming	> 8	3 hours to 3 days depending on the distance from port to the fishing grounds
Trawling (Fishing)	<3	~4 hours off the west coast, ~5 hours off the east coast 85% between 3 and 6 hours
Hauling (from the moment where the nets are released from the bottom up to the moment where nets are on deck)	<3	~15 minutes
Emptying nets and preparing them for setting	Any speed	~30 minutes
Setting (from moment where nets are put in the water until the moment where nets touch the bottom)	<3	~15 minutes
Total time between trawling	See the three previous rows	69% between 0.5 and 1.5 hours
Delayed fishing (repairing nets, waiting for better weather etc)	Any speed	Variable

From the tables above, the typical shortest fishing duration is about 30 minutes. From the tables and from the Nyquist-Shannon theorem, we derive that the vessel's position is needed every 15 minutes, in order to distinguish fishing from steaming. A higher sampling frequency will detect more phenomena, and detect phenomena with more certainty.

Note that for Tuna purse seining, the duration of setting a set depends on the size of the Tuna school. Details are available in the appendices of deliverable 3.1.

2.5.6 The economics of position and catch data gathering

Examining cost comparisons, daily communication costs, and recurring charges led Navigs to conclude the following:

- There is a broad range of communications services available to vessels that will allow them to meet CEDER requirements and these services correspond to an equally broad range of prices.
- Looking at the relative costs, it would seem obvious that a single message per day, combing both position and logbook data, should be the preferred solution. It must be taken into account, however, that such decisions are not always made on an economic basis

Details are available in the appendices of deliverable 3.1.

2.6 Benefits of Better Information

Detailed results can be found in D 3.2 Benefits Report.

Deliverable 3.2 addresses the following objective:

6. an assessment of the benefits to industry, authorities and to the sustainability of stock and the fishery.

This chapter summarizes some of the findings of deliverable 3.2.

2.6.1 Benefits for Authorities

2.6.1.1 ReelCatch

The Correlation System ReelCatch prototype has several advantages

For effort management

- It provides visual and numeric aids for cross-checking e-logbook haul information versus time spent fishing, which can be used by inspectors, in order to foster a culture of compliance.
- It enables automated control of effort in hours spent fishing.
- It provides useful statistical crosschecks of effort versus landings for effort-based management regimes.
- Because it only counts fishing time, it could assist in spreading fishing effort more evenly between different fishing grounds of the same area[11]. If trials are conclusive, a second stage could then reduce bureaucratic overhead

For monitoring closed areas:

[11] For instance, when fishing for redfish near the Faroe Islands, German fishermen submit fishing trip plans, which in turn grant them the right to traverse the North Sea without having the days for that traversal taken off their effort-based regime. This could be crosschecked and enforced by a VMS-based effort estimation algorithm.

- It could be the basis of an automated warning system that detects fishing behaviour in closed areas. Estimating when and where a boat is fishing allows inspections to be targeted, if indeed closed areas seem to be violated.

For quota controls:
- While the correlation between “effort while fishing” and fishing trip catches, discards, and landings is not strong enough to infer the latter from the former, it however can yield a first automated guess.
- The benefits depend on whether the TAC/GQ regime monitors “catches” or “landings”, and on whether discard monitoring is required. If catch and/or discard monitoring are sought, then the figures can be fed into a system of cross-checks.
- This algorithm could be used at an individual vessel level for enforcement and control purposes, as a cross-verification measure for IQ management schemes, in order to level the playing field. Fishermen that cheat significantly will have artificially low logbook catches, landings, and/or discards when compared to their effort. Since such cross-verification at a ship level meets with the inherent variability of catches per boat and trip, it would be an indicator, not a piece of court evidence

For effort controls, it requires the availability of high-frequency (15 minute) GPS data in near real time, and the accuracy of such data.

For quota controls, it requires the availability of e-logbook data. It also relies on availability and validity of metier specific information regarding CPUE, species composition, and observer discards, as current as possible. Especially for quota predictions, caution is required when interpreting the results.

2.6.1.2 CARFI

The CARFI system developed by FRI for Icelandic Redfish has several advantages.

For effort management
- Estimates effort from 2-hour VMS data. The effort estimation from VMS data has the following benefits for the Icelandic Redfish fishery in particular
- A more precise and automated effort estimation algorithm provides useful cross-checks for effort-based management regimes.

For closed areas:

- Estimating when and where a boat is fishing will allow inspections to be targeted, if indeed closed areas seem to be violated.

For quota controls:
- An estimation of catches is valuable, as it represents an additional variable to feed into an authority’s system of crosschecks. However, predictions must be interpreted with caution.
- This algorithm could be used at an individual vessel level for enforcement and control purposes, as a cross-verification measure for IQ management schemes. Fishermen that engage in cheating will have artificially low logbook catches when compared to their effort. However, such cross-verification at a ship level meets with the inherent high variability of catches per boat and trip.

CARFI needs VMS to be present and accurate. Furthermore the fishery needs to be similar to Icelandic Redfish fishery.

2.6.1.3 The Greenland Shrimp prototype

The Greenland Shrimp prototype developed by Sirius IT can be used for quota controls:

- The system's data mining facilities are able to identify data quality issues, that could affect mostly individual quotas, but to some extend also aggregate quotas. The rules can be extended to suit a range of different conditions. Any quota based system can benefit from such more accurate and timelier catch information.
- Tracks quota utilization using hail messages, data entered from paper logbooks, and sales note data.

The system requires that logbook data exist, but does not have to be accurate. VMS data and sales notes have to be accurate.

2.6.1.4 CEFAS models

The CEFAS models on "effort from VMS" and "catch-at-length" (the latter for North Sea demersal cod) can be used for quota controls:

- The CEFAS effort model can be simplistically linked with the CEFAS catch model, to provide a preliminary estimate of catch and discards.

Note: Before CEDER, CEFAS has developed a model that predicts effort from 2 hour VMS data. This in turn is the basis of the work that CEFAS performed during CEDER.

In order to be useable, VMS needs to be present and accurate. Applicable to NE and SW England beam trawls, otter trawls, and dredges. Information on year class strength from new surveys improves estimates. Predictions must be interpreted with caution.

2.6.1.5 JRC

The JRC's Time Series Forecasting of Quota Uptake can be used for quota controls:

- The JRC prototype assists in addressing the problem of being able to anticipate quota overshooting. Stakeholders can be warned, in case it becomes apparent that a particular quota is being overshot.
- Usually, the predictions prove fairly accurate. However the model breaks down in case of sudden changes in trends. Therefore, predictions must be interpreted with caution.

In turn, landing figures have to be accurate, and available for at least 2 years. Some regularity must exist in the data set, i.e. there is some structural stability in the quota consumption or landings.

2.6.2 Benefits for Industry

Given that today's goal of fisheries management is to have sustainable fisheries that run closer to their maximal sustainable yield, the ultimate beneficiary of an improvement in fisheries management must be the industry.

Under the current practice of TAC assessment by ICES, STECF, and others, Industry feels justified in claiming that the allocated TACs are not based upon reliable scientific data. However, it has been the practice and habit of industry to take a very non-cooperative stance in providing accurate data on catch composition and catch location. To date the scientific argument on TACs has always carried the day. Industry lacks a credible argument against the scientists' point of view.

Recently the development of joint activities, such as the UK Fisheries Science Partnership, has increased co-operation, collaboration and trust between the industry and science. It has also increased the understanding of the industry in the activities and information that are used in scientific assessments.

Industry can help its own cause by supplying more and better data to the scientists. First, ERS is their chance to rectify overly conservative stock assessments, which otherwise would lead to overly restrictive TACs, resulting in obligations to discard of otherwise commercially viable fish. Second, in the long term, more plentiful stocks and more sustainable harvesting will lead to increased profitability and a mitigation of economic uncertainty. Third, faster transmission of accurate data will lead to lesser economic uncertainty at the end of a calendar year, when quota is nearly consumed.

With the introduction of ERS, Industry needs to understand that they would be the ultimate beneficiaries of more and better quality data.

The advantages to Industry can be listed as follows:

1. An increase of TAC based on the more accurate and timely assessment of the target species. (Alternatively a transparent and therefore credible justification of why the TAC is lower than desired by Industry).

2. E-Logbooks together with on-board videos can replace observers in some cases. For instance, this can be used in incentive schemes for more selective gears and fishing grounds, to reduce unwanted by-catch. Usually, skippers benefit by an increase in days at sea to capture the target species.

3. The capability to fish to the maximum of the allocated quota through reduction in time taken to assess landing data. This today causes major problems in completing quota uptake at the end of each year.

4. Catch Prediction – Catch Management: Commercially applied versions of e-logbook products are today helping some fishermen in locating fish.

5. Traceability, directly derived from the e-logbook.

Some of these goals may seem in direct contrast to the goals of government and the scientific bodies charged with the task of stock management and sustainability of stocks. However, this is only an apparent paradox, as is further explained in Deliverable 3.2. By correct usage of the systems and data made available, we can transform the scenario of "poacher versus gamekeeper" to the benefit of all parties. Both parties stand to win from mutual cooperation.

2.6.3 Benefits for sustainability

Given the enormous complexity of the problem and the almost infinite number of variations of fishermen's behaviour that can affect the results of the problem, CEFAS has focused on two types of modelling approaches.

2.6.3.1 Real-time catch data for a recovering stock and the effect of the 15% TAC rule

CEFAS created a software model (using FLR) on the North Sea cod recovery, with a modelled 15% inter-annual constraint on TAC change. A lag of 1 year was compared with no lag, with and without a constraint on TAC change.

In the cod case study, while the CEDER system can offer some advantages for stocks under recovery plans, these were overshadowed by the imposition of an inter-annual limit on TAC change. This raises important issues regarding the management of not just fisheries systems, but all systems under management regimes. The feedback between the operating model (the underlying fish population within the model) and the management procedure, means that the TAC, SSB and fishing rate all interact.

2.6.3.2 The advantages of active management – South West Anglerfish example

First, let us define an active management by one that is using up-to-date data from a CEDER –like system, for a fish stock caught within a multispecies fishery. An active management scheme would be one that can make decisions about closing a fishery in real time, if one of the species has sustained excessive fishing pressure. The active management contrasts with business as usual in mixed-species fisheries: if the total allowable catch of a given species A is taken, but another key species B has quota remaining, then species A may be discarded as fishing for species B continues. The latter approach will be labelled “standard” management.

Simulation results suggest that an actively managed mixed fishery performs better than a fishery under standard management in terms of economic performance (measured as landings through time; **Error! Reference source not found.**) and in terms of ecological performance (i.e. whether biomass is above the target and whether fishing rate is below the target; **Error! Reference source not found.**). This clearly demonstrates the potential advantages of using a CEDER-style system to actively manage fisheries.

However, the success of the active management is strongly influenced by the accuracy of the real-time data estimates, with a consistent under-estimation bias from the CEDER system resulting in a stock decline not dissimilar to the standard management (**Error! Reference source not found.**).

It must be noted that benefits require fisheries management to be reactive, with rapid decision-making and enforcement capabilities, which would require changes to the Common Fisheries Policy.

2.6.4 Towards a more responsive fisheries management policy

Implementation of a reactive management system requires timely action, of a type only likely to be encountered where stocks are under individual or binding multinational control (e.g. management of short-lived squid stocks in the South Atlantic).

Whether this style of management is feasible in multinational EU waters is open to question. While Member States have primary responsibility for managing and monitoring quotas and avoiding quota overruns, potentially by closing fisheries, this is not straight forward in the generally multi-state fisheries within EU waters. While it is not the Commission’s role to step in where this issue arises, regulations are in place for them to halt fishing if necessary (Regulation (EEC) No 2847/93, Article 21(3) & Regulation (EC) 2371/2002, Article 26(4)).

As noted in the Court of Auditor's Special Report, however, due to the necessity of assembling sufficient evidence to provide assurance that a quota has been used up, the scope of this provision is confined to cases where there are a small number of ships and landings. In turn, to avoid legal risk, there must be a very high confidence level before action can be taken. Over-quota catches can also be deducted from the TAC for a country in subsequent years.

However, when a full roll-out of the ERS regulation (EC) 1966/2006 will be completed, then data for a larger number of vessels and landings should be available. There is reason to believe that this will diminish the incertitude about the usage of quota, but a limiting factor is sure to be the applicability to vessels due to vessel size. Industry could very well respond by creating smaller vessels in greater numbers. This defeats the key expected benefit of ERS, which is to help fisheries management to guide fisheries towards sustainability and profitability, with faster and better data delivery making management more responsive. In addition, research by CEFAS has shown that a larger number of smaller boats are more difficult to predict and manage.

One possible mitigation measure for the above issue is the introduction of complementary checks at fish markets and wholesalers. However, the majority of CEDER participants believe it is likely that the Industry will react negatively to such new measures. As we have seen above, such antagonism is detrimental to redressing issues related to the "gamekeeper versus poacher" mindset.

A majority of CEDER participants further believe that in order to realize the benefits of the ERS, an accompanying and beneficial measure would be more and better communication between the Fishing Industry and Government. Both parties stand to win from cooperation, and the present antagonistic situation is sub-optimal. In "prisoners' dilemma" type situations, conflict resolution techniques clearly are an option.

3 APPENDIX 2: DISSEMINATION PLAN

Section 1 - Exploitable knowledge and its Use

Exploitable Knowledge (description)	**Exploitable product(s) or measure(s)**	**Sector(s) of application**	**Timetable for commercial use**	**Patents or other IPR protection**	**Owner & Other Partner(s) involved**
Classification engine for vessel behavioural detection	ReelCatch for vessel owners	Industrial, Government, Security & border control	2008	US 61/064011	CorrSys (owner)
TAC and Quota uptake prediction tool	Intranet-based software	Fisheries Management	2008	Not needed	EC/JRC
Harmonized Database	Sumfish: A Prototype Tool for the Creation and Maintenance of a Harmonized Database	Fisheries Research	N/A	Not planned	Olrac
Olfish E-logbook add-on for CEDER	electronic logbook	Fisheries enforcement	Currently in use	full protection	Olrac
Description of fisheries; common description of data; and information descriptions for the Ceder project	document	Fisheries enforcement	N/A	N/A	Olrac
Dataset on Icelandic fishing vessel behaviour in Atlantic Redfish fisheries 2001-2005	database	Academics, Fisheries Controllers, Fisheries Monitoring Authorities	N/A	N/A	FRI and DIS
Classification algorithms for vessel behaviour in Atlantic Redfish fisheries	document	Academics, Fisheries Controllers, Fisheries Monitoring Authorities	N/A	N/A	FRI and DIS

Partners 4 and 9: FRI and DIS

Dataset on Icelandic fishing vessel behaviour in Atlantic Redfish fisheries 2001-2005

What the exploitable result is (functionality, purpose, innovation etc.);	The FRI and DIS have compiled a dataset intended for research purposes detailing vessel movements, reported catch and landed catch from the Atlantic Redfish fisheries of the Icelandic fleet.
Partner(s) involved in the exploitation, role and activities	FRI, DIS
How the result might be exploited (products, processes) - directly (spin offs etc) or indirectly (licensing) – on an individual basis or as a consortium/group of partners (market considerations, thresholds, obstacles, non-commercial use or impact)	Non-commercial use.
Further additional research and development work, including need for further collaboration and who they may be	Not planned.
Intellectual Property Rights protection measures (patents, design rights, database rights, plant varieties, etc – include references and details)	None Taken
Any commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.)	None Taken
Where possible, also include any other potential impact from the exploitation of the result (socio-economic impact)	Not applicable

Any technical and economic market considerations – commercial and technical thresholds etc.	Non-commercial use
Any obstacles identified which might prove to be barriers to commercialization	Non-commercial use
The existence or development of similar or competing technologies / solution elsewhere	N/A
Third party rights (eg patents belonging to competitors), standards,…	None
Analysis of any (potential) non-technical obstacles	None found
Any form of non-commercial use or impact, relating e.g. to the development of new standards or policies	See "what the exploitable result is"

Classification algorithms for vessel behaviour in Atlantic Redfish fisheries

What the exploitable result is (functionality, purpose, innovation etc.);	FRI has developed a classification algorithm to analyse vessel behaviour in the Atlantic Redfish fisheries
Partner(s) involved in the exploitation, role and activities	FRI
How the result might be exploited (products, processes) - directly (spin offs etc) or indirectly (licensing) – on an individual basis or as a consortium/group of partners (market considerations, thresholds, obstacles, non-commercial use or impact)	Non-commercial use.
Further additional research and development work, including need for further collaboration and who they may be	Not planned.
Intellectual Property Rights protection measures (patents, design rights, database rights, plant varieties, etc – include references and details)	None Taken
Any commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.)	None Taken
Where possible, also include any other potential impact from the exploitation of the result (socio-economic impact)	Not applicable

Any technical and economic market considerations – commercial and technical thresholds etc.	Non-commercial use
Any obstacles identified which might prove to be barriers to commercialization	Non-commercial use
The existence or development of similar or competing technologies / solution elsewhere	N/A
Third party rights (eg patents belonging to competitors), standards,…	None
Analysis of any (potential) non-technical obstacles	None found
Any form of non-commercial use or impact, relating e.g. to the development of new standards or policies	See "what the exploitable result is"

Partner 6: Correlation

ReelCatch

What the exploitable result is (functionality, purpose, innovation etc.);	ReelCatch for vessel owners is a service designed to provide vessel owners information regarding frauds performed by the vessel operator. The software analyses and detects the normal patterns of the vessel based on it's geospatial behaviour and alerts the vessel owner in case of abnormal behaviour. ReelCatch for fishing authorities provides a similar service for national fishing authorities in order to detect fraud performed by the vessel. Information generated by the VMS data is sent as an input for the service and an alert is issued whenever the system detects abnormal activity.
Partner(s) involved in the exploitation, role and activities	Correlation Systems
How the result might be exploited (products, processes) - directly (spin offs etc) or indirectly (licensing) – on an individual basis or as a consortium/group of partners (market considerations, thresholds, obstacles, non-commercial use or impact)	This product has not been developed under CEDER. However, experience gained from ReelCatch assisted in the project, and conversely, insight gained in the project will provide valuable in the product. ReelCatch exists in 2 versions, for vessel owners and for fishing authorities
Further additional research and development work, including need for further collaboration and who they may be	Further development of the product is expected during 2008.
Intellectual Property Rights protection measures (patents, design rights, database rights, plant varieties, etc – include references and details)	IPR lies with Correlation Systems. The algorithm for detection of deviations from normal behaviour is registered by Correlation Systems as a patent (US 61/064011).
Any commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.)	ReelCatch has been demonstrated to several potential customers mainly in Africa, no contract has been signed yet.
Where possible, also include any other potential impact from the exploitation of the result (socio-economic impact)	N/A

FishClass

What the exploitable result is (functionality, purpose, innovation etc.);	FishClass is a classification engine integrated with radar systems or with larger scale command and control systems, this engine is learning the normal behaviour of the vessels within the arena and alerts the system operator whenever a vessel has an abnormal behaviour. In addition the system identifies fishing vessels and fishing activity and updates the situation awareness picture with the detected activity.
Partner(s) involved in the exploitation, role and activities	Correlation Systems
How the result might be exploited (products, processes) - directly (spin offs etc) or indirectly (licensing) – on an individual basis or as a consortium/group of partners (market considerations, thresholds, obstacles, non-commercial use or impact)	This product has not been developed under CEDER. However, experience gained from FishClass assisted in the project, and conversely, insight gained in the project will provide valuable in the product. Defence sector
Further additional research and development work, including need for further collaboration and who they may be	Further development of the product is expected during 2008.
Intellectual Property Rights protection measures (patents, design rights, database rights, plant varieties, etc – include references and details)	IPR lies with Correlation Systems
Any commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.)	FishClass has been introduced to several companies in the defence area
Where possible, also include any other potential impact from the exploitation of the result (socio-economic impact)	N/A

Partner 13: Olrac

Harmonized Database (SUMFISH)

What the exploitable result is (functionality, purpose, innovation etc.);	This is a tool we developed in order to carry out our task in CEDER of harmonizing Fisheries Data.
Partner(s) involved in the exploitation, role and activities	Olrac
How the result might be exploited (products, processes) - directly (spin offs etc) or indirectly (licensing) – on an individual basis or as a consortium/group of partners (market considerations, thresholds, obstacles, non-commercial use or impact)	The IP cannot be used by members unless they wish to come to some commercial agreement with Olrac. (licensing etc) The database comes with an interface and some queries tools – this will be (already is) freely available to members. It includes all the data that was provided by the consortium partners - It doesn't allow users to harmonise data themselves but they can browse and extract from it any data they wish. Olrac has named this database FISHSUM.
Further additional research and development work, including need for further collaboration and who they may be	It has been highlighted in the CEDER project that some data is not available due to government restrictions on the dissemination of these data. VMS is a prime example. Until complete freedom of data exchange is agreed there will always be a lack of the complete picture regarding the data analysis.
Intellectual Property Rights protection measures (patents, design rights, database rights, plant varieties, etc – include references and details)	None Taken (this however may change in the future)
Any commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.)	None Taken
Where possible, also include any other potential impact from the exploitation of the result (socio-economic impact)	Not applicable

Any technical and economic market considerations – commercial and technical thresholds etc.	N/A
Any obstacles identified which might prove to be barriers to commercialization	N/A
The existence or development of similar or competing technologies / solution elsewhere	N/A
Third party rights (eg patents belonging to competitors), standards,…	N/A
Analysis of any (potential) non-technical obstacles	N/A
Any form of non-commercial use or impact, relating e.g. to the development of new standards or policies	N/A

Document: Description of fisheries; common description of data; and information descriptions for the Ceder project

What the exploitable result is (functionality, purpose, innovation etc.);	From the 8 fisheries participating in the CEDER project, the following information was requested: 1. Description of the fisheries, level of discarding, years of data available, geographical area, maps, number of vessels, type of gear, legal regulations, reliability of data 2. common description of data (parameters measured, naming conventions) 3. information description (IT platforms, access rights for project partners
Partner(s) involved in the exploitation, role and activities	OLRAC: summarized IRD, FRI, DIS, GINR, GFLK, IMARES, FRS, CEFAS: provided input
How the result might be exploited (products, processes) - directly (spin offs etc) or indirectly (licensing) – on an individual basis or as a consortium/group of partners (market considerations, thresholds, obstacles, non-commercial use or impact)	The document summarizes way in which fisheries data is managed, for 8 different fisheries. It can be used as an input for various DG FISH activities. For instance, one could imagine that the knowledge contained helps the Commission draft new legislation for fisheries management.
Further additional research and development work, including need for further collaboration and who they may be	Not planned.
Intellectual Property Rights protection measures (patents, design rights, database rights, plant varieties, etc – include references and details)	None Taken
Any commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.)	None Taken
Where possible, also include any other potential impact from the exploitation of the result (socio-economic impact)	Not applicable

Any technical and economic market considerations – commercial and technical thresholds etc.	N/A
Any obstacles identified which might prove to be barriers to commercialization	N/A
The existence or development of similar or competing technologies / solution elsewhere	N/A
Third party rights (eg patents belonging to competitors), standards,…	N/A
Analysis of any (potential) non-technical obstacles	N/A
Any form of non-commercial use or impact, relating e.g. to the development of new standards or policies	See “what the exploitable result is”

Olfish e-logbook add-on for Ceder (a.k.a. "Dynamic Data Logger")

What the exploitable result is (functionality, purpose, innovation etc.);	The Olfish software system is an "intelligent" database system which was developed specifically for the collection of data associated with commercial fishing operations. These include catch data, gear information, logistical information, environmental information and more, as well as multi-media content. Olfish allows the user to, virtually, analyse and report on any captured data.
Partner(s) involved in the exploitation, role and activities	See cell below
How the result might be exploited (products, processes) - directly (spin offs etc) or indirectly (licensing) – on an individual basis or as a consortium/group of partners (market considerations, thresholds, obstacles, non-commercial use or impact)	Olfish has not been funded in anyway by Ceder. However, since the E-logbook technology we have developed is relevant to Ceder requirements, we have developed a utility that produce the Correlation Systems data requirements and we are offering to test it within Ceder and to include the testing and it outcomes as Ceder project. NOT OLFISH ITSELF. As it stands OLFISH is a fully developed commercially available E-logbook. It is in use in several fisheries on the planet and it is currently under technical review to provide several EU countries with their E-logbook statutory requirements.
Further additional research and development work, including need for further collaboration and who they may be	See cell above
Intellectual Property Rights protection measures (patents, design rights, database rights, plant varieties, etc – include references and details)	All rights by Olrac
Any commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.)	Olfish is the Olrac flagship product.
Where possible, also include any other potential impact from the exploitation of the result (socio-economic impact)	N/A

Any technical and economic market considerations – commercial and technical thresholds etc.	N/A
Any obstacles identified which might prove to be barriers to commercialization	N/A
The existence or development of similar or competing technologies / solution elsewhere	Olrac has been developing the Olfish E-logbook solution for almost 10 years –there are of course other companies which have designed E-logbooks and these companies participated in the recent EU SHEEL project. Suffice to say that the Olfish solution was the best performing E-logbook.
Third party rights (eg patents belonging to competitors), standards,…	N/A
Analysis of any (potential) non-technical obstacles	N/A
Any form of non-commercial use or impact, relating e.g. to the development of new standards or policies	If it may be so termed as non-commercial, the EU has recently passed legislation that requires all fishing vessels above 15mtrs to be equipped with an E-logbook by the end of 2010. As previously stated our system is currently under review to provide the relevant government bodies with the means to carry out this reporting obligation.

Partner 15: JRC

TAC and Quota uptake prediction tool

What the exploitable result is (functionality, purpose, innovation etc.);	An intranet web application that can warn a user of likely quota exhaustion for a particular nation and fishery. This tool would be adapted to larger and seasonal fisheries. The tool combines web technology with a separate statistics module, interacts with relational databases.
Partner(s) involved in the exploitation, role and activities	JRC
How the result might be exploited (products, processes) - directly (spin offs etc) or indirectly (licensing) – on an individual basis or as a consortium/group of partners (market considerations, thresholds, obstacles, non-commercial use or impact)	This tool is mainly aimed at public regulatory entities, such as EU member states and the EU commission, especially DG FISH directorate D.
Further additional research and development work, including need for further collaboration and who they may be	None planned. Parts of the algorithms may be re-used in the framework of the JRC and FISH Administrative Arrangement.
Intellectual Property Rights protection measures (patents, design rights, database rights, plant varieties, etc – include references and details)	Outside of the CEDER contractual framework, no protection measures have yet been taken.
Any commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.)	None yet. At present, this tool is experimental. In order to realize its potential impact, further study may be necessary.
Where possible, also include any other potential impact from the exploitation of the result (socio-economic impact)	This tool can be an element that aids in addressing the quota overshoot problem.

Any technical and economic market considerations – commercial and technical thresholds etc.	Non-commercial use.
Any obstacles identified which might prove to be barriers to commercialization	Non-commercial use.
The existence or development of similar or competing technologies / solution elsewhere	N/A
Third party rights (eg patents belonging to competitors), standards,…	N/A
Analysis of any (potential) non-technical obstacles	N/A
Any form of non-commercial use or impact, relating e.g. to the development of new standards or policies	See “what the exploitable result is”

Dissemination of knowledge

Second period of the project

During the second period, partners disseminated project results primarily through the following means:

- Conferences: A total of 4 conferences, with 2 more planned in 2008
- Publications: A total of 2 reviewed and 4 draft papers
- At DG MARE, participants held a dissemination meeting
- In July 2008, JRC plans to publish all deliverables at CORDIS.

Section 2 – Dissemination of knowledge

Planned/ actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible /involved
March 2006	Press release(press/radio/TV)	General public	Iceland	General public	FRI/DIS
04/06	Conference Geo Intelligence 2006	Government and Industry	USA	250 People	Correlation
24.1 – 2.2. 2007	University of Iceland web-site	Higher Education	Iceland	10000	FRI/DIS
2.2.2007	Talk at a Conference	Research	Iceland	50	FRI/DIS
2.2.2007	Poster	Research	Iceland	100	FRI/DIS
April 2007	Presentation at working group - ICES NWWG	Research	ICES	25	GINR
September 2007	Tool posted on website	Research	Worldwide	General public	Olrac
After September 2007	Distribution of flyers	Government and Industry	EU, ISL, GRL, ISR, ZAF	General public	JRC + others
October 2007	Presentation at working group – NAFO	Research	ICES	45	GINR
March 2008	Talk at a Conference IMDIS 2008	Research	EMEA	205	Olrac
April 2008	Meeting DG MARE	European Commission	EU	15	JRC Olrac, Correlation, CEFAS, Sirius
April 2008	Presentation at working group - ICES NWWG	Research	ICES	25	GINR
April 2008	Talk at a Conference - ERS technical meeting Copenhagen	Government and Industry	EU, ISL, FRO, NOR	56 (Gov't)	Olrac
June 2008	Talk at a Conference - Profet Policy	Government and Industry	ICES	40	JRC
July 2008	Deliverables posted on website -	Research - CORDIS	Worldwide	General public	JRC
August 2008	Draft publication: "A model based on observer data … "	Research	Worldwide		Cefas
September 2008	Talk at a Conference – ICES Halifax	Government and Industry	ICES		Olrac
Late 2008	Draft publication: Benefits for management	Research	Worldwide		Cefas

FRI and DIS

In March 2006 a couple of press releases were issued to the Icelandic newspapers concerning the ongoing research projects, including CEDER, at the Fisheries Research Institute, University of Iceland.
On February 2-4 2007 a conference was held at the Department of Engineering, University of Iceland, where graduate students presented their research projects. On this occasion, Tryggvi Hjörvar, who works on CEDER for the FRI, presented a poster and gave a talk on Prediction models for Atlantic Redfish Fisheries.
In the week preceding this event, the projects were introduced on the website of the University of Iceland.

Correlation

The Effort Estimation algorithm, and capabilities as well as the preliminary results have been presented during the Location Intelligence conference in San Francisco 4/06.
A summary of the presentations can be found at
http://www.correlation-systems.com/events.htm

Olrac

Olrac disseminated SUMFISH at several meetings

- At the IMDIS conference in Athens in March 2008
- At the DG MARE meeting in Brussels in April 2008
- At the 3rd and final ERS technical meeting in Copenhagen in April 2008

Olrac wrote 2 papers related to CEDER ("SUMFISH: a data harmonisation tool for commercial fishing data.", "Olfish Dynamic Data Logger: A complete, solution for the recording, reporting and transmission of commercial fishing data.") and will present the Dynamic Data Logger at the September 2008 ICES meeting in Halifax .
As part of its obligations to the CEDER project, OLRAC took upon itself to modify elements of its Olfish software, in order to make it compatible with some of the CEDER objectives. The outcome of OLRAC's efforts is a much simpler version of its OLFISH software which was named OLFISH-DDL (Dynamic Data Logger). The OLFISH Dynamic Data Logger (DDL) presents a simplified data-capture front-end to the OLFISH suite of tools. The DDL can be customised to match the data collection requirements of any fishery or fishing authority.

Note on the SUMFISH harmonized database: The database is freely available to consortium members (and EU Commission) for downloading. It comes with an interface and some queries tools – this is freely available to all members. It includes all the data that was provided by the consortium partners - It doesn't allow users to harmonize data themselves but they can browse and extract from it any data they wish. Olrac has named this database SUMFISH.
Commission and CEDER members are reminded that the data in CEDER, and thus in SUMFISH comes with legal bindings. Commission and CEDER members may not extract this data in order to perform research on the data, for reasons other than producing or checking CEDER deliverables. Deliverables must be verified with respect to data protection laws. In particular, deliverables should always preserve anonymity of vessel names, and vessel patterns are not admissible as evidence.

JRC, Olrac, Correlation, CEFAS, Sirius

In April 2008, aforementioned partners disseminated their project knowledge at DG MARE in Brussels.

JRC

In June 2008, JRC presented key CEDER results at the Profet Policy workshop organized in Copenhagen by ICES. The following CEDER outputs were presented

- Olrac's SUMFISH harmonisation tool
- Correlation Systems' "ReelCatch" for EU fisheries
- The Sirius IT Greenland Shrimp prototype
- The FRI's CARFI Icelandic Redfish system
- CEFAS' "North Sea Cod Catch at Length" model
- IMARES' "Spatial and temporal distribution of effort"
- CEFAS' impact assessment models, both single species recovery and multi-species active versus passive management.

Publications

GINR wrote 2 papers

Sünksen, K., 2008. Discarded by-catch in shrimp fisheries in Greenlandic offshore waters 2006-2007. Working Document for ICES NWWG, 21. – 29. april, 12 pp. (Also published as NAFO SCR Doc. 07/88, 12 pp.)

Sünksen, K., 2007. By-catch in the Greenlandic off shore shrimp fisheries 2006-2007, - preliminary results. Working Document for ICES NWWG, 24. april - 3. maj, 10 pp.

IMARES wrote a draft paper for submission to a peer-reviewed journal:

G.J. Piet and F.J. Quirijns
"Spatial and temporal scale determine the impact of fishing"

CEFAS wrote a draft paper for submission to a peer-reviewed journal:

A.J.R. Cotter and A. South,
"A model based on observer data for forecasting numbers-at-length and –at-age of cod (Gadus morhua) caught per trip by North Sea trawlers"

Section 3 - Publishable results

All deliverables

Endnotes