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Electronic catch registration onboard commercial fishing vessels for commercial and scientific use

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Abstract

In assessment and management of marine fish resources, representative data of statistically good quality describing the actual catch are lacking for many fisheries. Even for the most studied fisheries in the north Atlantic, the uncertainty regarding what is actually caught has implications for management.

Fish stock assessments and sound advice in most cases rely on representative samples of catches. Distant and high sea fisheries often suffer from poor sampling due to sampling personal logistics. Consequently, stock assessment and management of marine fish resources exploited by those fisheries are based on poor or scarce catch data. Presently, sampling at sea are often random in time and place, and not necessarily representative with respect to the fleet metier.

Biological sampling in distant waters is a challenge due to logistics and high costs. The use of electronic scales onboard commercial fishing vessels opens for a new approach in data collection. In recent years electronic scales measuring individual fish weights on deck have been connected to GPS in combination with data on depth, fishing gear, logbook information etc. This approach will link detailed data to auxiliary information on the fishery, thereby meet the challenges of obtaining representative fishery data, continuous and full sampling providing a sufficient data basis for fish stock assessments and subsequent fisheries management for species found in distant waters.

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Introduction

In assessment and management of marine fish resources, representative data of the actual catch are lacking for many fisheries. Even for the most studied fisheries in the north Atlantic, the uncertainty regarding what is actually caught has heavy implications for the management of a number of species. Estimation of commercial catch composition is most often based on port samplings or more rarely observation onboard fishing vessels. However, onboard sampling are often few and scattered and it may be questioned how representative those data are for the actual catches. The samples onboard fishing vessels are often conducted by scientific personnel and the long trips in distant waters by some high sea fisheries make it a challenge to sample those fleets.

he waters of East Greenland and the Barents Sea are important fishing areas for the commercial fishing fleet for several nations. These waters represent large as well as distant areas and which means that science faces comprehensive challenges to obtain representative data from the fishing fleet (Helle & Pennington, 2004). The fishery is conducted far from shore in both East Greenland waters and the Barents Sea and the vessels operating in the areas are large factory vessels processing the catch on board. This implies trips of long duration, and as the catch is processed on board, port samplings from offshore fisheries is most often impossible. A scientific crew will have to stay onboard for a long time, which not necessarily fulfills the needs for a representative sampling from the total catch. Presently, sampling from the fishery is limited, especially from the offshore fleet in East Greenland, and observer's data are often limited in time.

The logistic challenges are related to all species caught in these waters (pelagic fisheries for redfish, herring and blue whiting, demersal fisheries for northern shrimp, cod and Greenland halibut). The catch is usually sorted at sea with respect to size, depending on market demands and production onboard. Related to this sorting procedure, many vessels now use electronic sorting mechanisms – called "graders" that record individual weights of the fish in the catch. This detailed information is now only used for sorting by size and to estimate total produced fish weight on board (Fossen 2003 a, b). Data modules are now being developed aiming to currently record individual fish weights and combine those with other available data from log-instruments on the vessels – such as GPSand echo sounder readings (Fossen, 2003 and b; Dyb & Bjørshol, 2005). This will make a more detailed and continuous outline of the catch, combined with information on fishing depth position, and effort.

This paper summarises the experiences made from a pilot project on electronic catch registrations funded by NORA and Norwegian Research Council. The overall aim of the pilot project was to evaluate the current possibility of using electronic scales and to establish a basis for a larger, comprehensive project that will focus on the potential for combining and collecting data from automatic weight registrations (Grader measurements) as well as other data systems onboard fishing vessels employing existing or new software (*e.g.* Datafangst). Furthermore, there is the potential of streamlining the catch registration process onboard fishing vessels, to improve fishing performance, as well as to increase data acquisition from fisheries which would improve the scientific management of fish stocks.

State of the art

Graders and other electronic weight recording systems onboard fishing vessels often measure individual weights and sort the fish into weight groups. Combining such data with other electronic measurements from the fishing operation (depth, temperature, position, date, weather, etc) which is usually available on most fishing vessel, will provide data that will be a major contribution for fisheries research and management and the results will be useful for both the fishing industry and fish management.

A new software program “Datafangst” was developed to retrieve, store and exploit such data. The program receives data from several data sources onboard fishing vessels (GPS, echo sounder, trawl data), and combines and stores them automatically with the individual weight and species recordings. The software must today be controlled by an operator, typically the captain who easily can replace his logbook with this tool with no difference in time spent.

A basic platform for the program is now finished, but to reach the full potential of the program there is a need for additional modules for generating reports as well as data export. The program was developed to take into account the needs of the fishing industry as well as scientific requirements. It has been constructed to correspond to established sampling routines, making it easily to export familiar data to researchers. The fishing industry can use the data in many ways. For example, detailed information can follow the fish to the buyers at the market, providing good tracking possibilities of the size composition useful for the processing plants. Furthermore, the vessels will have detailed history of earlier catches. Maybe this can even be used to predict catch rates, and where and when to go next year? For larger companies with several boats, information can more easily be exchanged among the vessels and priceless information will not disappear with the captain. “Datafangst” is presently installed on two fishing vessels operating in the North Atlantic; “Leinebris”, a Norwegian longliner and “Sisimiut”, a Greenland trawler.

So far a few projects have studied the potential of grading data. Møreforsking Marin and the Institute of Marine Research, Bergen have during the last 7 years worked with several small projects directed especially towards the collection and use of grading data together with the company Maritech AS (Fossen, 2003 a, b; Dyb & Bjørshol, 2005).

Today individual recordings of the entire catch can theoretically be collected from a number of vessels. This has been made possible by several projects supported by the Research Council of Norway (Fossen 2003 a and b; Dyb & Bjørshol, 2005). The projects have focused on the general characteristics of this type of data as well as evolving solutions for how to store data from grader systems combined with information regarding the specific station (position, date, time, depth, weather conditions, etc). The latest project (NFR nr. 162410/110) developed software from Maritech AS called “Datafangst” which has been installed on fishing vessels. “

Several authors have suggested describing size and species composition through using weight registrations from commercial catches (Berntsen et al. 1999, Anon 2000, Fossen 2003 a, b).

The main gain related to using such data in assessment and advice, is that uncertainty in fish stock assessments will be reduced by using weight data from fishing vessels directly. Today weight at age data for stock assessments are often obtained using relations deriving from few samples or obtained from scientific surveys with other gear. Furthermore, grading data will provide large amount of objective data that will allow a continuous online description of fishing operations, a new evaluation of present sampling strategies as the variation in catch composition is made available, and, finally, will increase our biological understanding of the fishery. It is also obvious that individual fish weights can be sampled in a cost-effective way as most electronic graders can be connected to a PC for continuously storing weight records in a simple manner. The data are particularly useful for fisheries where no or little data are available, and will optimize scientific sampling regimes through a full description of catch compositions onboard vessels. The data will provide information on catch composition over time and reveal if there is variability in catch composition over time or geographical area. Weight measurements from electronic scales are objective, which will provide an international standard with respect to sampling.

Previous studies have pointed to the possible gains with storing electronic data automatically both with respect to science and for the fishers. There is no indication of anyone using such detailed information, as suggested in our study, for the management of fish stocks at present. The only known onboard set-up is the one onboard the Norwegian longliner MS Leinebris and the proposed implementation onboard the Greenlandic trawler “Sisimiut”.

There are other software’s that seeks to obtain and store information from the onboard fishery operation for better planning of coming operations and reporting through electronic logbooks. These are however not aimed at storing information of individual fish but rather summed per day or by station data (catch rates). A South African company thus has delivered a software called “olfish” (www.olrac.com), an Icelandic company “Trackwell” (www.trackwell.com) is developing an electronic logbook in association with The Icelandic Directorate of Fisheries, NAFO, NEAFC, and the Faroese Directorate of Fisheries. Both include many of the same ideas as presented in our projects. On a general bases it is easy to see the potential for the use of electronically stored data in describing the catches. This is the case *e.g*. through electronic logbook systems, traceability information, description and availability of previous operations, and for assessment purposes. There is also likely a number of other utilisations of the data which is not yet as obvious (migration patterns, biology etc.) (Fossen 2003 a, b).

Evaluation of ”Sisimiut” and ”Leinebris” trials

The installation of “Datafangst” onboard “Sisimiut” was conducted in Faroe Islands and in Denmark. A dedicated computer was installed on the bridge and connected to GPS and echo sounder to serial ports. The computer was also connected to the data network onboard. The grader had to be modified to send out the measurements from a print port. This port is preinstalled on the grader, but it had to be made suitable for a cable from the outside. A communication cable was also installed from the grader to the office in the factory, where the

data network onboard was available. The grader transmit the weights as text strings to a serial port. These data were made available to the computer on the bridge through a serial to LAN converter (Moxa box), which create virtual serial ports on the data network. The weights from the grader were successfully sent to “Datafangst”, but the new setup blocked the possibility to manually program the grader in the factory. This is essential for the production process, and the grader had to be returned to its original setup. This problem was solved with a new Eprom, which gives the grader a new software. After the upgrade it was possible to both send weights to the “Datafangst” and to manually program the grader.

“Datafangst “was originally programmed to conform with the operation onboard fishing vessels that use passive fishing gear, but it needed set-up modifications for use in trawl fishery. Because of several reasons this modification process went rather slow, but was finally successful. Even if “Datafangst” is intuitive easy to use, training is needed. On board Sisimiut, the software is installed, but there is a need for training to get the system going. This must be Completed during fishing. It is further planned to collect data from the trawl monitoring system to provide better effort data.

Onboard the longliner “Leinebris” “Datafangst” was installed in the same way as on “Sisimiut”, but some modifications were necessary. A serial cable was drawn from the processing deck to the bridge of the boat. Depth and position was collected from the echo sounder and the GPS. “Leinebris” has used “Datafangst” for some time and has asked for further development of the equipment.

Potential use in research and fisheries advice

Scientific observers are usually required for sampling of detailed catch information from fishing vessels. There are fisheries where observer requirements are hard to fulfill, such as distant high sea fisheries and in waters with no requirements for observers. These fisheries are especially suitable candidates for implementation of the present grader software. The weight records obtained from graders can, with a minor additional effort in length sampling, provide the basic information on size distributions of catches for input to stock assessments. An advantage of this system is the low cost of manpower associated with data collection (software installation and data retrieval) and the unbiased sampling by the device (all catches are recorded). With additional information on data from the fishing operation such as GPS data, echo sounder data and logbook data, this constitutes an ample input for a CPUE analyses for stock assessments and for generic research on the spatial distribution of fishable resources.

Future perspectives

Electronic catch registrations will have several benefits for the fishermen. Firstly, the data will allow better documentation of previous fishing operations. Secondly, the data will easily

provide a detailed description of the catch which will be of benefit for a closer cooperation between fishing industry and scientists which in turn will contribute to a better utilisation and exploitation of marine resources. A comprehensive overview of the actual catch may contribute to a better price for the catch. Traceability of fish products with respect to fishing time and area will be demanded in future. Electronic catch registration has a great potential of meeting this request.

Electronic catch registrations will mean several gains for science as continuous data collection from the entire fishery, not only parts of it, which often is the case when scientific personnel collect data during lilited fishing trips. The method will mean a substantial improvement for obtaining data from geographically long distant fishing areas where logistics more or less makes sampling impossible because of high costs and long lasting trips. East Greenland, Norwegian Sea, Barents Sea, and Mid Atlantic Ridge are some examples of such distant areas. Also, electronic catch registrations represent new possibilities of obtaining data from fisheries where the fish are processed on board which makes port sampling impossible. Data that are sampled automatically through electronic catch registration are without the personal/subjective factor and, therefore bias is reduced.

A extended software program may also have a potential for dividing historical catches into possible new size-groups (and thereby also earnings). Through a better description of the precision grading-equipment, more optimal separation weights might be determined (for instance, dependent on swell height) to meet the request from buyers and increase the value of the catch. The equipment may provide better fisheries dependent data for assessments and allow analyses factors affecting various fisheries, including changes in size distribution. Such information is central for the planning of future operations.

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This project “Elektronisk fangstregistrering” was initiated in spring 2007 aiming to establish a Nordic network to summarize state of the art regarding electronic sorting systems, discuss how to meet new challenges and possibilities in future catch registrations as well as use of data in assessments. The idea was based on previous project conducted by Møreforsking in collaboration with industrial partners Maritech AS, and a Norwegian longliner Leinebris as well as Institute of marine research in Bergen. The project has been financed by NORA, Norwegian Research Council and all the participating partners; Møreforsking Marin (Project leader), Greenland Institute of Natural Resources, DTU Aqua/National Institute of Aquatic Resources, Marine Research Institute, Iceland, Institute of Marine Research, Bergen, Maritech AS and Royal Greenland.

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