Workshop on Fully Documented Fishery
Held at the Technical University of Denmark on 9th and 10th March 2010

DTU Aqua-rapport nr. 221-2010

Af Jørgen Dalskov

DTU Aqua
Institut for Akvatiske Ressourcer

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Denmark and The EU invest in sustainable fishing.
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Colophon

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By Jørgen Dalskov

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Introduction

Trial studies using electronic monitoring systems (sensor and CCTV camera recordings) to document fishing operations and catches have been carried out in Denmark, Sweden and in Scotland in 2008 and 2009. The Danish, German, UK and Scottish ministers responsible for fisheries policy expressed on the 8th October 2009 their joint desire to shift to a result based management system which provides incentives for good fishing practices. Such a system would give fishers more scope in conducting their fishery as an economic activity, but only if they take full responsibility for their activities by accounting for all the fish they remove from the sea. The experiences obtained during the fully documented fishery trials indicate that the electronic monitoring systems could support a management system based on total catches (landings as well as discards). However, further work is needed to develop the technology and methodology to provide an effective monitoring system to support the introduction of a catch quota management system.

The European Council and the European Commission stated on the 19th October 2009 that: "The Council and the Commission appreciate further experiments and development in 2010 on fully documented fishery with the view to assessing whether the implementation of this principle can offer a real alternative".

In January 2010 the EU Commission and Norway agreed, that a scheme based on CQM (catch quota management) could be implemented in 2010.

To encourage further work on the development of catch quota management systems in Europe the National Institute for Aquatic Resources, Technical University of Denmark and the Danish Ministry for Food, Agriculture and Fisheries invited the fishing industry, fishers, fisheries scientist, fisheries inspectors, fisheries managers and data base developer and managers for a workshop on fully document fisheries and the use of electronic monitoring technology.

The aim of the workshop was to:

- Establish a common understanding of fully documented fisheries and define the information needs required to support them.
- Examine the operational requirements of electronic monitoring program and its applicability for various fishery needs such as stock assessment, biological sampling (i.e., in a reference fleet context), research and compliance monitoring.
- Examine approaches for cost effective control and "intelligent control" based on compilation of electronic data in relation to fisheries behavior in order to establish advanced risk based control methods.

- Define other relevant consequences and perspectives of a management system based on full catch documentation (more information on the concept at www.fvm.dk/yieldoffish).

The workshop was organized in a way where a number of presentations were presented followed up by discussions in four breakout groups. The workshop agenda can be found in appendix 1.

The presentations were:

At-Sea Observing Using Video-Based Electronic Monitoring by Howard McElderry, Archipelago Marine Research Ltd., Canada

The Danish Trial by Jørgen Dalskov, DTU Aqua

The Scottish trial and future monitoring and control possibilities by using Remote Electronic Monitoring data by Allan Gibb, Sea Fisheries Policy, Marine Scotland.

The use of Video-Based Electronic Monitoring data in stock assessment and for fisheries management by Rick Stanley, Pacific Biological Station, Fisheries and Oceans, Canada.

Challenges and perspectives of a management regime based on full catch documentation by Mogens Schou, Advisor to the Danish Minister of Fisheries.

The breakout groups had the following topics:

Group A: Electronic monitoring and fisheries research. How can data obtained with an electronic monitoring system be used in stock assessment and fisheries research? Are there specific re-search based requirements to be taken into account when developing the monitoring scheme?

Group B: Electronic monitoring and compliance monitoring. How can an electronic monitoring system be used for inspection and surveillance to ensure vessel compliance with fishing regulations? Can the control measures be simplified for vessels having electronic monitoring systems?

Group C: Operational considerations of using electronic monitoring. What are the operational requirements involved with the use of electronic monitoring systems? What are the challenges with field service, analysis, data storage, data base developments and other technical issues concerning electronic monitoring?

Group D: Catch quotas versus landing quotas. Can the electronic monitoring system provide the necessary documentation to operate a catch quota system? Other aspects of catch quota management.

Summary of the presentations

At-Sea Observing Using Video Based Electronic Monitoring Technology

by Howard McElderry, Archipelago Marine Research Ltd.

Electronic Monitoring (EM) technology consists of multiple closed circuit television cameras, a variety of sensors including GPS, winch rotation and hydraulic pressure, all connected to a data storage control box. The EM system is designed to operate autonomously and continuously while a fishing vessel is at sea. Pilot studies have been carried out over the past decade in a wide range of geographies, fishing gears and fishing vessels. In 2009, EM was being used in 12 fisheries with total of about 500 vessels and 25,000 monitored days at sea. The technology has proven to be very useful in a variety of fishery monitoring applications and its use will continue to grow in coming years. Key advantages of EM as compared to observer programs include: suitable on virtually any sized vessel, continuous 24/7 data collection, effective for fleets with irregular or unpredictable fishing schedules, less intrusive than observers, about a third the cost of observer programs (much less labour is required), and EM can be used to audit self reported data, a synergy that both reduces monitoring costs and engages industry. Some of the main challenges with EM include: the technology is not tamperproof, the technology is advancing rapidly, and implementation of programs is complex and it may take 3-5 years to fully implement.

EM has been effectively used for a wide range of fishery monitoring issues. A key strength of EM is the continuous sensor data record providing very accurate temporal and spatial information on gear setting and retrieval activities. The use of EM for catch monitoring depends upon gear type. It can be very reliable with gears that bring catch aboard serially (i.e., gill net or long line) whereas seine or trawl methods can be difficult to monitor by camera because of the large quantity of fish landed at once. In these instances EM has can be used to verify full retention or discards at selected control points. In terms of protected species (e.g., marine mammals, turtles and seabirds), EM can be much more cost effective, as significant coverage levels may be required for detection of these relatively rare catch events. Large conspicuous protected species are easily detected while it can be difficult to detect events such as seabirds in trawl catch. The efficacy of EM for monitoring fishing gear and methods can be high for issues such as gear quantity, soak duration, and deployment method. Likewise, EM can be very effective to monitor the use of mitigation measures (i.e, seabird streamer lines) designed to reduce protected species encounters.

EM programs are more complex than observer programs. Essential elements of an EM program include: equipment supply, responsive field services for keeping EM systems operational on the fleet, data interpretation services for production of standard fishery data from the sensor and image data sets, services for consolidating results from EM with other data sources, and an overall management structure to coordinate among all elements of the program. Cost influences for an EM program include elements intrinsic to the fishery such as the number of vessels, number of trips, fishing events per trip, and landing ports. As well, program cost is influenced by design elements of the program including coverage level, audit method, program performance levels, level of outreach/feedback with stakeholders, degree of program centralization, and the cost recovery method. Co-funded monitoring programs involving industry and government leads to more cost effective programs as each group becomes responsible for the parts of the program where cost is created.

In my view, EM is a significant development that will create a paradigm shift in fisheries management. EM technology can be effectively used to engage self reporting processes in fisheries, providing cost effective monitoring solutions that were previously unavailable. As well, and significantly, the expanded use of audited self reported data will actively engage industry participants in constructing much more comprehensive information systems for their fisheries, a process that will lead to better data and more cohesive organizational structures for decision making.

The PowerPoint presentation can be found in Appendix 2.

The Danish Trial

by Jørgen Dalskov, National Institute for Aquatic Resources, DTU Aqua

Total Allowable Catch (TAC) is a central concept in the Common Fishery Policy of the European Union. It is, however, generally recognized that the catches counted against the TACs are not reflecting the total catches taken but only the part of the catch that is landed and officially registered. This discrepancy between the actual and reported catches may be a result of discarding, high grading, illegal landings and area misreporting and may be linked to increasingly complicated and non-transparent regulations. In order to address this discrepancy and to achieve higher accuracy in the data which forms the basis for fisheries advice, the Danish Government proposed in 2008 a new reporting and quota paradigm based on actual catches rather than reported landings.

The foundation for this new paradigm is an obligation for the vessel owners to report total catches by species and not only landings. All catches, discards as well as landings, should be counted against the TAC. Such a system should provide an incentive for the fishers to target marketable species and size classes and to avoid discards. The TACs will have to be adjusted to reflect total catches and not only landings.

A requirement for entering into the new catch quota scheme is that the fishers operating under the scheme must have comprehensive, complete and reliable documentation of all their catches including discards.

The electronic monitoring (EM) system used in the pilot project consisted of up to four closed circuit television cameras, a GPS receiver, a hydraulic pressure sensor, a gear rotation sensor and a system control box. The EM Systems were installed on seven volunteer commercial fishing vessels where the cameras provided view of the aft deck, closer views of the fish handling areas and discard chute areas for catch identification.

The objectives were to evaluate the reliability and functionality of the (EM) system as a tool to monitor discarding of cod in Danish trawl, gillnet and seine fleets, and the secondary objective was to document catch handling and observe the discard pattern to verify whether the fisher's record of discarding of cod was correct.

The EM system has been collecting sensor data and images throughout the period September 2008 to July 2009. According to the vessel logbooks the vessels were at sea for 16,955 hours, carried out 561 fishing trips, and conducted 1,558 fishing operations during the project period.

The analysis of the sensor data (GPS, hydraulic pressure and rotation of the winches) showed that determination of where and when a fishing operation takes place can be made with a high degree of accuracy. In addition, by viewing the video imagery it can be determined whether the vessel was actually fishing or for example, just cleaning their net.

An estimate of the total catch amount and the species composition can be made by reviewing the video records of the catch handling onboard. The focal point for this project has been the documentation of discards of cod. The results of the pilot project showed that the estimate of discards of cod by viewing the video records can be made with high accuracy, especially if the vessel had a sorting conveyor belt where the discarded fish passed the discard chute individually. If large amounts of discards occur the accuracy of the estimated discard amounts decreased unless specific onboard catch handling protocols were followed. The conclusion is that image quality of the video recordings is very high and can be used to provide reliable estimates of species and size composition of the catch and eventual discards.

The cost for documenting a vessels fishery using EM is significant lower than obtaining the same documentation using onboard observers. The analysis showed that on average less than one hour data analysis and image viewing was required for verifying one fishing event and the associated catch handling.

The experiences gained during the pilot project have shown that the fishers have been more active in avoiding catches of small cod. If large quantities of small cod were caught the fisher would change fishing grounds or even try to change mesh size. Furthermore, there has been a positive reaction from the fishers and they have shown an increased awareness of their fishing patterns. The idea of giving the individual fishers an incentive to reduce discards by introducing a catch quota system where all catches (retained and discarded part) are counted against the quota and the fisher is responsible for documenting his fishery can be seen as a way forward toward sustainable fishing where the catches are utilized optimal.

The electronic monitoring system has proven its reliability. The experiences obtained during this pilot project have shown that the EM system can be applied on almost all types of Danish fishing. Onboard some vessels it may be necessary to modify vessel deck setups and interior catch handling flow in order to obtain appropriate image coverage for the full documentation processes.

The PowerPoint presentation can be found in Appendix 3.

The Scottish trial and future monitoring and control possibilities by using Remote Electronic Monitoring data

by Allan Gibb, Sea Fisheries Policy, Marine Scotland

The current trial in Scotland involves 7 vessels of varying size in both the whitefish and nephrop fisheries North Sea, early results from the trial are extremely positive, the technology proving to be reliable and cost efficient with the early results indicating quite clearly that the tool will very likely be capable of delivering the necessary confidence on control that is required to verify a catch quota system and discard band if applicable. Additionally it is clear that there are significant opportunities to enhance our data collection and scientific assessments and work in this area will be evaluated further to identify just exactly where and how good these opportunities may be. The current system is one of barriers where Total Allowable Catches (TACs) are set taking account of estimated discards yet are counted on landings, this is a simply a waste of a valuable resource that can ill be allowed to continue. This is the theory of land more catch less, taking control over the removals from the sea where what is caught is landed not discarded and the incentives are clearly for greater selectivity to maximise value and the continuation of responsible fishing practices. This can only be effective if we are confident that what is caught is fully recorded.

This is only one part of the solution to reduced mortality in fish stocks whilst maintaining economically viable and vibrant fleets. Recovery plans for a single species impact on the activities of a vessel fishing all species and Remote Electronic Monitoring (REM) is one way to be more efficient in applying such plans. Fishermen are prepared to behave responsibly as is demonstrated by the expanded system of Real Time Closures we have in place where you can see the benefit and the distances vessels are prepared to move in an attempt to avoid large aggregations of Cod. Continuing effort restrictions are now reaching such a point where fishermen do not have the available time at sea to carry out these responsible actions. REM is one vehicle that could be used to effectively count fishing time and not just time at sea which would allow for these responsible avoidance measures to continue to the clear benefit of the stock.

Under a catch quota system where you can be confident that what is caught is recorded and once the limit reached fishing ceases then what difference does it make how long it takes a vessel to catch the fish?. These are businesses who will maximise selectivity and fishing patterns to make the best returns from their available opportunities, of that there is no doubt. There is huge potential to move away from limited trials to a more formal system at least for some selected species where the discard information is currently available to a system managing removals and not landings plus discards. The opportunities whilst not yet certain are certainly there for science to have a better view of what is happening in real time where each vessel with REM onboard is potentially a data collecting platform a huge increase in capacity. The criticism is often that science is behind reality, such systems offer the potential for a more in time response to significant stock changes or special distribution of species. It is our view that this is an opportunity that is just simply too good to ignore.

The PowerPoint presentation can be found in Appendix 4.

The use of Video-Based Electronic Monitoring data in stock assessment and for fisheries management

by Rick Stanley, Pacific Biological Station, Fisheries and Oceans, Canada.

In 2003, the commercial groundfish industry and the Department of Fisheries and Oceans Canada introduced the Canadian Groundfish Integrated Pilot Project in British Columbia (BC) waters. One of the key elements of the Project was the implementation the Groundfish Hook-and-Line Catch Monitoring Program (GHLCMP) which includes Electronic Monitoring (EM). This presentation focused on two aspects related to the implementation of the GHLCMP in BC. First, it summarized how the project solved the operational problem of developing a scoring system for comparing the catch reported by captains in their fishing logs (FLogs) with the pieces counted from video footage (VF). Second, it briefly reviewed the value and some different uses of the enhanced catch data that is now being provided through the GHLCMP as well as the 100% trawl observer program introduced in 1997.

Briefly stated, the GHLCMP uses a video review of randomly selected gear retrieval events (10%) to test whether the Captain's FLog is reliable, particularly with respect to discards. In the GHLCMP, the FLog is treated as the official record of discards rather than attempting to estimate total catches from the VF (see Stanley et al. 2009a for more details). This 10% audit approach was chosen to reduce costs.

The audit approach, however, requires a scoring system to evaluate whether the FLogs are sufficiently close to the VF counts. The initial basis for the scoring is shown in Table 1. The higher scores were scaled relative to an experimental comparison of observer to VF results and conditioned with the expectation that captains should be "almost as accurate" as an observer. A score of 8 or better is considered adequate. Based on the individual scores for selected TAC species and an averaged score, the FLog is deemed adequate or inadequate. If inadequate, the consequences could be that the vessel would have to pay for 100% of the video to be reviewed and/or take an observer for the next trip, also at vessel expense.

However, during Year 1 and despite the many inadequate FLogs, the managers and the advisors were reluctant to impose any consequences. Many captains argued that the overall program was too new, and that the scoring system was not only arbitrary but too strict.

Table 1. Scoring of differences between video review and FLog piece counts.

Difference (Video – FLog)	Difference (Video – FLog/Video)	Score
< 30 pieces	***≥ 30 pieces***	
0-1 Piece	0-4*%	10
2-3 Pieces	5-10 %	9
4-6 Pieces	10-20%	8
7-12 Pieces	20-30%	7
13-15 Pieces	30-40%	5
14-18 Pieces	40-50%	3
19-30 Pieces	> 50%	0

At the end of Year 1, the results indicated that most captains were meeting the standards, but managers and advisors continued in Year 2 to be reluctant to impose consequences for inadequate logbooks. While captains could no longer argue the scoring was too strict, they did argue that they were still adjusting to the process and that the method was overly sensitive to the results of those few events that were reviewed. They argued that poor recording in one event could result from extenuating circumstances.

Following Year 2, the Program began to calculate the annual average score for each captain in addition to the individual trip score (Table 2). These results now indicated there were repeat offenders (i.e., the red zone in Table 2) and armed with these results, managers and their advisors began to impose consequences on some captains.

The second aspect of the presentation focused on some of the benefits that have been derived from the enhancement of groundfish catch monitoring in BC waters. With respect to research, the presentation provided an example of how the uncertainty in stock assessment is increased through uncertainty in estimates of historical catch and, in particular, discards (Stanley et al. 2009b). The presentation also provided an example of using the VF observations to estimate incidental bird catch during long-line fishing (Stanley et al. 2009a). In Year 2 of the GHLCMP, the video review of approximately 10% of all the fishing hauling events indicated a total capture of 37 birds, some of which were identified to species. Since the video events were randomly chosen, these observations extrapolate to approximately 370 birds overall and provide the first estimate of the magnitude of this fishing impact. While the species resolution is poor, this information will provide the basis for planning mitigation (i.e., looking for catch hotspots in time and space) as well as tracking the success or failure of any future mitigation.

Table 2. Trips scores in Year 2 in the GHLCMP organized by individual Trip Score and the annual average score by the vessel corresponding to that trip.

	Annual Scores											
Trip Scores	0 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 -10	Total	Percent
0 - 1	0	1	0	2	3	4	5	7	4	1	27	1.8%
1 - 2	0	0	0	2	2	6	5	2	2	1	20	1.3%
2 - 3	0	1	0	1	5	2	6	4	9	0	28	1.8%
3 - 4	0	0	1	2	5	3	4	7	9	2	33	2.2%
4 - 5	0	0	0	2	5	6	6	6	5	3	33	2.2%
5 - 6	0	0	2	2	5	7	14	16	13	6	65	4.3%
6 - 7	0	0	1	0	6	7	14	24	32	8	92	6.0%
7 - 8	0	0	1	4	8	20	25	51	78	26	213	13.9%
8 - 9	0	1	2	5	15	18	39	88	264	163	595	39.0%
9 -10	0	1	0	1	3	3	24	47	179	163	421	27.6%
Total	0	4	7	21	57	76	142	252	595	373	1,527	100.0%
	0.0%	0.3%	0.5%	1.4%	3.7%	5.0%	9.3%	16.5%	39.0%	24.4%	100.0%	

Enhanced catch data with high spatial resolution also provides information on the distribution of the species. In data limited situations where these are no survey indices or biological data, trends in distribution can be used to infer trends in abundance. Researchers in BC have also used these data can be used to enhance analysis of commercial CPUE (looking for serial spatial depletion) and the design of fishery independent surveys (Sinclair et al. 2003) and Marine Protected Areas.

Lacking accurate catch data obviously renders quota management problematic. In previous decades, many assessments implicitly assumed that "reported" landings provided a constant proportion or index of total catch by assuming a constant discard or misreporting rate. As long as this assumption remained true and the stock assessment and TAC's were expressed in total landings, it was less critical if discards were unknown to the managers. However, most fisheries are now constantly in flux because the markets, the fishing gear, and the management regimes are constantly changing, thus the assumption of a constant rate of misreporting will often no longer be reasonable.

Related to quota management, the presentation also emphasized the particular need for accurate catch data by managers during the execution of recovery strategies for threatened or endangered species. In the Canadian context, if a species is designated as threatened or endangered, the Species At Risk Act (SARA) requires that a defensible recovery plan must be put in place within two years of the official designation. A recovery plan that requires that incidental harvests be kept below a specific amount cannot be defended if the catch monitoring cannot be defended.

Managers have also noted in the BC context that upgrading the monitoring in the commercial groundfish fisheries has put pressure on other fisheries, such as recreational and aboriginal, to upgrade their monitoring. This pressure partially results from a desire expressed by some fisheries to trade quota among the different fisheries.

From an enforcement perspective, it is questionable whether there was any point in introducing the network of remote Marine Protected Areas that was implemented in BC, without the capability of GPS-based tracking of illegal fishing through the post-trip EM-sensor analysis. The costs of using vessel patrols to remote areas to enforce MPA's would be prohibitive. Finally, in addition to the benefits that industry would derive from improved research, management, and enforcement, it is becoming increasingly obvious that any attempt to obtain ECO-labeling for a fishery (i.e., MSC certification) will be difficult without defensible catch monitoring for all species that are affected by the fishery.

The PowerPoint presentation can be found in Appendix 5.

Challenges and perspectives of a management regime based on full catch documentation

by Mogens Schou, Advisor to the Danish Minister of Fisheries.

Mogens Schou informed about the principles and perspectives of fully documented fishery in a New EU Fisheries Policy. He made reference to the documents and videos on the subject on www.fvm.dk/yieldoffish

Summary of the outcome of the breakout groups

Group A. Electronic monitoring and fisheries research. How can data obtained with an electronic monitoring system be used in stock assessment and fisheries research?

Participants
Eskild Kirkegaard (chair.)
Mette Blæsbjerg (rapp.)
Aukje Coers, Bram Couperus, Grant Course, Brian Cowan, Therese Jansson, Jens Møller, Coby Needle, Christoph Stransky, Rick Stanley, Katja Ringdahl

Questions/Topics
The following questions had been given to the participants for preparation, although the discussion did not stringently follow the questions.

- How can data obtained with an electronic monitoring system be used in stock assessment and fisheries research?
- Are there specific research based requirements to be taken into account when developing the monitoring scheme?
- Implications if only changing from landing quotas to catch quotas for a limited number of species?
- How can data be made available to scientists
- Is there a need for a standard data definitions (e.g. definition of fishing effort), exchange formats and/or data base system?
- Can EM be used to quality assure fishers self sampling?

Discussion

General considerations in using EM data for scientific research
It is highlighted that the EM system is not being set up to deliver information to scientists or to improve stock assessment, but for other purposes, such as control or monitoring. This doesn't mean that it cannot be used for science, but it is important to keep in mind.

There are, however, many possibilities for using the EM system in science, both stock assessment and other scientific questions. From the presentations it was clear that we can get data different to what we normally see, on a finer scale and resolution and with more details. Also, whereas previous initiatives have worked on measuring the discard (and by-catch) but without doing much to reduce them, the catch quota programme is an attempt to reduce discard.

There are several ongoing activities with developing this new monitoring system within the EU. From the beginning we must take into consideration any scientific requirements or additional information we would like – it is easier to incorporate now in the beginning rather than later in the process. What has been driving the EM process is cod in the North Sea. But it is obvious that you would want to use the system to collect as many information as possible within the overall objective of data collection.

However, it was also argued that it is important to have objectives really clear, because the problem layer is quite complex. Do not try to do everything at once, but focus on few clear objectives, and be specific about what you want from this. You should always be aware of what the risks are and how you manage those risks. Maybe you get more frustrated if you have more things that you do not meet.

We have to face that this is not initiated as a scientific sampling system – and data collected cannot extrapolate to non-CCTV vessels. This does not mean that it cannot be developed into a scientific sampling system. In doing this there should be focus on designing trials carefully and involving statisticians when designing tests, in order to have sufficiently powerful trials – for example with respect to areas, fish, gear, etc. There has not been time to explore these issues yet. The discard estimates from cameras and discards from observers cannot be compared, until there has been more testing.

Scientific drivers – what would we like to know which we could get from EM
It is again mentioned that the system provides a powerful tool to get even more data in addition to what already exists, in order to get more data and more reliable stock assessments. This system will give us more information on fishing operations, with an accuracy never seen before.

A number of scientific issues that could be explored further with EM data are mentioned and discussed:

- **Behaviour and fishing practices** The CCTV can provide a way to find out what is going on onboard. It does not give info on biology of fishes, although maybe it can in the future. But we can find out more about the behaviour of fishers and if they behave differently when observers on board.
- **Stock assessment** The EM could improve data and methods currently used to make stock assessment more precise.
- **Catch composition** The system can be used to estimate total amount of catch, and also give more details on catch composition
- **Effort** The system can provide effort data on a much finer scale and accuracy than currently available. It will make it possible to give a much more precise definition of fishing effort e.g. the fishing effort of gill netters; and soak time.
- **Sensitive species** This system is a very promising tool in by-catch monitoring of sensitive species, such as harbour porpoises. It is difficult to get any information on porpoise by-catch from observers, as not all fisheries or métiers are covered, and is a rare occasion.
- **Seafood safety and consumers** There are strong market incentives to use this system, to ensure the quality of the product and the sustainability it comes from. Can for example be used in relation to MSC and for the fishers to show that what they have logged is accurate. MSC certification requires documentation of e.g. catch composition, by-catches and discards. The system could also improve traceability and document how the fish has been treated onboard

Data collection with EM in relation to other data collection programmes and data needs

The data collection framework (DCF) aims at insuring collection of standardised data to be used by scientists and administrators. The EM system should be used as one of the data collection tools within the DCF.

The EM system can be a very efficient tool in delivering data, under the DCF, and it can provide high quality data, cheap and in large quantities.

In comparison, observer data collection system which is a mandatory system in the DCF is extremely expensive to operate and although the data may be very detailed the coverage is often too limited to allow reliable estimates to be delivered. The EM system however can provide a huge amount of data. A combination of the two systems and use of a fisheries self-sampling system might be optimal.

Making data available to scientists
This is a difficult but very relevant issue. The EM data is being collected from a conservation-of-cod-stock point of view, and not for general stock assessment or scientific research purposes. This means that the data collected may not be delivered in a form and format required by the scientists. To ensure that EM data can be used in scientific work it is important that the format-issue is addressed. To this end it may be necessary to take into consideration legal aspects of using data collected on individual vessels.

The need for a standardization of data, exchange formats and/or data base system
One problem in the DCF is standardization. It is important that data is standardized, and based o common definitions, e.g. define effort (what is effort for a gill netter etc, what is steaming time).

The systems are being set up for different needs and requirements in the different countries, but the technology is the same. It should therefore be possible to develop a standard format for data.

Ideas for improving the data we get
There are many possibilities with this system to collect additional data. The main cost is to get the data storage system installed. As soon as it is installed it should be relatively simple and cheap to add new sensors. Additional equipment onboard could include depth sensors, scanners, and CTDs. In relation to the harbour porpoise discussion, it has been discussed whether it would be possible to have hydrophones allowing monitoring of the presents of the animals in an area.

There was also discussion on the design and set up of the cameras and system on board, in order to optimize the system. It was suggested that experiments being conducted on how to optimize the quality of the data, e.g. by changing the way the catch is sorted and the set up on board, so we get the best quality image

Onboard pelagic vessels the set-up may need to be different, in order to cover all decks and sorting areas and tanks. It may be more difficult than on demersal vessels, because the setup is more enclosed and not as open. But definitely possible to develop, we should just be aware that the requirements may be different in the pelagic fisheries.

Future research and funding
There is so far no formal setup for coordination of future research and so far the coordination has been very loose and informal. It was suggested to create a formal setup – maybe within ICES. DTU Aqua could be prepared to facilitate some kind of share point, like a document repository, allowing everybody to upload documents and comment. There was agreement that it could be a good idea with a workshop at the end of this year, after trials, to share experiences.

Funding is required to support the use of EM in research and data collection - a new tender, maybe under the DCF, could cover the development costs. This should also cover data collection purposes but the main purpose of proposal would be to set up a forum for data sharing and exchange. In addition some development on e.g. video analysis could be made.

What would be the focus of a future workshop - science or more monitoring was also discussed. It was argued that more practical experience using the systems is required, before planning a new workshop. In the short term it is more important to get these trials running, before discussing more about data and standardization.

Group B: Electronic monitoring (EM) and compliance monitoring. How can an electronic monitoring system be used in inspection and surveillance?

Participants
Johan L. Davidson (chair.)
Lotte Kindt-Larsen (rapp.)
Participants: Birgit Bolgann, Kerrie Campbell, Mads Dueholm, Alis Eidesgaard, Kertil Grødal, Ian Hepbrun, Malin Hultgren, Mik Jensen, Søren Palle Jensen, Ragnar Johannesen, Arne Madsen, Marika Malonek, Christian Olesen, Alex Olesen, Keith Porter, Bjarne Schultz, Jóhan A Simonsen, Helga Valgeirsdóttir, Jack van Leeuwen, Katerina Veem.

For the first time fishers, inspectors, researchers, buyers, fishery managers, IT companies and others with high interest in the EM system were gathered around a table discussing the possibilities of using EM for control and enforcement purposes.

The text below represents the outcome of the group discussions and gives an introduction to the different aspects and opinions which has to be taken into account if the EM system is implemented within the commercial fishing fleet for the above mentioned purpose.

Discussion

The EM-systems ability to increase the verification and assure quality in the fisher's recordings in the logbook

The group generally agreed that the video/sensor data can be used to verify the log books notations of position and in some fisheries even to estimate the amount of fish. Members who already had worked with the system found it easy to analyze the data. Being able to view sensor data and video data at one time is a great tool but also features such as adding maps to the sensor data and the high resolution of the GPS were found to be very useful. Especially the possibility to add maps would be of high use to verify if fishery has been taken place within specific management areas or in areas with specific gear regulations or prohibitions. However, even though there is a lot of verification to which the system will be very useful, it is mentioned that the system cannot stand alone since the catch weight cannot be verified. This can cause underreporting of catches. In Canada 100% of the landings are verified in port, hereby saying that control people are still needed in port.

The EM systems ability to decrease the administrative burden for the fishermen by integration with the electronic logbooks

The group highlighted that the electronic logbook needs to be integrated with the EM system. There is no reason for the fishermen to register the same data as what is obtained through the EM system. A representative from Archipelago stated that such integration would not be a problem. An integration will also increase the quality of the data by removing the manual labour of entering data and thereby decreasing the risk for typing errors.

The EM systems ability to simplify, quality assure and cost reduce present control schemes

At this stage it is not possible to note down the exact rules which can be eliminated or loosened. It is important to remember that control and enforcement are a reflection of the management or recovery plans often with a connected specific control plan and not to forget the technical rules. This package of rules is the result of scientific advice for how a specific fishery must be carried out to be sustainable. Most of the control measurements are designed from the management rules. If the management system is complex the control and enforcement will be complex and expensive.

The general view is though that some of the existing control rules can be simplified if the system is installed on the vessel. In order to simplify it was once again mentioned that gathering of EM, E-Log, VSM and maybe even sea packed products would be of high need in order to simplify fishermens duties onboard.

According to quality assurance of both catch data and the fishing activity the information created by the EM-system will be very useful if the information was integrated into a traceability system hereby covering the whole procedure from catch to table.

The needs for real time access to data was also discussed. Control and enforcement would benefit from having sensor data sent real time. This can create possibilities for a more efficient and risk based surveillance at sea. Real time data from sensors and GPS will present information about what happens at sea. Information we do not have today. It is probably not needed to have the video information in real time. The video information can be used to verify suspected misbehaviour that has been identified via the sensor data. Sensor data combined with GPS trials at Hawaii have tested the system's ability to send sensor data real time. It is very important that the different stakeholders together define what is needed.

It is also clear that the EM system will fill out some of the gaps of the surveillance existing today and much data will be obtained from the time between inspections. However technical inspection of mesh sizes and other gear related controls will be difficult to perform with the EM. Therefore it is important to clarify to witch extent a catch quota system needs technical measurements. However rules for soak time will be easily monitored and the solutions for trap fishing which Archipelago presented looked very promising.

It might therefore for be that the surveillance at sea can be reduced to some extent. It might also be possible to get rid of benchmarks by the use of EM.

From a cost benefit point of view it is clear that surveillance by patrol vessels is expensive. Today we have no information about the costs for analyzing the information provided by the EM-system from a control point of view. It's therefore important that the new trials carefully study the cost benefit of the EM-system from a control and enforcement point of view.

Can EM be forced on the fishers as a control measure or must it be a part of a new management system

The management part is the most important; if the management makes sense the fishers will join and maybe even pay for the equipment. The ethical problems about having cameras onboard are slightly decreasing and the fishermen proceed with their normal work. The crew has also great interest in having the system onboard, if the system increases the earnings of the vessel. However, the consumer always has that last word. If they want EM onboard, the fishermen will have to adapt. A lot of positive skills exist within the Archipelago system but maybe cheaper or better solutions can be found.

How the EM benefits the control?

This question was put as a "Tour de Table" where everyone was to state their opinion. They were:

1. Statements related to fishery:
    - Fishing in closed areas can be verified.
    - Control and enforce the prohibition of transhipments at sea.
    - Control and enforce movement of catches between different management areas.
    - Documentation of the fish that are taken onboard.
    - Miss reporting of area can be reduced.

2. Statements related to at sea surveillance
    - Reduce inspection at sea.
    - The possibility to install EM onboard vessels where it is difficult to have observers or sea patrol.
    - Patrol vessels is still needed
    - A new definition of at sea patrol duties needs to be defined.
    - CCTV combined with VMS and E-log is good tool but it will not replace at sea control.

3. Statements related to fish stocks
    - Discard will be less.
    - Better estimates of what is removed from the sea will be obtained.
    - Better understandings of the ecosystem interactions.

4. Statements related to managing of the EM-system
    - A cost benefit analysis is needed.
    - Useful tool to implement for fishers behaving badly, make it there only way to continue fishing.
    - Consumers will ask for the EM system.
    - Consumer transparency is needed.
    - Fish could be sold before it is landed in the future
    - Landings need to be filmed to give full traceability.

- Change in legislation is required.
- Great challenge with large pelagic boats.
- Problems with mixed fisheries where the quotas do not fit.
- Fishermen wants to be relieved form other burdens if they have the systems onboard.

5. Statements related to research
    - All kinds of sensors can be applied to the system.
    - Great potential for the research projects such as picture recognition, length measurement.
    - Projects until now have not focused on control questions, look at costs and control perspectives in the future.
    - The systems greatest weakness is that it cannot verify the catch. Verification is possible within the hook and line fishery but not within trawls, gillnets or seine, but it is a step forward.

6. Statements specific for control purposes
    - Video cannot be used in court cases
    - Camera needs to run 24 hours
    - Inspections cannot be omitted but it can make it more efficient
    - Systems increase the awareness on who to look at

Conclusions from the group

When locking at the outcome of the group discussion on the possibilities to use EM-systems to increase the efficiency in control and enforcement and to decrease the administrative burden for fishers it is important to remember that this was the first time the subject was discussed between members in such an open context. It's obvious that we all have different views on this subject and have analysed the possibilities in different ways for different purposes.

It was agreed that EM-system can contribute to decrease the administrative burden in the context of the obligations for fishers to manually report their fishing activities in logbooks but also when it comes to hailing and pre-notification. It is important to remember that this demands for integration between the EM system and the electronic logbook. The effect will appear when the information provided by the EM-system automatically transfers to the electronic logbook. Important to remember is that the EM-system in itself will not *lead to a decrease of the information that the fishers are asked for from a scientific purpose, management purpose* *or from a control and enforcement point of view. The need for this information in the future is the result of the definition of the management system itself, in this case the catch quota system.*

It was also agreed that the EM-system can contribute to more efficient control and enforcement by providing the control system with new information, especially about what is really happening at sea. This can lead to more efficient sea surveillance and also a better risk based control system for sea inspections carried out with patrol vessels. The system can provide authorities with information that can be useful in a strategic risk analysis and planning of the control and enforcement resources. EM system will not lead to a total reduction of sea inspections via patrol vessels. The reason for this is that control and enforcement of the technical regulations must be made at sea and not via cameras or at shore. *To take this issue forward there is a need for clarification to what extent a management system with catch quotas really demands for technical regulations such as mesh size.*

To create added value for the control and enforcement some of the information from the EM system must be provided close to real time. This will provide the control system information about the fishing activities. *It's therefore necessary with a technical analysis about the possibilities to provide some of the information real time.*

The power of the consumer will increase with higher demands for legally caught fish and fish from sustainable stocks. This creates needs for traceability systems. We are obliged through the new control regulation and the IUU regulation to provide systems for traceability. The information created with an EM system creates value to such systems.

Group C: Operational aspects for using electronic monitoring (EM)

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Break out group C dealt with the operational aspects of using electronic monitoring (EM) and tried to come to an understanding of what is needed to be able to put a program together to be operational and successful by using the results and perspectives from pilot projects. The following questions had been handed out to the participants beforehand although the discussion did not stringently stick to these questions but progressed without restraint.

- What are the operational requirements involved with the use of electronic monitoring systems?
- What are the challenges with field service, analysis, data storage, data base developments and other technical issues concerning electronic monitoring?
- Is there a need for analyzing EM data more automatically by using more intelligent data recording or image recognition tools?
- Is there an interest in establishing a network?

Discussion

Operational requirements

It was highlighted that the requirements for running a fully operational EM program are different from those of a pilot project. An example was given using the groundfish EM program in British Columbia (Canada, see Stanley presentation). It was a requirement the EM systems were continuously operational and a vessel would have to cease operations and come to port for repairs if the EM system malfunctioned. This requirement implies that the vessel and the land based part of the program have to be able to meet this demand (e.g. in form of gear durability, technical expertise at sea and on land, etc.) as the consequences for gear failure can be loss of income for the participating fisher.

Workgroup participants who had previous experience with Archipelago's EM system all agreed that the equipment was very robust and at the same time user friendly. No problems had been encountered due to malfunctioning of the gear used. There was agreement in the group in securing proper education of staff should be prioritized not only as a consequence of the above mentioned issues but also to ensure the quality of the analysis and interpretation of collected data. As was mentioned by several participants, the land based part of an operational EM program should be up and running before beginning collecting data at sea.

As a prerequisite to a well functioning land based part of an EM program it is important to identify the aims and goals of the program before starting data collection. Detailed data collection formats and methodologies need to be established in advance as once the monitoring begins, the data processing challenge becomes one of keeping up with the large volume of data collected.

It is also essential to have some information about the amount of data being collected during the program as well as knowledge to how the vessels are operating when at sea (e.g. length of fishing trips, number of fishing events per day, specific on board catch procedures) in order to optimize EM system configurations. The sensor data (e.g. hydraulic pressure) is being used to determine when the vessel is fishing. This is then compared with images from the cameras to check if this is in line with the aim of the project. The next level is to determine the accuracy of the measurement carried out.

Establishing a responsive feedback loop between program operations and fishers during the early stages of a program is essential to resolve technical issues, encourage industry participation and ensure optimal data collection.

No effort is being made to minimize the data collection in the field as storage capacity usually is sufficient to ensure that everything that could be useful can be collected. Truncation of data can be made afterwards. The image data is much more time consuming to analyze and also consumes more storage capacity. If vessel self reporting processes can be established, a random sample routine can be used for processing image data. In the BC groundfish program, 10 % of the fishing events are randomly selected for each fishing trip, with each fishing operation being defined as a sampling unit.

Data handling should be done in a central place especially in the upstart phase of a program. It was mentioned that the running of a program in general is much easier if there is offered a 'package solution' to the user. Integration of EM data with other data sources (e.g. VMS, self reporting data, etc.) should to be done at an early stage in the program.

Technological challenges for the EM

The use of EM as a tool to verify the fishers' logbooks and thereby contribute to carry the 'burden of proof' was discussed together with possible solutions for enhancing the accuracy of the length measurements. It was noted that camera positions are crucial also in this context but that it is almost impossible to verify certain information recorded in the fisher's logbook from the camera imagery. In the Danish and Scottish trials, the best camera placement for catch monitoring was at the conveyor near the discard chute (See Dalskov presentation). This camera provided a general index of species composition, catch volume, and quantities of cod discarded. A system with two cameras directed at the conveyor but from different angles was suggested as a means to improve enhance the accuracy but it would still be difficult to obtain accurate length and weight estimates. It was suggested that EM technology should be used more as a means to audit fisher data rather than counting and measuring everything but this of course depends on the aim of the program. The use of intelligent video to measure the fish is still not an option under normal conditions but technology is rapidly developing in this field. Workshop participants recognized that inspection of the vessel before enrolment in a program (e.g. with an observer onboard) is needed in order to ensure that of the vessel is suitable for monitoring with EM system.

A challenge in the future for the EM is when dealing with a mixed species fishery and the monitoring focus extends to more species than cod. This calls for development of a proper methodology to ensure but for the EM the species interactions and the mixed fishery can be a challenge for the EM but the proper methodology can be developed to ensure good solutions to this issue.

New and already existing technology should be implemented as tools in the data handling phase when applicable and useful (e.g. after the expression 'keep it as simple as possible but as complex as necessary'). One example is the use of data transmission from the vessel EM system, either by satellite, internet or via mobile phone. While transmission of the large volume of data recorded on an EM system would be prohibitive, transmission of summary data allows for system status check from land and hence preparation of service of the EM gear. This is important especially early in the program where onboard knowledge of EM system functional requirements may be limited.

Establishing of a network

A participant from the Scottish EM pilot program emphasized the need for sharing information and experiences learned from the pilot projects. There was a strong agreement in the group to go ahead with creating a network to ensure essential communication between countries using EM. This will be very important in the near future as several countries begin to establish operational EM programs in contrast to the more easily managed pilot study programs. It was also suggested that a single group could be set up to develop data structures, analysis methodologies, and programming for European EM projects.

Sharing of information is important at a variety of levels. Sharing between different programs enables everyone to learn from each other's programs. Sharing of information within a program helps enable data uses beyond those specific to the program. For example, EM data could be used to help fishers meet traceability requirements for their catch. Thus, the technology not only becomes a tool for the burden of proof aspect but also an alternative quality stamp to MSC certification.

The linking of the different parts in a EM program (e.g. fisher, user, environmental groups) is a process and it should be prioritized as all participants seem to be able to benefit from it.

Benefitting from the EM

A more broad viewed motivation for the fishery could be getting away from high grading and discard observed in some fisheries. The fishers themselves now begin to realize that they have to do something and they see the EM as a useful tool in this context to verify reported fishing locations and corroborate vessel log records of catch composition and discarding. The existing rules are many and complex and for some fisheries these could abandoned or simplified if they adopt the 'fully monitored fishery' approach using EM (e.g. the KW effort days). Another benefit from EM is that the fisher can show proof of his catch history which is an important argument when selling a fishing vessel with quota included. Incentives for participation are thus very important for the fisher but at the same time it is important for them to consider the consequences of not documenting their fishery. The EM can open doors for other projects involving fishers and support other data collecting schemes in other ongoing scientific projects.

Conclusions

The following points were presented in plenary at the end of the workshop by the chairman of the workgroup.

Operational program success is achieved easier if:

- Program aims and goals have been clarified from the very beginning.
- The land based part of the program should be ready before collecting data (training of staff, definition of sampling scheme, definition of fishing event, etc.). This includes both the field service and data analysis components.
- Prior to their acceptance in a program, vessels should be inspected to confirm their suitability for monitoring using EM technology.
- Communication/feedback between skipper/crew and user is a key element to resolution of various issues and thereby can ensure that the whole EM system is performing optimally (camera views/angles, working procedures on deck during catch handling, etc.). There is a need to consider the necessary communications structures to optimally enable this interaction.

- The ability of EM for independent determination of catch quantity (weight) is limited but the technology can be useful to corroborate vessel records of catch volume, species composition and level of discards. Improvements with camera placements and onboard catch handling procedures will aid in this area.
- EM is a valuable tool for determining time and location of fishing operations.
- A length measurement (approx.) of individual fish is possible when using conveyer belt or chute with size reference (discard fish). New technology is promising.
- Proper methodology should be developed when dealing with several species in mixed fishery.
- If an audit approach is used, the length of the sampling unit (e.g., reporting by fishing event versus daily reporting) should be kept as short as possible to improve reporting accuracy and make the data analysis easier.
- It is important to consider centralization and integration for various components of the program (e.g., field services, data analysis), particularly with new EM programs.
- Future visions are advancements of technology and how EM fits in (e.g. real time, E-logs, VMS, etc.)
- Incentives for the participating vessels are important to keep the EM successful.
- A network should be established thereby making it possible to share information and experiences from pilot projects and programs. A kick-off meeting is proposed soon to initiate collaboration on a range of operational issues (e.g., incentive structures, vessel requirements, data analysis methods, metadata, databases, etc.).

Group D. Catch quotas versus landing quotas

Participants
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Group D had a broad spectrum of issues to consider, many of which are central to the effectiveness of an EM based catch quota system in practice within a complex management and plocy context. The questions spurred additional discussions relating to e.g. overall management considerations, compliance issues as well as increased emphasis on the applicability of EM & the catch quota system in relation to mixed fisheries. The main points that emerged from the group’s discussions are synthesized below.

Discussion

Can the electronic monitoring (EM) system provide the necessary documentation to operate a catch quota system?

On the basis of existing trials it was generally agreed that the electronic monitoring system can provide the necessary documentation to operate a catch quota system. The system has sufficient detail to monitor effectively and to enable the identification of species. Even with many species present, the system has the potential to effectively monitor catches. Detailed methods can be developed to do so more effectively.

It is not the intention to review all camera footage captured aboard the vessels for all fishing operations. A more feasible strategy is mainly to review randomly sampled footage. In addition, there is a need to develop methods for risk analyses of fisheries in order to identify which fleets or vessels that require more attention.

Relative stability – catch quotas versus landing quotas

In relation to the question of catch quotas vs landing quotas within the framework of relative stability (i.e. a system whereby Member States are consistently allocated the same proportion of particular stocks.) it was the general attitude of group participants that, since Member States are currently unwilling to engage in this discussion on an EU level, the group should focus the discussion on other topics.

Nonetheless, it was expressed that it is an important issue if the basic principle of relative stability is abandoned altogether. Others expressed that relative stability based on catch quotas constitutes a problem for those Member States that have fisheries with high levels of unwanted by-catch. In relation to the latter point of view, one response was that catch quotas would create an incentive to move towards cleaner fisheries.

According to participants, there are ways that catch quotas could work *within* relative stability. One is "across the board or opt-in". Two columns: one with TAC share and one with TAC share plus discard. Another option is the swapping of quotas between Member States.

Catch quotas in an overall management context

Throughout group sessions the participants touched upon a number of issues that pertain to overall management considerations.

One initial point of view was that instead of discussing discards, we should be focusing on reducing fishing mortality on stocks, i.e. reducing what we do not wish to catch. It was emphasized that the near future provides unique opportunities to provide ideas to change the current European fisheries management system.

It was described that a catch quota system may be introduced as what was referred to as a second management track. Such a management track could e.g. support markets in certification processes, provide freedom for fishers by facilitating a move away from the kW-day system.

Another participant described EM as one tool in the management tool box. Among other tools in this box are e.g. gear selectivity and real time closures, and the aim should be to use the right combination of tools for a given task.

Control and compliance issues

It was agreed by all that the EM system must be driven by incentives in order to avoid compliance issues. However, history has made it apparent that most systems can be tampered with. The EM system has proven to be very robust at sea, but malfunctions can happen and these must e.g. be fixed before leaving port, as is the case with the VMS system. Therefore there must be rules connected with EM and consequences for breaking them.

When control and compliance issues are dealt with efficiently, EM could be a great advantage for fishers in public relations and in the establishment of trust in relation to consumers, managers and NGO's.

Practical aspects and challenges of a catch quota system

There are some overall challenges regarding EM and a catch quota system, most of which remain unsolved but may provide opportunities for research and development. It was stated on several occasions that *flexibility* will be key in overcoming many of the challenges that the catch quota system and EM will meet.

For instance, there are a number of species for which ICES data was said to be insufficient or non-existent. This also constitutes a challenge when baselines need to be selected for setting of additional quotas. One proposed solution was based on political decision rather than science. If we are to rely on science, the ICES approach to discards could be revisited.

It was suggested that advice could be made more flexible, i.e. a departure from traditional annual advice. This, however, was deemed a "slippery slope" by other group members.
It was mentioned that a buffer, or compromise regarding "access to land" would be detrimental to the catch quota system as a concept.

If a catch quota system and EM can be brought forward in relation to the reform of the CFP, the policy must allow for this opportunity to happen. Group members found that it was important to push the EM system forward, as an alternative could be e.g. a total discard ban. It was mentioned that a discard ban would require increased control and that such a ban is unfavourable in comparison to catch quotas because in EM fishery/catch quotas discards are *accounted for*.

Implications if only changing from landing quotas for a limited number of species? (Emphasis on mixed fisheries)

The use of the EM/catch quota system in mixed fisheries was one theme that frequently emerged throughout discussions. The assumption was that there is no need for a by-catch rule for mixed fisheries within catch quotas because once the quota for the lowest common denominator species is caught then the fishery on that species must stop unless quotas for these species can be swapped, shared or traded. If this is not possible then it was mentioned that fishers must adapt their gears, fishing grounds and fishing patterns to avoid the species. Soft TAC's, multiannual TAC's or biologically grouped multi-species quotas within scientifically set levels were also mentioned as possible solutions to this challenge. The latter proposal was, however, deemed to be prone to abuse. Another comment was that the complexity of multispecies aspects might be dealt with by dealing with the individual species.

Again, building in flexibility was said to be key to success and a hierarchy of solutions was proposed, incl. year-to-year flexibility within quotas on vessel level, quotas managed by groups of vessels, buying/trading/pooling quotas, swapping of quotas between nations and a regional approach to advice and other management issues. It was also suggested that member states could set aside buffer quotas. Real time catch data as is available in Iceland was also mentioned as a way to make management more flexible. Iceland also has system with species conversion and transfers of quotas to the following years as examples of flexibility.
When dealing with lowest common denominator species it was repeated that the alternative to a catch quota system is likely to be the closing of fisheries or an extension of the kW-day system.

On an optimistic note, one participant suggested that, if given the opportunity, the future may show that many of these problems may fix themselves, if not nationally then internationally.

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Ole Henrik	Skov	R-Cubed I/S	os@rcubed.dk
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Christoph	Stransky	Johann Heinrich von Thünen-Institut, Hamburg	christoph.stransky@vti.bund.de
Thomas Kirk	Sørensen	DTU Aqua	tks@aqua.dtu.dk
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Helga Sigur-rós	Valgeirsdóttir	Directorate of Fisheries, Island	helga@fiskistofa.is
Jack	van Leeuwen	General Inspection Service	j.c.w.van.leeuwen@minlnv.nl
Katarina	Veem	Baltic Sea 2020	katarina.veem@balticsea2020.org
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Christopher	Zimmermann	Institut für Ostseefischerei (OSF)	czimmermann@clupea.de

Appendix 1

Agenda

Tuesday, 9th March 2010

12:00 - 13:00	Registration and sandwiches
13:00 - 13:20	Welcome and introduction by Deputy Director Eskild Kirkegaard, DTU Aqua
13:20 - 13:45	At-Sea Observing Using Video-Based Electronic Monitoring by Howard McElderry, Archipelago Marine Research Ltd., Canada
13:45 - 14:10	The Danish Trial by Jørgen Dalskov, DTU Aqua
14:10 - 14:35	The Scottish trial and future monitoring and control possibilities by using Remote Electronic Monitoring data by Allan Gibb, Sea Fisheries Policy, Marine Scotland.
14:35 - 15:00	The use of Video-Based Electronic Monitoring data in stock assessment and for fisheries management by Rick Stanley, Pacific Biological Station, Fisheries and Oceans, Canada.
15:00 - 15:20	Challenges and perspectives of a management regime based on full catch documentation by Mogens Schou, Advisor to the Danish Minister of Fisheries.
15:20 - 16:00	Coffee
16:00 - 17:30	Breakout groups Group A: Electronic monitoring and fisheries research. How can data obtained with an electronic monitoring system be used in stock assessment and fisheries research? Are there specific research based requirements to be taken into account when developing the monitoring scheme?

Group B: Electronic monitoring and compliance monitoring. How can an electronic monitoring system be used for inspection and surveillance to ensure vessel compliance with fishing regulations? Can the control measures be simplified for vessels having electronic monitoring systems?

Group C: Operational aspects for using electronic monitoring. What are the operational requirements involved with the use of electronic monitoring systems? What are the challenges with field service, analysis, data storage, data base developments and other technical issues concerning electronic monitoring?

Group D: Catch quotas versus landing quotas. Can the electronic monitoring system provide the necessary documentation to operate a catch quota system? Other aspects of catch quota management.

19:00 Dinner

Wednesday, 10th March 2010

09:00 - 11:00 Breakout groups, continued

11:00 – 11:30 Coffee

11:30 - 12:30 Presentation of the outcome of breakouts.
Convener Eskild Kirkegaard

12:30 -13:00 Where to go from here?
Conclusions and recommendations for future work and co-operations on electronic monitoring of fisheries in Europe in relation to Catch Quota Management regimes.
Conveners Eskild Kirkegaard and Mogens Schou

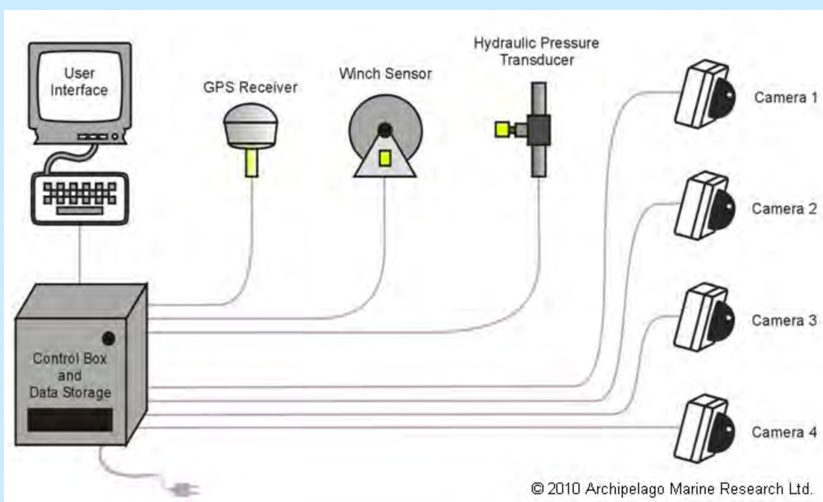
Appendix 2

At-Sea Observing Using Video-Based Electronic Monitoring Technology

Presentation to:
Workshop on the Fully Documented Fishery
Denmark Technical University
National Institute of Aquatic Resources
March 9-10, Copenhagen, Denmark

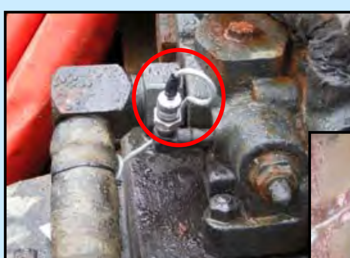
Howard McElderry
Archipelago Marine Research, Ltd.
howardm@archipelago.ca
Victoria, BC CANADA

What is EM?



Control Box

Sensors



Hydraulic
Pressure

Winch
Rotation

GPS

CCTV Cameras

EM Applications 1999-2009

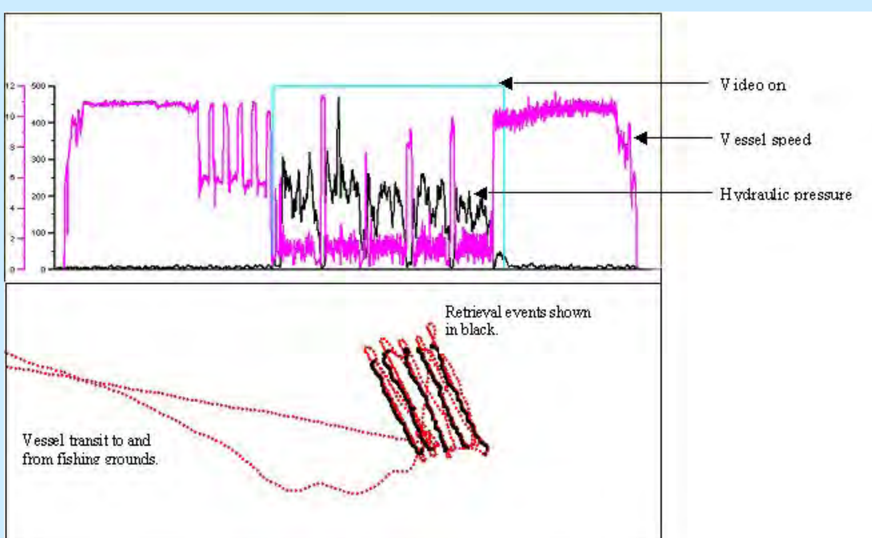
Country	Region	Vessels	Gear/Fishery	Days
Canada	BC	350	6	90,000
US	NW	40	1	6,500
	AK	25	5	1,100
	NE	12	3	100
	SE	6	1	150
	SW	10	2	150
	PIR	3	1	400
Sweden		1	1	100
Denmark		6	3	1000
Scotland		7	2	400
New Zealand		14	4	700
Australia		3	3	150
Totals		**477**	**12**	**100,750**

2009 – 460 vessels/12 fisheries/~24,000 days

Key Fishery Monitoring Issues

- Fishing Location
- Catch Monitoring
- Catch Handling
- Fishing Methods
- PS Interactions
- PS Mitigation
- (Compliance Monitoring)

Fishing Location



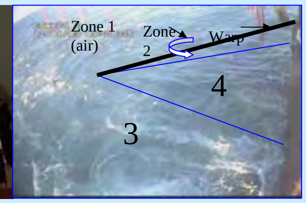
Catch: Serial Catch

Catch – Trawl and Seine

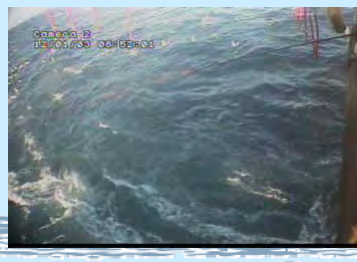
Catch - Trawl

PS Interactions: Proximity

PS Mitigation: Trawl Warp Streamers



Baffler Present



Baffler Absent

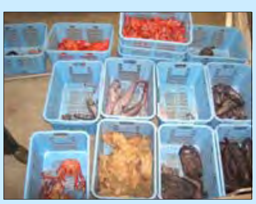
Key Challenges with EM

- EM is Not 100% Fault Tolerant
- Technology Rapidly Advancing
- Large Data Volumes
- Program Implementation is Complex
- Implementation Timeline Long (1-2 yrs to stage, 2-3 yrs to become operational)

Key Advantages of EM

- Not limited by vessel size
- Less impacted by irregular fishing schedules
- 24/7 data collection
- Less intrusive than observers
- Less costly than observer programs
- Can be used to audit self reported data

Audit Based Monitoring Model



Landing Records

Fishing Logbook

Electronic Monitoring

Official Catch Record

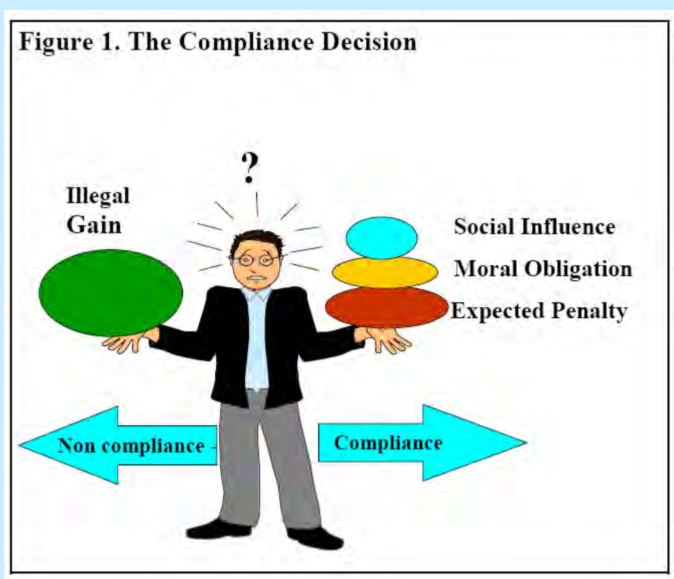
Traditional Monitoring Model

Landing Records

Electronic Monitoring

Official Catch Record

Fishing Logbook



(From Sutinen, 2008)

Fully Implemented EM Programs

- BC Area A Crab Fishery (since 2000)
  - 50 vessels, 4,000 seadays
- BC Groundfish Longline Fishery (since 2006)
  - 230 vessels, 12,000 seadays
- West Coast Shore Side Hake Fishery (since 2004)
  - 30-40 Vessels, 1,000 seadays
- Alaskan H&G Factory Trawlers (since 2006)
  - ~10 vessels, 2,000 seadays
- BC Inshore Trawl Fishery (since 2007)
  - 12 vessels, 1,500 seadays
- BC Hake Fishery (northern region since 2006)
  - 30 vessels, 1,200 seadays

Key Elements of EM Program

- Equipment Supply
  - Sales, leasing, repairs, spare parts, upgrades
- Field Services
  - Installation, servicing, data retrievals
- EM Data Interpretation
  - Interpretation of sensor and image data
- Data Consolidation, Analysis and Reporting
  - Integration with other data (logs, VMS, landings)
  - Analysis, reporting, feedback, outreach
- Program Management
  - Program operations rules and governance
  - Coordinating project team, vessel participants and others
  - Monitoring overall program performance
  - Integrating with data users

Cost Influences and Sensitivities

- Inputs
  - Fishery activity (vessels, landings, fishing operations and seadays)
  - Landing patterns (temporal and spatial)
- Outputs
  - Audit method and coverage level
  - Analysis and reporting requirements
  - Overall maturity of data model
  - Feedback and outreach processes
  - Performance tolerances
  - Program responsiveness
  - Degree of program centralization
  - Cost recovery method

Closing Thought:

EM enables a new paradigm in the science, management, and control of fisheries

For Further Information:

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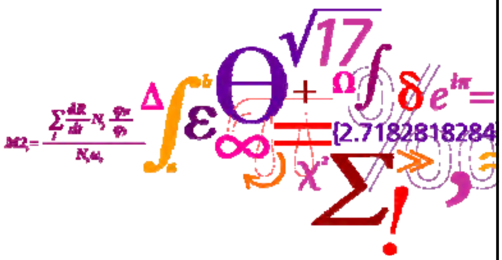
Appendix 3

DTU

Fully documented fishery

By
Jørgen Dalskov & Lotte Kindt-Larsen
National Institute of Aquatic Resources
Technical University of Denmark



DTU Aqua
National Institute of Aquatic Resources

DTU

Aim of the project

- To test a new fishery management paradigm where vessels with full documentation get incentives in form of increased fishing possibilities.
- To test whether electronic monitoring can be used to provide reliable documentation of the fishing operation and the catches.
- To demonstrate that a fully documented fishery can ensure:
  - that total catches - landings and discards – are recorded,
  - a vessel self sampling system provides reliable and useful data for the scientific advisory system,
  - an improved economy for participating vessels,
  - a documentation which can be used in evaluation of the sustainability of each of the fisheries.
- **In short term to demonstrate that discards of cod in the Danish fishery can be minimized.**

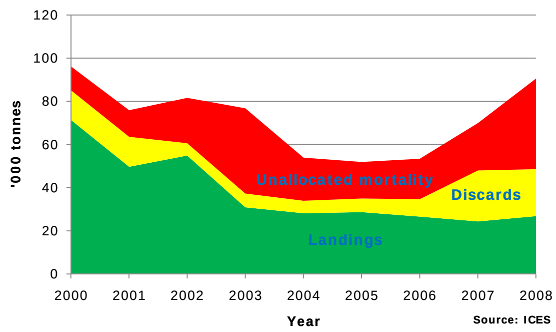
Vessel duties and profits

- The total catch of cod (above and below the minimum landing size) was deducted from the vessel cod catch quota.
- The fishermen were obliged to sort out all cod (above and below the minimum landing size) from the total catch.
- Fishermen were obliged to length measure all or a minimum of 50 specimens of cod that were discarded.
- Catches of species, which are managed by quota must not be discarded if they meet the minimum landing size.
- All participating vessels were obliged to record detailed information on each fishing operation.

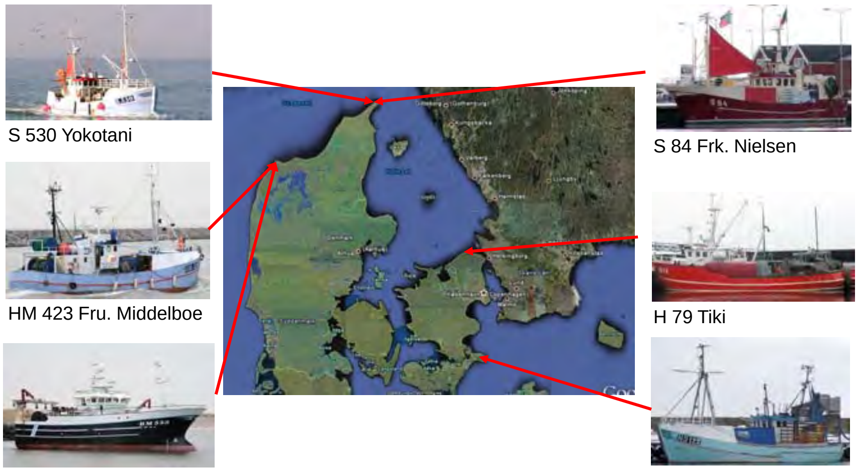
The vessels duties and profits

- Each of the vessels is having cod quota (landing quota) per management area. These quotas have been increased by a factor depending on area to a “cod catch quota” per management area.

Example: Cod in the North Sea and the Skagerrak (ICES)



Participating vessels



S 530 Yokotani

HM 423 Fru. Middelboe

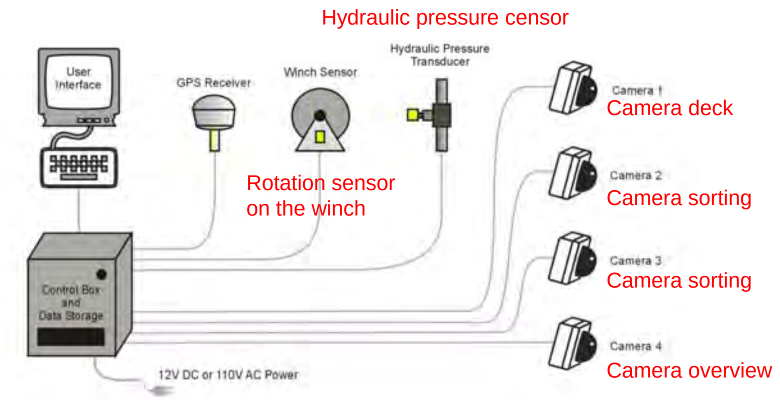
HM 555 Kingfisher

S 84 Frk. Nielsen

H 79 Tiki

ND 176 Søstrene

Archipelago Marine Research Ltd. EM system



Sensor data – Trawl

Video data

Video data

Logbook data inventory

Number of hours at sea, number of fishing trips and number of fishing operation per vessels for the data collection period September 2008 – July 2009.

Vessel	No. of hours at sea	No. of trips	No. of hauls
A	2,547	135	287
B	2,553	79	167
C	6,386	61	552
D	375	31	34
E	512	35	40
F	1,695	124	124
G	3,124	134	370
Total	**17,192**	**599**	**1,574**

EM data inventory by vessel for the period September 2008 to July 2009.

Vessel	Sensor data collected (hours)	Percent data complete	Fishing data collected (hours)
A	2,841.7	99,5	1,908.4
B	2,370.1	90.5	528.4
C	5,977.3	100.0	3,327.7
D	363.4	99.4	245.0
E	583.3	100.0	292.4
F	1,717.7	98.6	731.8
G	3,052.4	97.3	1,879.1
Total	**16,905.9**	**97.9**	**8,912.8**

Discard analysis

The videos showing the catch handlings is reviewed and the discard amount is estimated.

Short key	Code	Species
1	UBS	Unknown species
2	TOR	Cod
3	DVH	Norway lobster
4	ROK	Rays and skates
5	FLX	Flatfish
6	TFX	Roundfish
7	INV	Invertebrates
8	NDI	No discards
9	NCS	No catch sorting

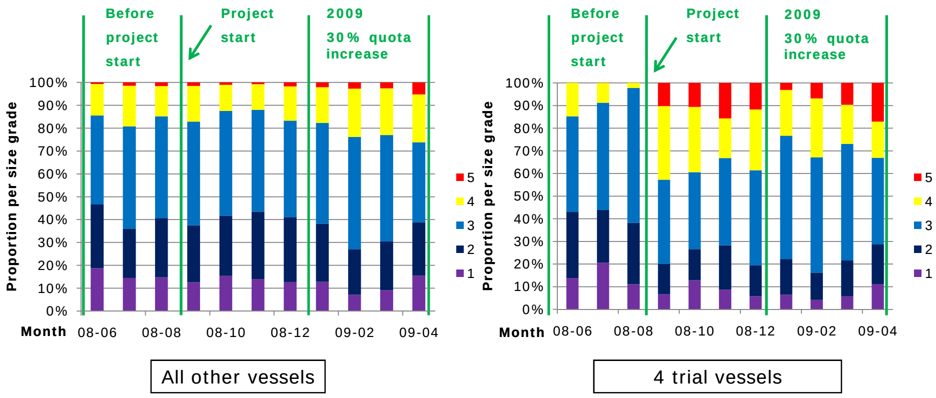
Short key	Kg
1	0 – 5
2	5 – 10
3	10 – 20
4	20 – 50
5	50 – 100
6	100 – 250
7	250 – 500
8	500 – 1000
9	> 1000

Discard estimate accuracy

Fishing events given in percent of times where the image viewer either had estimated less, more or the same amount of discard cod as the fishers.

Vessel	Fisher < Viewer	Fisher = Viewer	Fisher > Viewer	Total no.
A	4	85	11	53
B	8	69	23	39
C	12	57	31	77
D	0	90	10	10
E	0	82	18	17
F	5	62	33	21
G	35	60	5	20
Mean	**9%**	**72%**	**19%**	**Total 237**

Size grade composition of all landings of cod by all vessels fishing in the North Sea and Skagerrak in 2008 and 2009



Costs issues

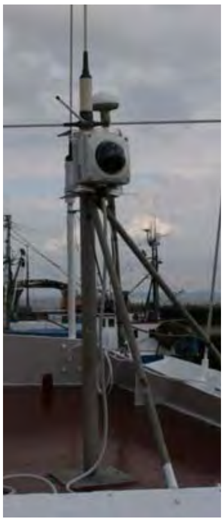
Installation costs	Cost in €
EM System	5,500
Onboard installation	1,200
Consumables, blacksmith etc.	1,500
Total	**8,200**

Running costs per year (500 hauls)	Cost in €
Maintenance of the system pr. year	500
Exchange of hard disk per year	1,000
Sensor data analysis per year	2,000
Image analysis of catch events per year	5,500
Total	**9,000**

For comparison: Cost for an DK observer for 300 sea days = app. € 200,000

Conclusion

- The fishermen's detailed recordings on fishing events, catch composition and discards can be verified by viewing sensor data and videos. High security can be obtained.
- “Fully Documented Fishery” can improve the quality and precision of the catch statistic which in the end will improve the quality of the stock assessment and the scientific advice.
- The industry can use EM to demonstrate that they can operate responsible in return for access to increased fishing rights.
- The discard of cod has for the trial vessels been reduced significantly.



Some fishers' opinion on "Fully documented fishery":

- facilitate the individual fishers possibility of showing increased responsibility towards sustainable fishing,
- facilitate simplification of fisheries management rules,
- revoke burdensome rules such as hails for management area shift, departure and active – passive reporting,
- improve the awareness of areas where catches of small fish is significant and therefore changing fishing ground,
- be an alternative to or even better brand than a MSC certification.

Thank you for your attention

For further information or questions contact

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Lotte Kindt-Larsen
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Phone: +45 33963300

Report can be found at: www.aqua.dtu.dk or www.fvm.dk/yieldoffish

The project has been funded by the European Fisheries Fund and the Ministry for Food, Agriculture and Fisheries

Appendix 4

The Scottish Trial and Future Possibilities

Allan Gibb, Marine Scotland - Sea Fisheries Policy

The Scottish Government

marinescotland

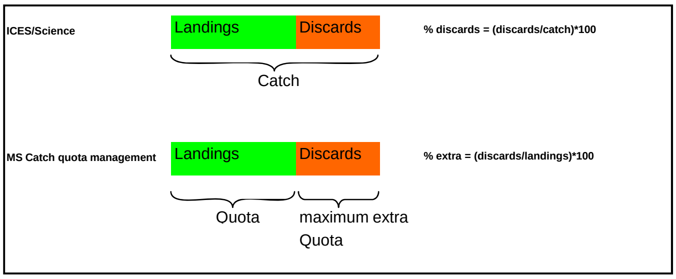
First A few Sage Remarks

Barriers

- (TAC) Total Allowable Catches – If Only !!
- Effort – A reminder (CRP and absent from port)
- Confidence *def*: trust in a person or thing.
- Land more catch less ??

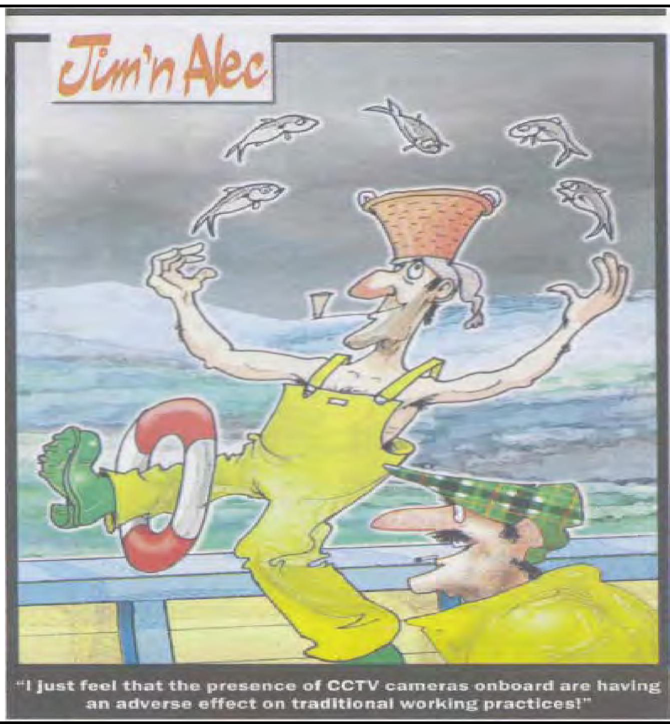
LOOKING TO THE FUTURE – OPPORTUNITIES and POTENTIAL

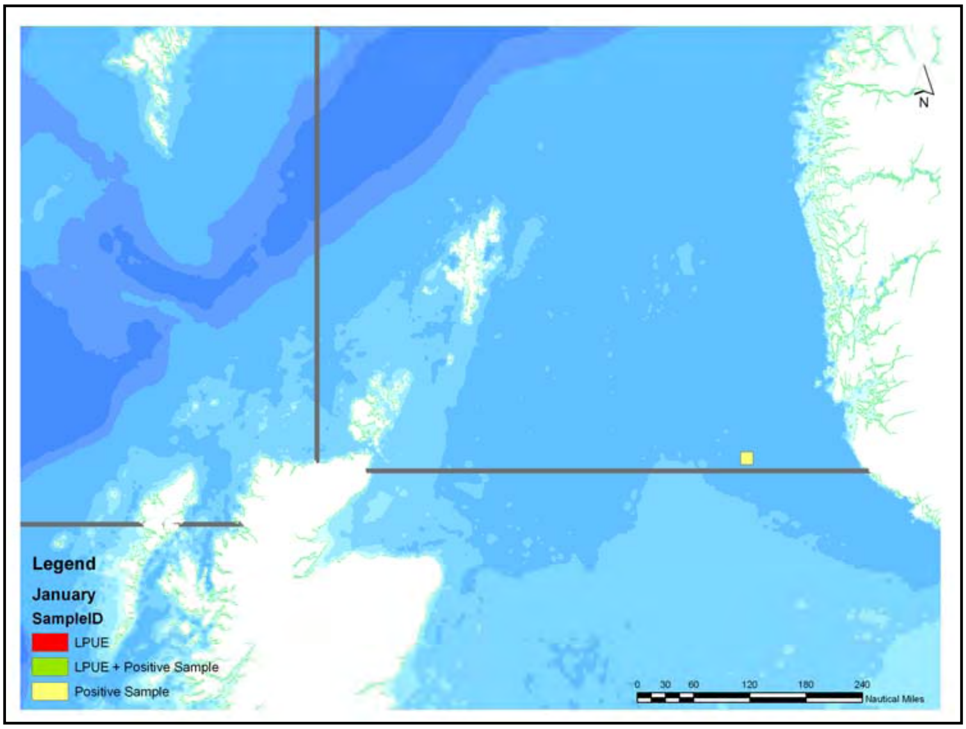
A reminder of some of the different expressions used to describe discards.

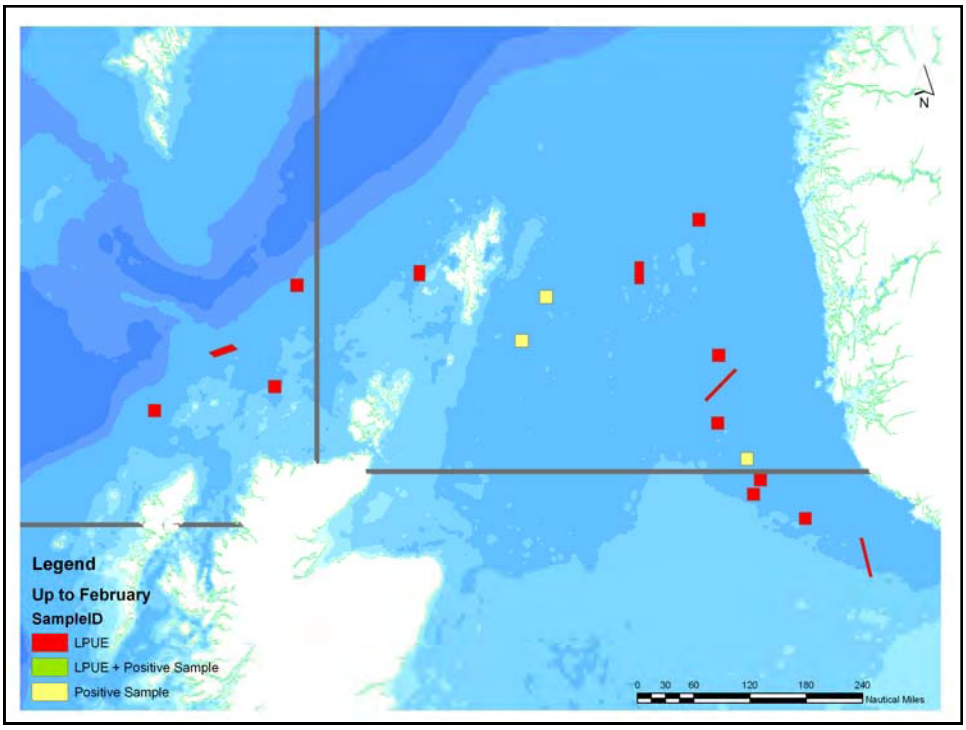


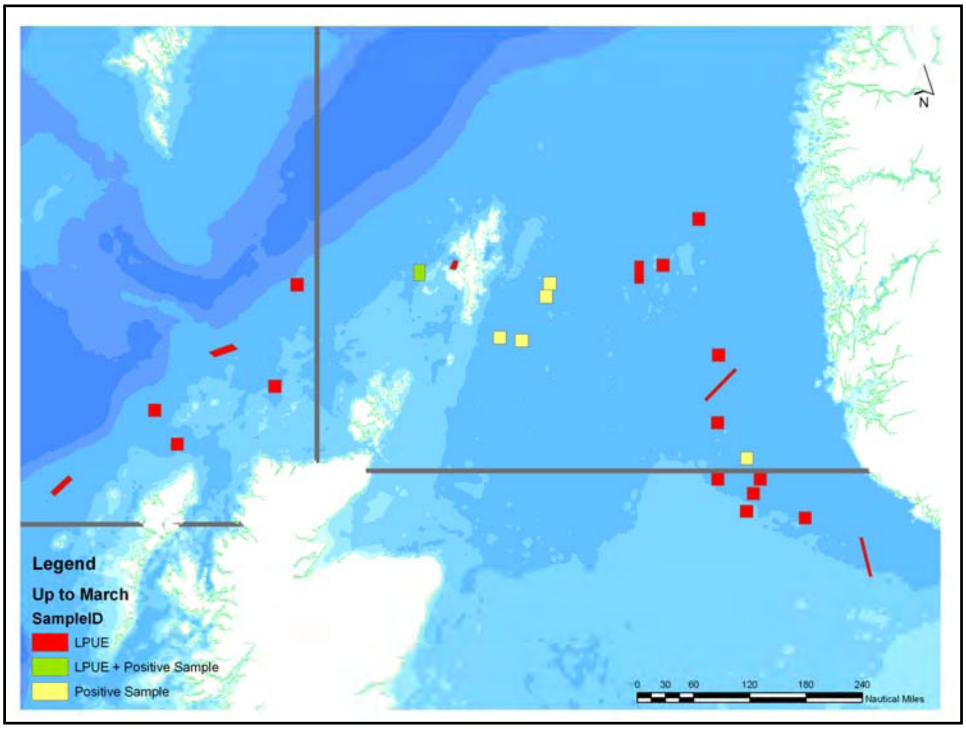
Year to Year

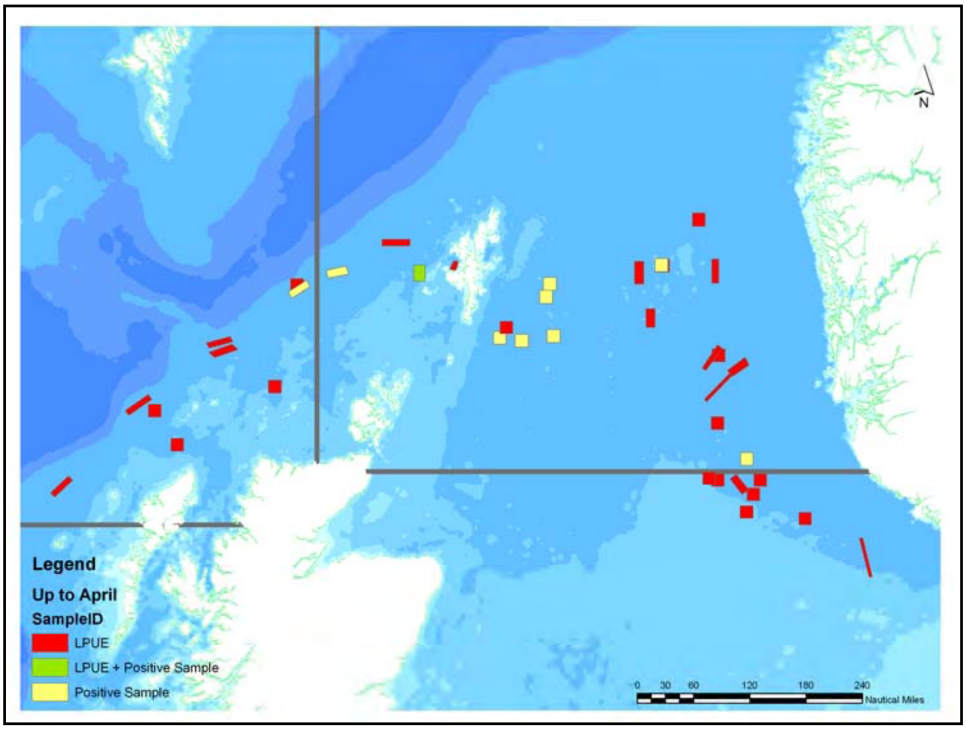
- It's a Linear Programming Problem so will favour corner solutions
- In complex mixed fisheries such solutions are not available
- Need to resolve the interaction and regulatory requirements to allow for both corner and central activities to thrive




N
Legend
January
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles


N
Legend
Up to February
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles


Legend
Up to March
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles
N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Up to April
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
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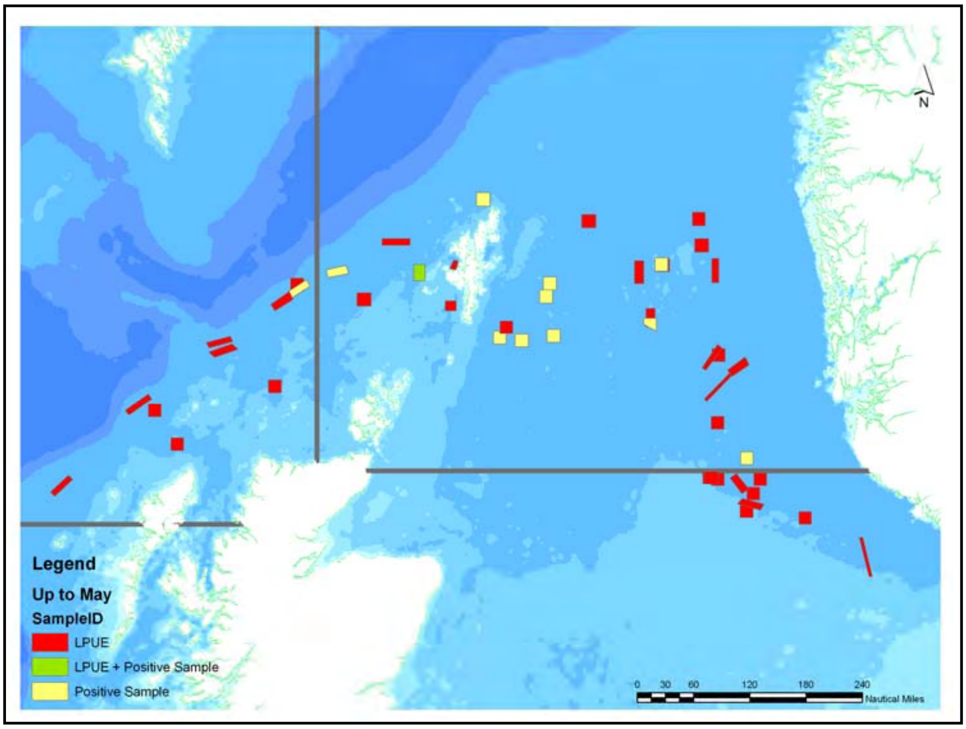
Nautical Miles
N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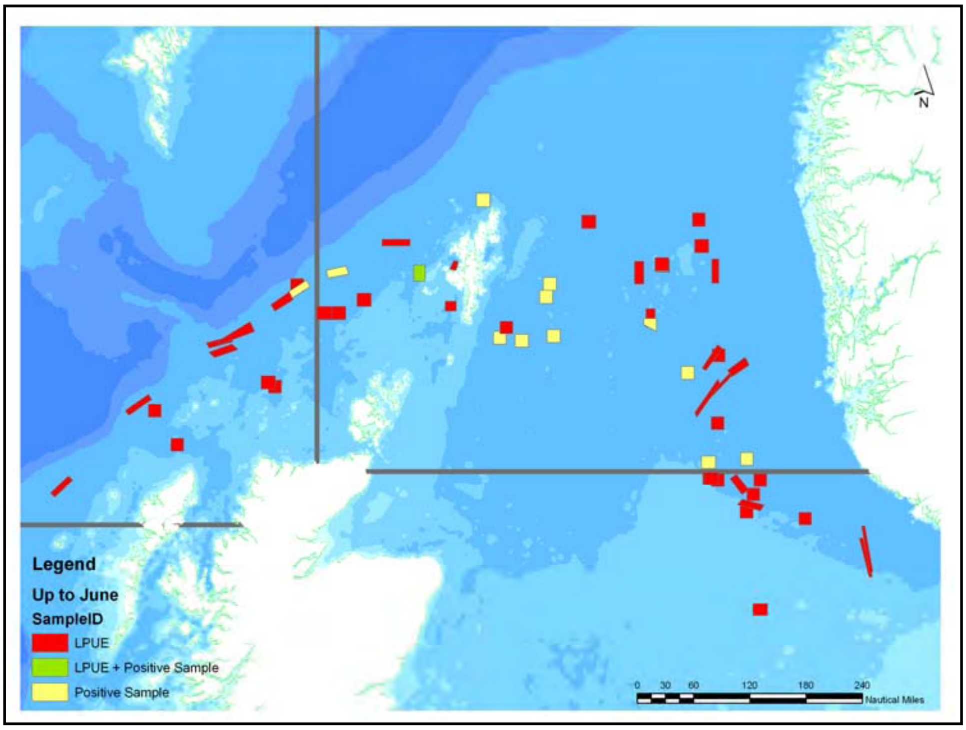
Up to May
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles
N


Legend
Up to June
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
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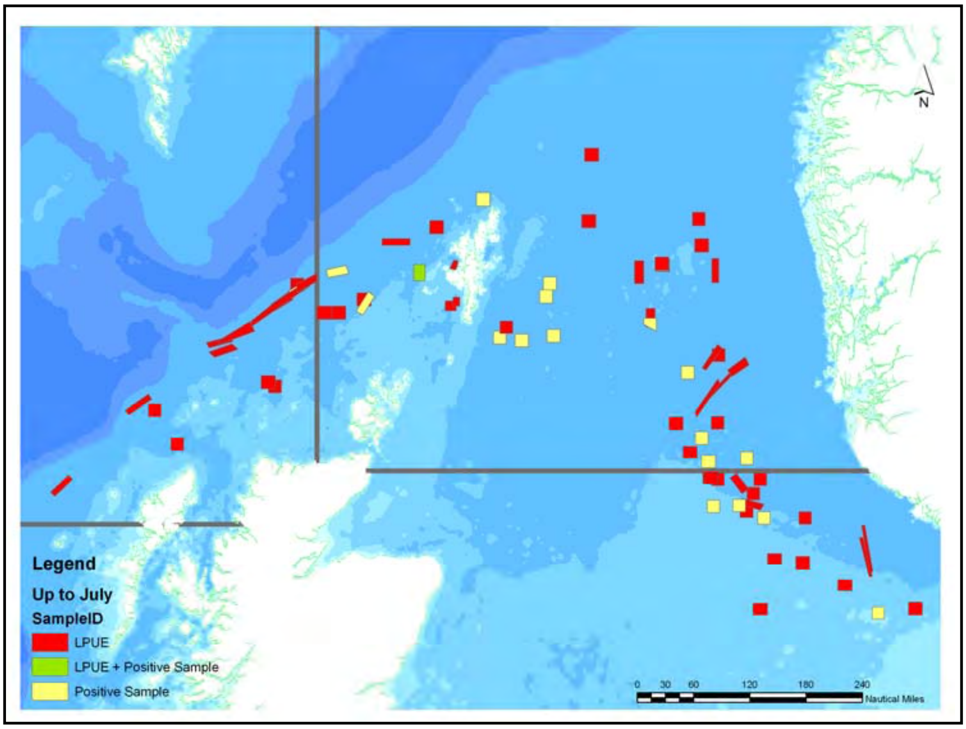
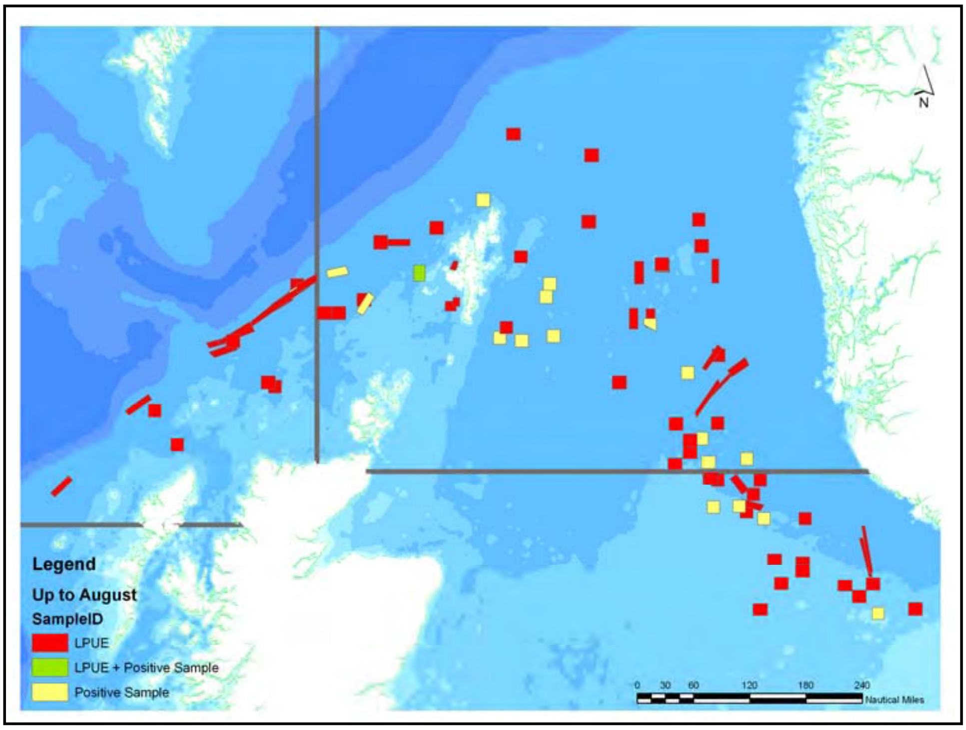
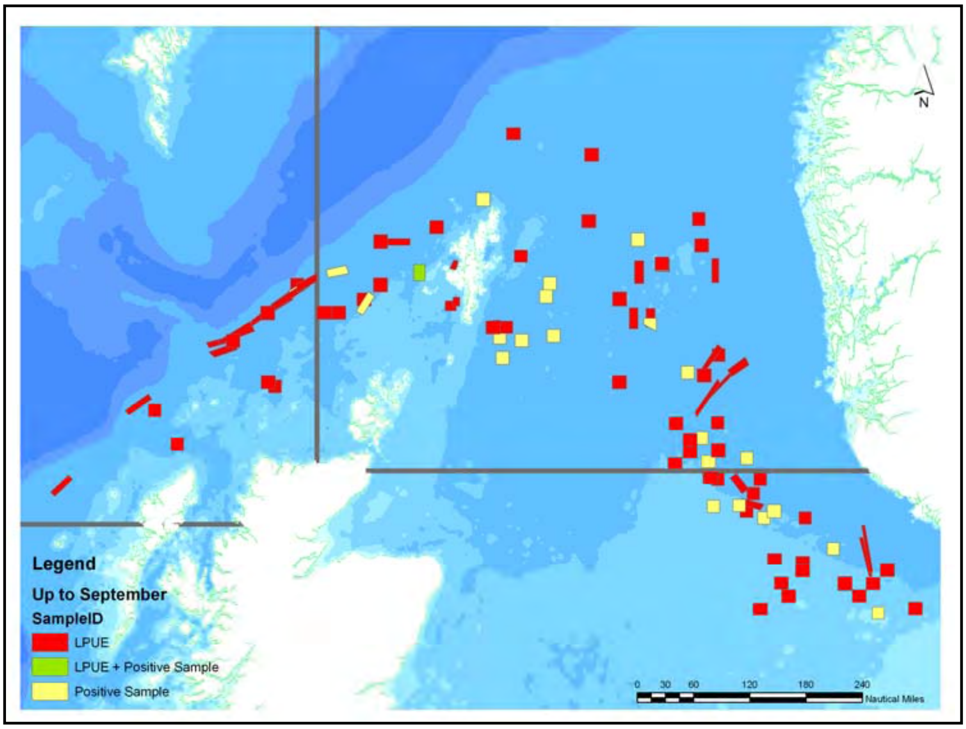
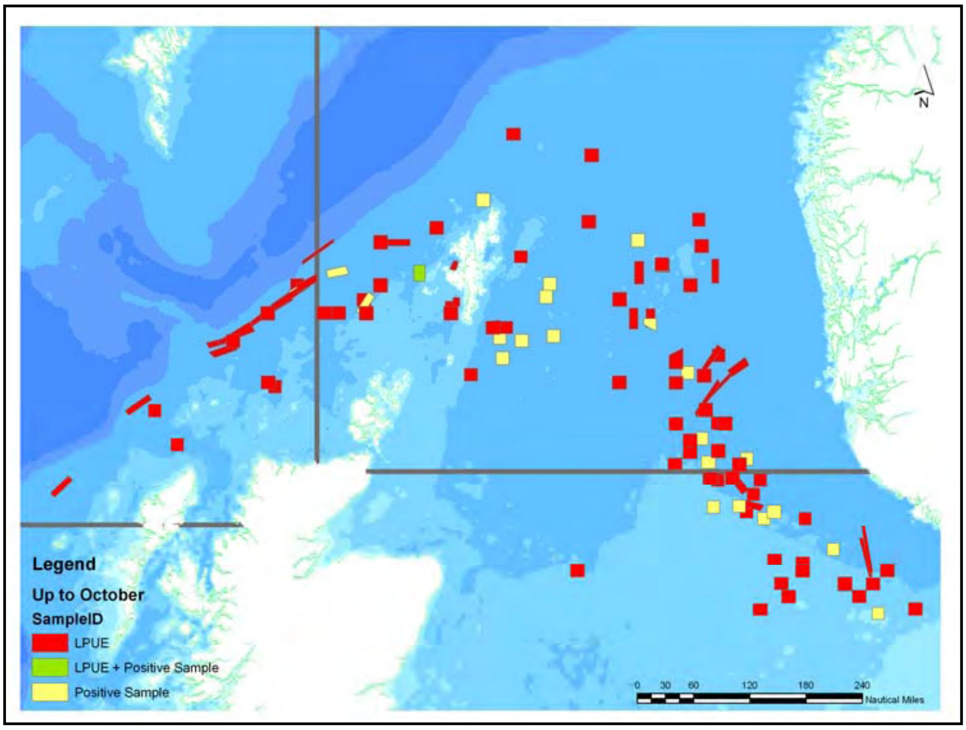
Nautical Miles
N


Legend
Up to July
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles
N


Legend
Up to August
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles
N


Legend
Up to September
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles
N


Legend
Up to October
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
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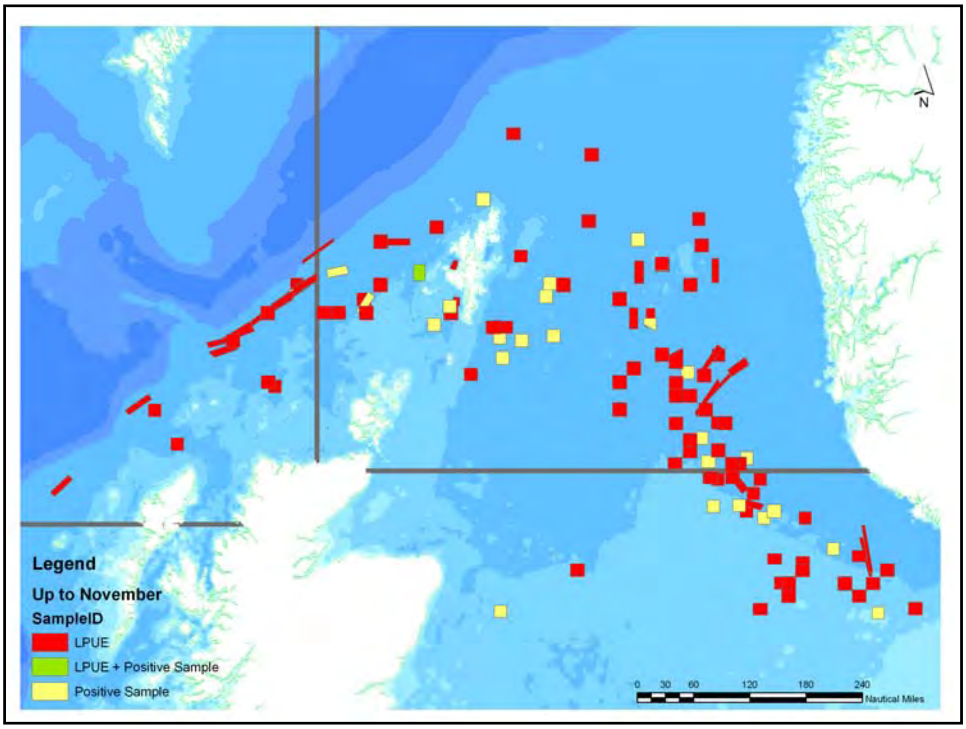
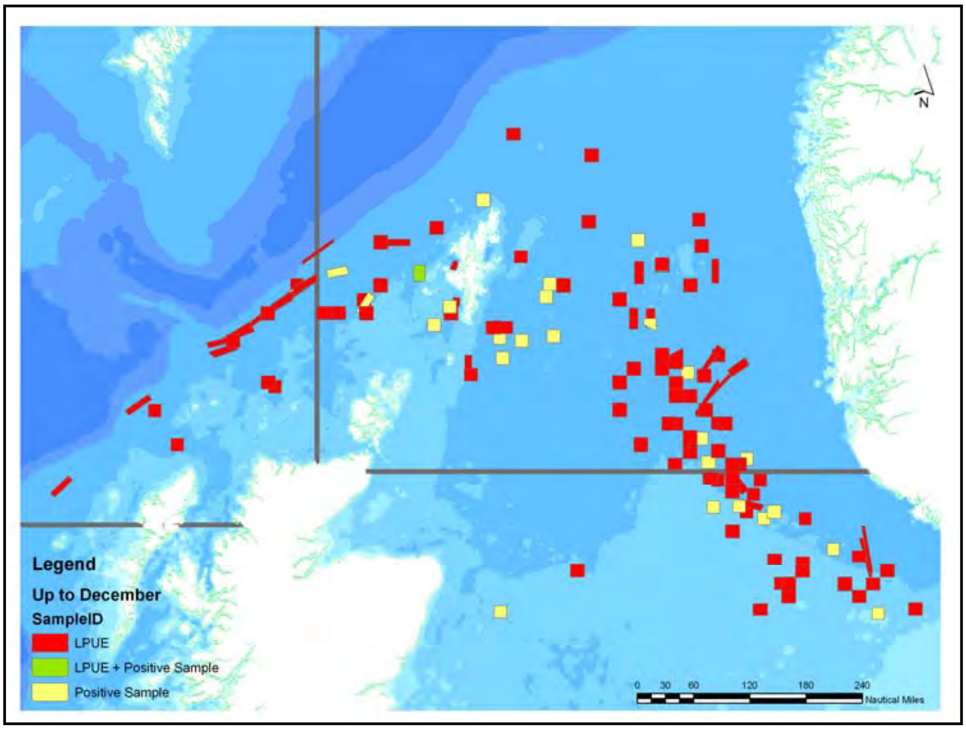
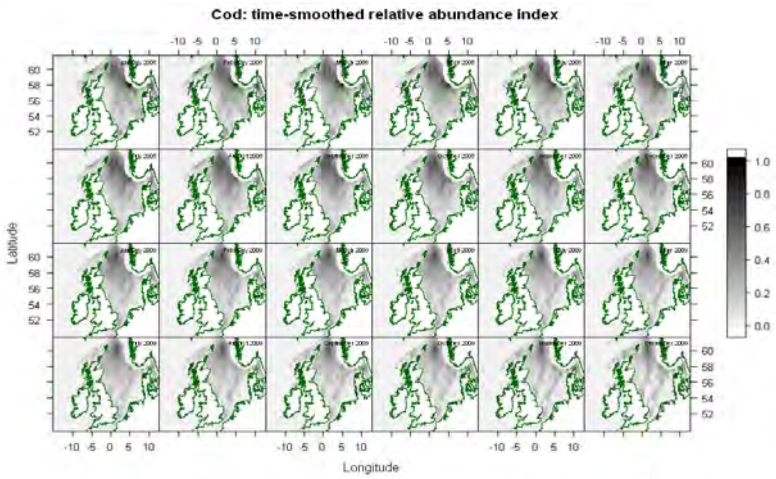
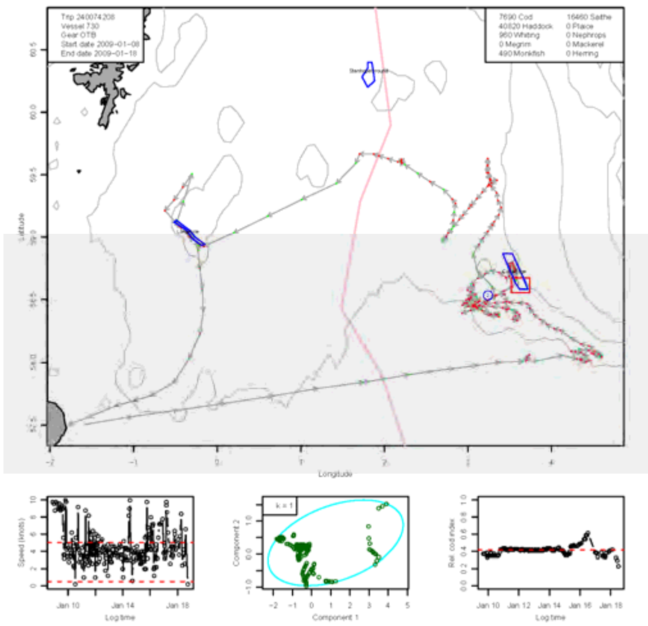
Nautical Miles
N

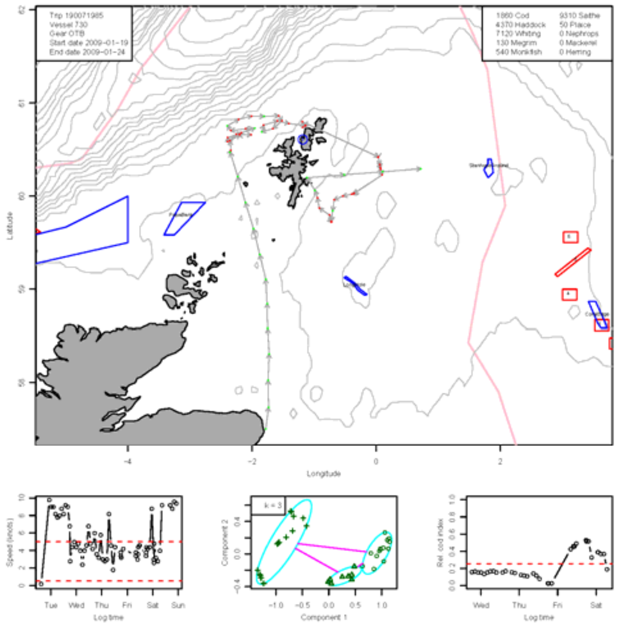

N
Legend
Up to November
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles


N
Legend
Up to December
SampleID
LPUE
LPUE + Positive Sample
Positive Sample
0 30 60 120 180 240
Nautical Miles

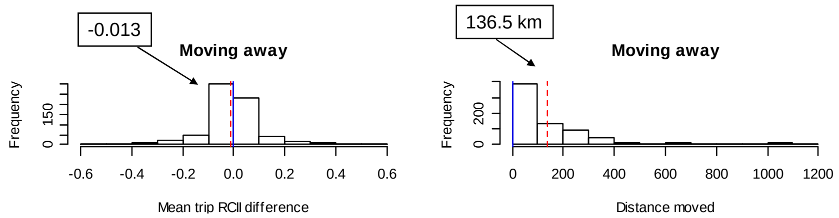
RTC work


Cod: time-smoothed relative abundance index
Latitude
Longitude
-10 -5 0 5 10
60 58 56 54 52
1.0 0.8 0.6 0.4 0.2 0.0

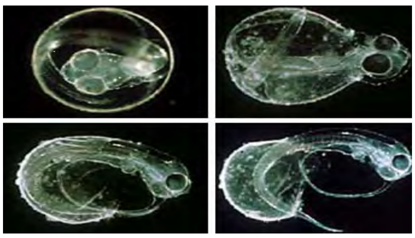

Trip 240074208
Vessel 730
Gear OTB
Start date 2009-01-08
End date 2009-01-18
7690 Cod
40820 Haddock
960 Whiting
0 Megrim
490 Monkfish
16460 Saithe
0 Plaice
0 Nephrops
0 Mackerel
0 Herring
Longitude
Log time
Component 1
Component 2
k = 1



run	vessel	trip	rtc	cl1	clcod%1	rcii1	clrcii1	cl2	clcod%2	rcii2	clrcii2	drcii	dclrcii	dcod%	dist
3	730	240074208	before	1	13.9	0.412	0.308	1	13.9	0.253	0.308	-0.159	0	0	339.20608



The Science / Research Conundrum



	01	02	03	04	05	06	07	08	09	10
1	10000									
2		3677								
3			1353							
4				499						
5					183					
6						67				
7							25			
8								9		
9									3	
10										1

Importance of the Trial For Science

- Potential : Additional data gathering platforms.
- Potential: Scientific stock assessment on landing verification, where all catch retained.
- Potential: Assessment of catch and discard rates of other species and composition issues.
- Potential: Resource boost increasing observed data functions, limited by how many observers you can actually have at sea.
- Potential: At high confidence levels to consider in year adjustments.
- Potential: To deliver to the scientific community enhanced confidence levels in the available data.

Like VMS it is hard to predict others until you have extensive experience BUT…


C3 090905 230416 Fruitful Bough 5859.069 00031.244


C3 090905 230542 Fruitful Bough 5859.027 00031.313

Quote

“Both the SG and Industry are acutely aware of the challenges in making a catch quota system work….. However it is a learning opportunity for all that is too good to ignore.”

Richard Lochhead
Cabinet Secretary

Appendix 5

Fisheries and Oceans Canada   Pêches et Océans Canada

Fully documenting the commercial groundfish fisheries in BC Canada

Presentation to:

Workshop on the Fully Documented Fishery

Denmark Technical University

National Institute of Aquatic Resources

March 9-10, Copenhagen, Denmark.

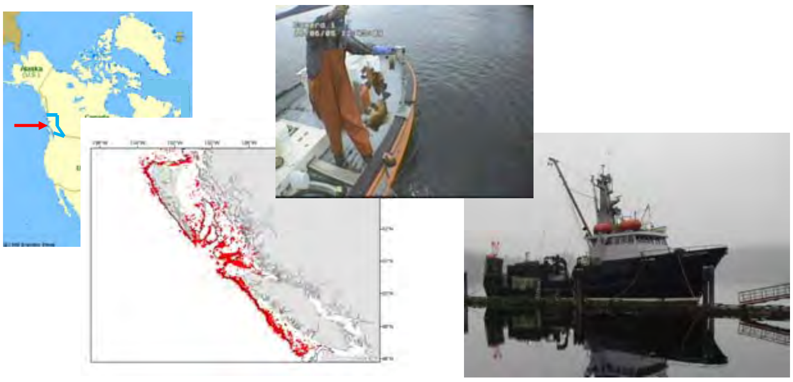
Rick Stanley

Fisheries and Oceans Canada

Canada

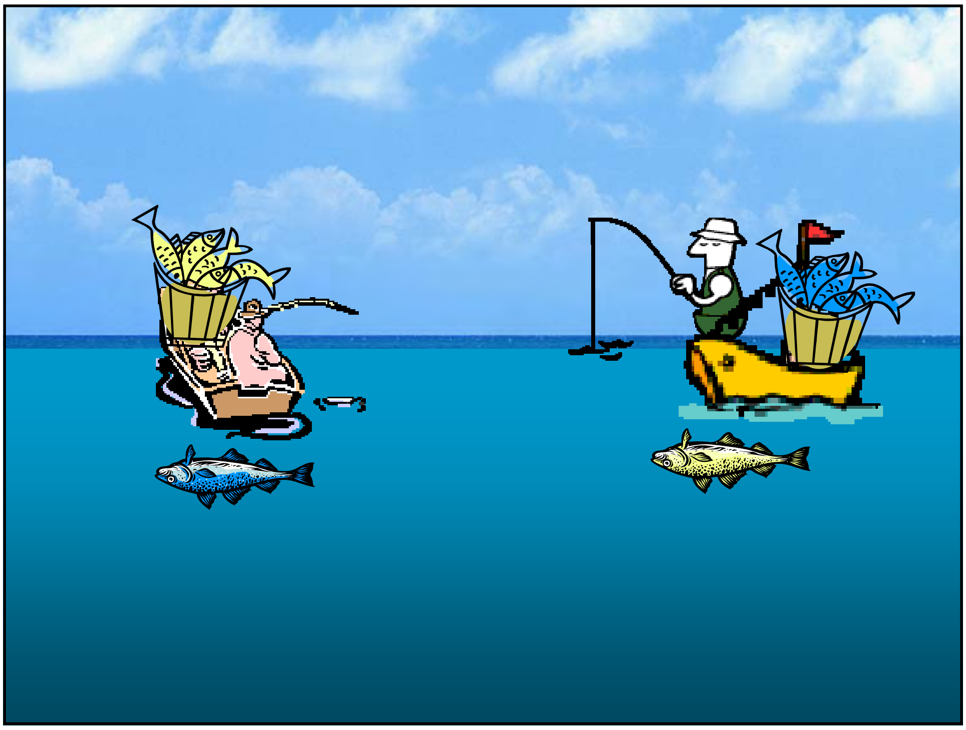
Fisheries and Oceans Canada   Pêches et Océans Canada

BC Groundfish Hook-and-line Catch Monitoring Program (GHLCMP)



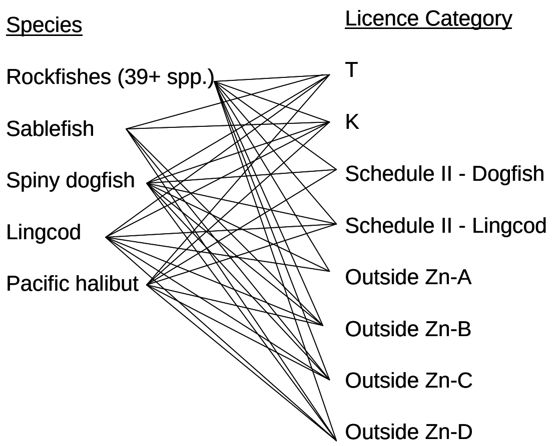
1

Canada



Fisheries and Oceans Canada Pêches et Océans Canada

Prior to 2006



Canada

Fisheries and Oceans Canada Pêches et Océans Canada

Today's Presentation

EM in the GHLCMP and how we "audit" 10% of the video to **verify Fisher Logs**, rather than use EM to **estimate catch**

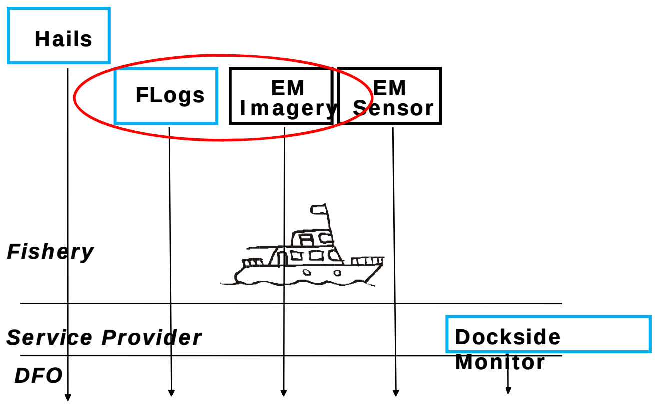
- ??? When we compare **Fisher Logs** against **EM**… how do you decide good or bad
- How useful are the improved catch data. (Hook and line, and trawl)

1

Canada

Fisheries and Oceans Canada Pêches et Océans Canada

The **GHLCMP** has 5 data streams



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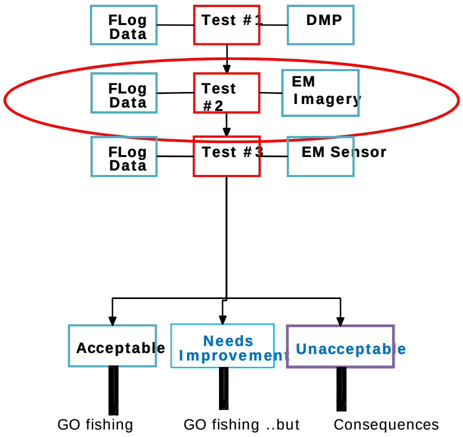
We conduct a series of comparisons



Canada

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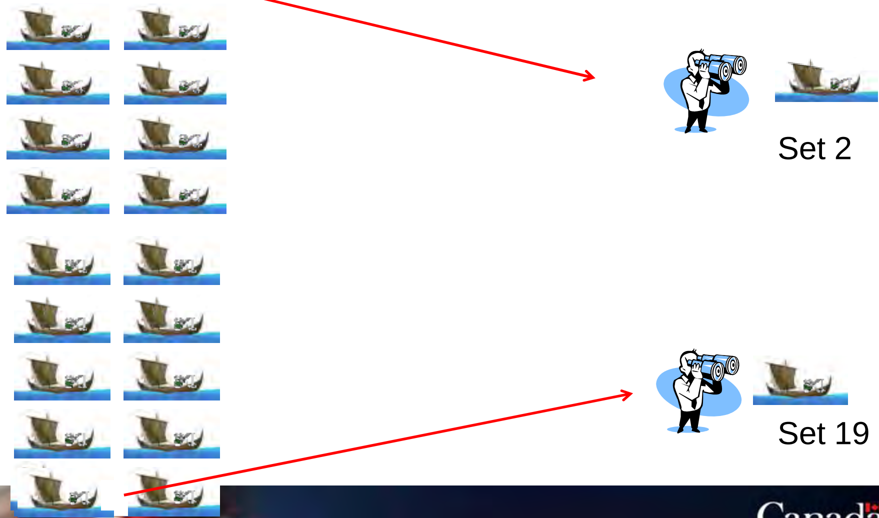
The *Sea Stallion* conducts 20 fishing sets

Canada

The *Sea Stallion's FLogs*

Set		Kept	Released
1	Rockfish	45	1
	Halibut	65	6
	Sablefish	0	14
2	Rockfish	50	0
	Halibut	8	2
	Sablefish	0	1
3	Rockfish	54	3
	Halibut	102	56
	Sablefish	0	10
...20	Rockfish	22	1
	Halibut	32	6
	Sablefish	0	10

The Audit (10% reviewed)



Fisheries and Oceans Canada | Pêches et Océans Canada

FLog vs EM comparison

Set 2

	FLog Kept	Video Kept	FLog Released	Video Released
Rockfish	50	49	0	0
Halibut	8	10	2	2
Sablefish	0	0	1	22

Set 19

	FLog Kept	Video Kept	FLog Released	Video Released
Rockfish	20	20	0	0
Halibut	0	0	10	11
Sablefish	0	0	15	50

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Scoring Method

Difference (EM – FLog)	Difference (EM – FLog/EM)	Score
<30 pieces	*≥ 30 pieces*	
0-1 Piece	0-4*%	10
2-3 pieces	5-10 %	9
4-6 Pieces	10-20%	8
7-12 Pieces	20-30%	7
13-15 Pieces	30-40%	5
14-18 Pieces	40-50%	3
19-30 Pieces	> 50%	0

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Sea Stallion

Set 2

	Flog Kept	Video Kept	Score Kept	Flog Released	Video Released	Score Released
Rockfish	50	49	=10	0	0	na
Halibut	8	10	=9	2	2	=10
Sablefish	0	0	na	1	22	=0

Set 19

	Flog Kept	Video Kept	Score Kept	Flog Released	Video Released	Score Released
Rockfish	20	20	=10	0	0	na
Halibut	0	0	na	10	11	=10
Sablefish	0	0	na	15	50	0

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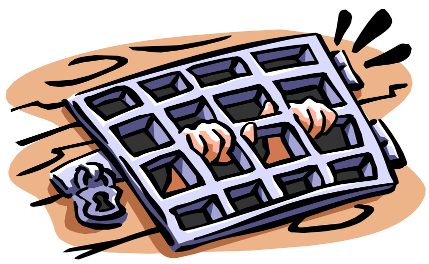
Fisheries and Oceans Canada Pêches et Océans Canada

However.....were there consequences?

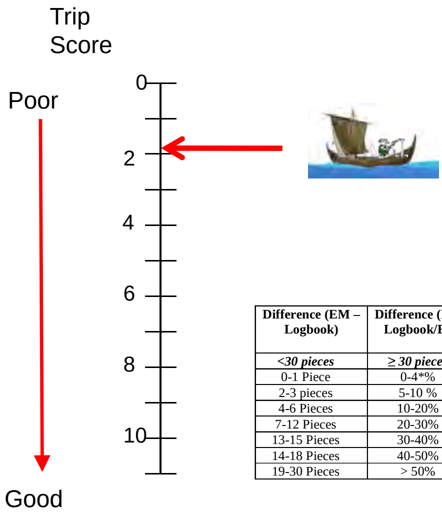
Consequences =
-Take an observer $$
-100% video review $$



Canada

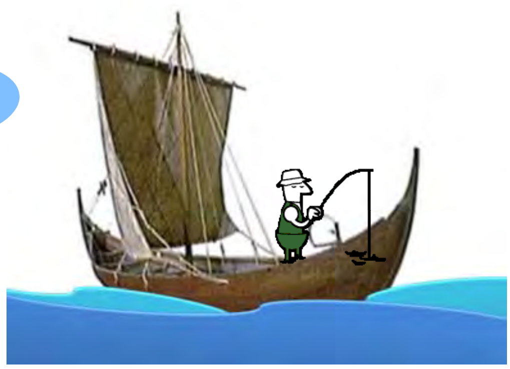
Year 1

Sea Stallion: “No fair to punish me, the system is new, and besides the scoring is too difficult to satisfy”.



Difference (EM – Logbook)	Difference (EM – Logbook/EM)	Score
<30 pieces	*≥ 30 pieces*	
0-1 Piece	0-4*%	10
2-3 pieces	5-10 %	9
4-6 Pieces	10-20%	8
7-12 Pieces	20-30%	**7**
13-15 Pieces	30-40%	**5**
14-18 Pieces	40-50%	**3**
19-30 Pieces	> 50%	**0**

Year 1 No consequences



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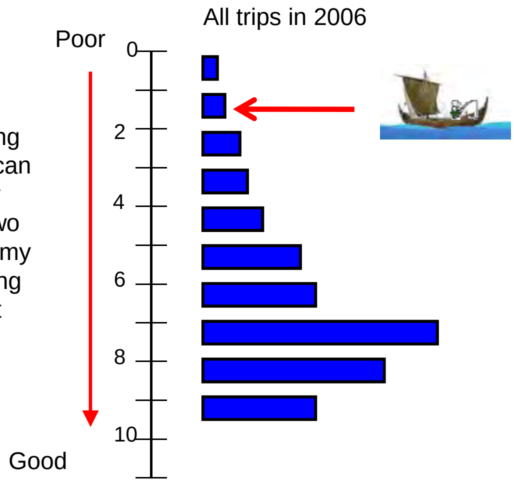
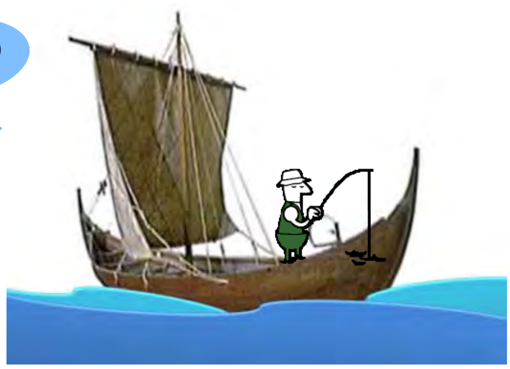
Year 2

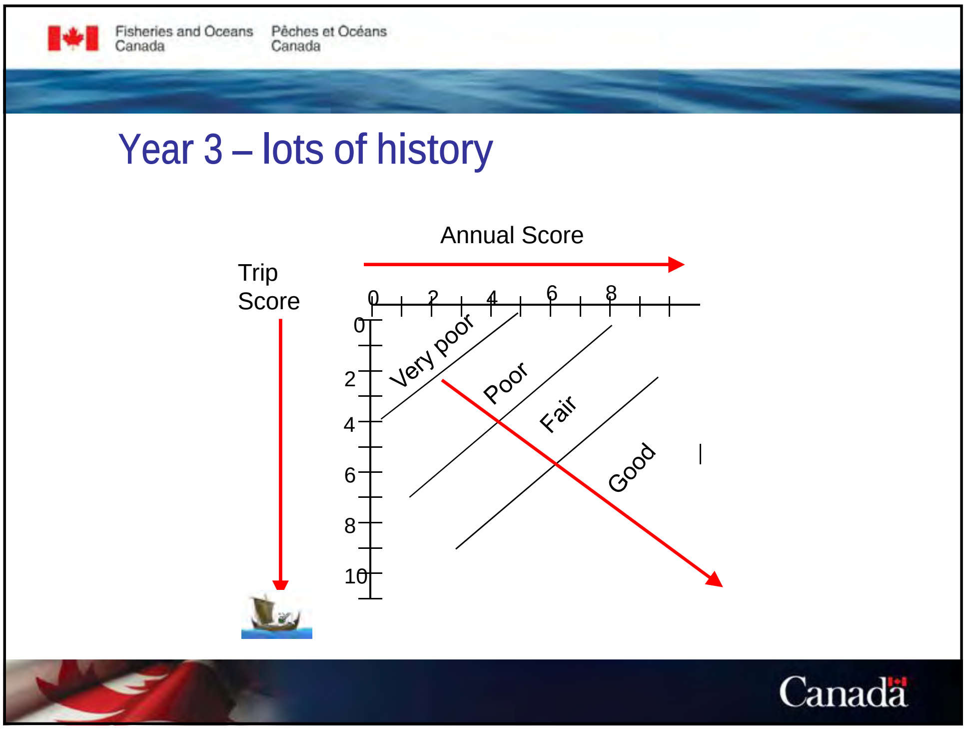
Sea Stallion: “Ok, the scoring may be fair and most trips can pass but you cannot fail my logbook this time. Those two sets you chose were when my 14-year old son was counting the fish. They were his first sets”.

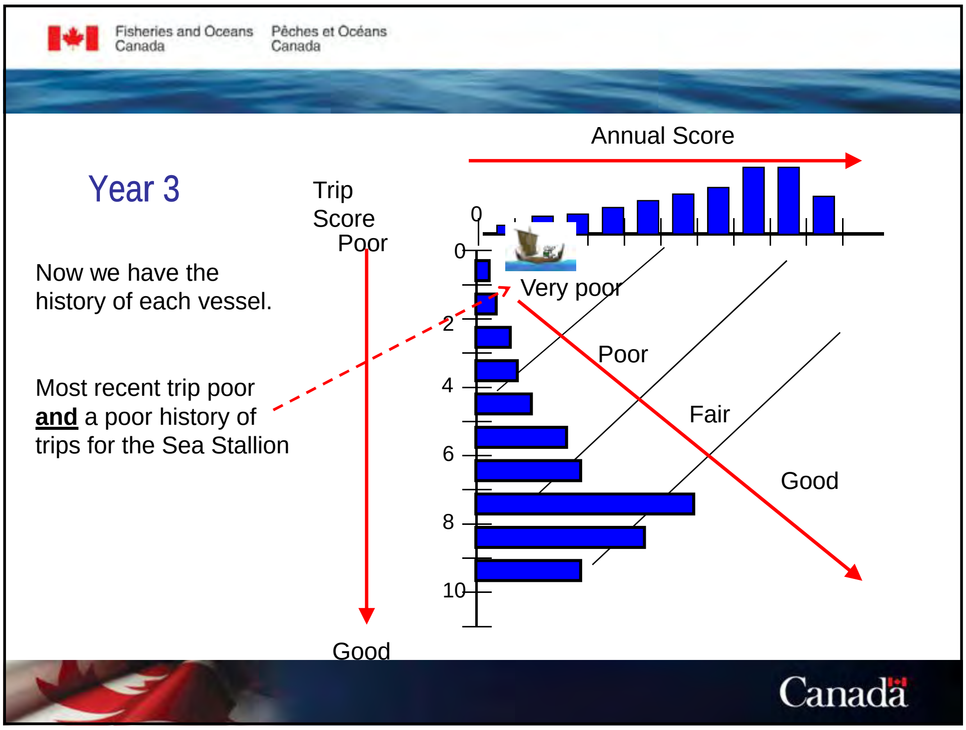


Fisheries and Oceans Canada Pêches et Océans Canada

Year 2 No consequences




Fisheries and Oceans Canada
Pêches et Océans Canada
Year 3 – lots of history
Annual Score
Trip Score
0 2 4 6 8
0
2
4
6
8
10
Very poor
Poor
Fair
Good
Canada


Fisheries and Oceans Canada
Pêches et Océans Canada
Year 3
Now we have the history of each vessel.
Most recent trip poor and a poor history of trips for the Sea Stallion
Annual Score
Trip Score
Poor
Good
0
0
2
4
6
8
10
Very poor
Poor
Fair
Good
Canada

Fisheries and Oceans Canada | Pêches et Océans Canada

Distribution of Trips by Annual Score and Trip Score Distribution

Trip Scores	Annual Scores 0 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 -10	Total	Percent
0 - 1	0	1	0	2	3	4	5	7	4	1	27	1.8%
1 - 2	0	0	0	2	2	6	5	2	2	1	20	1.3%
2 - 3	0	1	0	1	5	2	6	4	9	0	28	1.8%
3 - 4	0	0	1	2	5	3	4	7	9	2	33	2.2%
4 - 5	0	0	0	2	5	6	6	6	5	3	33	2.2%
5 - 6	0	0	2	2	5	7	14	16	13	6	65	4.3%
6 - 7	0	0	1	0	6	7	14	24	32	8	92	6.0%
7 - 8	0	0	1	4	8	20	25	51	78	26	213	13.9%
8 - 9	0	1	2	5	15	18	39	88	264	16[illegible]	595	39.0%
9 -10	0	1	0	1	3	3	24	47	179	163	421	27.6%
Total	0	4	7	21	57	76	142	252	595	373	1,527	100.0%
	0.0%	0.3%	0.5%	1.4%	3.7%	5.0%	9.3%	16.5%	39.0%	24.4%	100.0%	

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Year 3 There were consequences and "the word" spread

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Value of catch data from a fully documented fishery

- Science/Research ←
- Management
- Enforcement
- Industry

Canada

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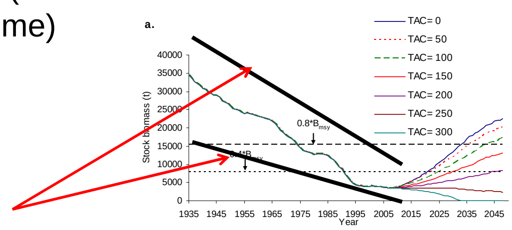
Value of catch data from a fully documented fishery

- Science/Research
  - Stock assessment (total catch for the first time)



Uncertainty partially due to unknown discarding

Bocaccio

Canada

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Value of catch data from a fully documented fishery

- Science/Research
  - Stock assessment (total catch for the first time)
  - Catch of non-directed species

Birds counted during 10% review in 2008

Species	Piece Count
Albatross (sp?)	4
Black-Footed Albatross	2
Black-Legged Kittiwake	1
Gulls (sp?)	11
Unknown Bird	19
Total	**37**

If 37 birds in 10% of the events, then ~370 birds

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Value of catch data from a fully documented fishery

With this information can inform planning for mitigation, such as
- Estimates of magnitude and a metric for tracking catch rates over time
-Hotspots in time/space

Birds counted during 10% review in 2008

Species	Piece Count
Albatross (sp?)	4
Black-Footed Albatross	2
Black-Legged Kittiwake	1
Gulls (sp?)	11
Unknown Bird	19
Total	**37**

If 37 birds in 10% of the events, then ~370 birds

Canada

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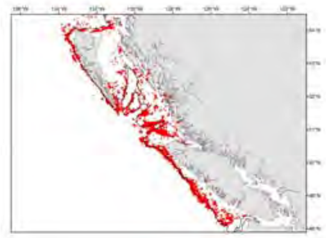
Value of catch data from a fully documented fishery

- Science/Research
  - Stock assessment (total catch for the first time)
  - Catch of non-directed species
  - Distribution (changing distribution is a "poor-man's" stock assessment)



Catch locations of Boccaccio from 100% trawl and HL coverage

Canada

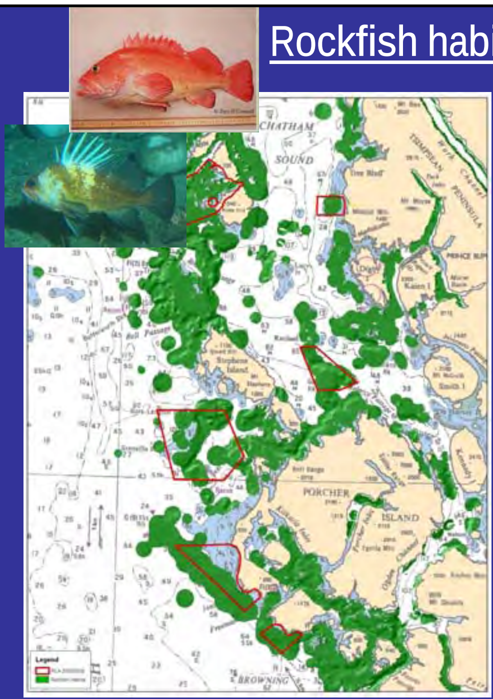
Fisheries and Oceans Canada Pêches et Océans Canada

Value of catch data from a fully documented fishery

- Science/Research
  - Stock assessment (total catch for the first time)
  - Catch of non-directed species
  - Distribution
  - Using fishery data to enhance survey design

Canada

Rockfish habitat model



Fisher log CPUE
density analysis

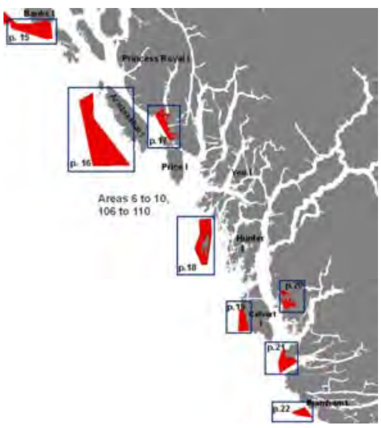
Change in slope
bathymetry analysis

Fishing ground CPUE + complex bottom

Rockfish “habitat”

Fisheries and Oceans Canada / Pêches et Océans Canada

Marine Protected Areas



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Fisheries and Oceans Canada / Pêches et Océans Canada

Value of catch data from a fully documented fishery

- Science/Research
- Management ←
- Enforcement
- Industry

Canada

Fisheries and Oceans Canada / Pêches et Océans Canada

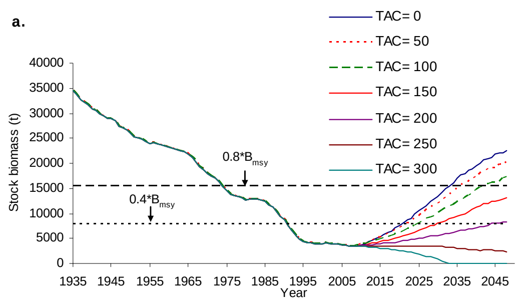
Value of catch data from a fully documented fishery

- Management
  - Quota management "questionable" without total catch
  - Are recovery plans for **Threatened and Endangered** species possible without accurate catch?

Canada

Fisheries and Oceans Canada | Pêches et Océans Canada

Value of catch data from a fully documented fishery



Bocaccio

Can you defend a recovery plan that allows a catch of <200 t, if catch is not monitored?

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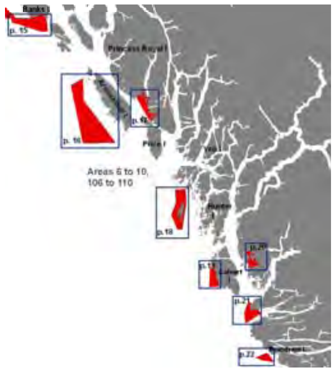
Value of catch data from a fully documented fishery

- Management
  - Quota management “questionable” without total catch
  - Are recovery plans for Threatened and endangered species possible without catch?
  - Pressure on other fisheries for better monitoring
    - Such as: Sport fishing …. Aboriginal …… Salmon troll
    - If these sectors wish to purchase quota, how is this possible if their catches are not monitored?

Canada

Value of catch data from a fully documented fishery

- Science/Research
- Management
- Enforcement
- Industry



are Marine Conservation Areas possible with EM? Canada cannot afford frequent patrols to remote areas.

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Value of catch data from a fully documented fishery

- Science/Research
- Management
- Enforcement
- Industry

Canada

Fisheries and Oceans Canada | Pêches et Océans Canada

Value of catch data from a fully documented fishery

- Industry
  - Better catch monitoring and IVQs allows all fishermen the opportunity to retain valuable fish (5€/kg)
  - MSC or ECO certification difficult to obtain without defensible catch monitoring

Canada

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Fully Documented fisheries not cheap or perfect

- This talk focussed on benefits of better catch monitoring, but not implying it is easy or cheap
- $$$ for monitoring
- $$ for costly/complex information management system
- EM works less well for similar species (small skates, rockfish, birds)
- etc.

Canada

Fisheries and Oceans Canada
Pêches et Océans Canada

Canada

DTU Aqua-rapportindex

Denne liste dækker rapporter udgivet i indeværende år samt de foregående to kalenderår. Hele listen kan ses på DTU Aquas hjemmeside www.aqua.dtu.dk, hvor rapporterne findes som pdf-filer.

Nr. 177-08 Implementering af mere selektive og skånsomme fiskerier – konklusioner, anbefalinger og perspektivering. J. Rasmus Nielsen, Svend Erik Andersen, Søren Eliasen, Hans Frost, Ole Jørgensen, Carsten Krog, Lone Grønbæk Kronbak, Christoph Mathiesen, Sten Munch-Petersen, Sten Sverdrup-Jensen og Niels Vestergaard.

Nr. 178-08 Økosystemmodel for Ringkøbing Fjord - skarvbestandens påvirkning af fiskebestandene. Anne Johanne Dalsgaard, Villy Christensen, Hanne Nicolajsen, Anders Koed, Josianne Støttrup, Jane Grooss, Thomas Bregnballe, Henrik Løkke Sørensen, Jens Tang Christensen og Rasmus Nielsen.

Nr. 179-08 Undersøgelse af sammenhængen mellem udviklingen af skarvkolonien ved Toftesø og forekomsten af fladfiskeyngel i Ålborg Bugt. Else Nielsen, Josianne Støttrup, Hanne Nicolajsen og Thomas Bregnballe.

Nr. 180-08 Kunstig reproduktion af ål: ROE II og IIB. Jonna Tomkiewicz og Henrik Jarlbæk.

Nr. 181-08 Blåmuslinge- og stillehavsøstersbestandene i det danske Vadehav 2007. Per Sand Kristensen og Niels Jørgen Pihl.

Nr. 182-08 Kongeåens Dambrug – et modeldambrug under forsøgsordningen. Statusrapport for 2. måleår af moniteringsprojektet med væsentlige resultater fra 1. måleår. Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen, Jens Skriver, Søren Erik Larsen, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen og Anne Johanne Tang Dalsgaard.

Nr. 183-08 Taskekrabben – Biologi, fiskeri, afsætning og forvaltningsplan. Claus Stenberg, Per Dolmer, Carsten Krog, Siz Madsen, Lars Nannerup, Maja Wall og Kerstin Geitner.

Nr. 184-08 Tvilho Dambrug – et modeldambrug under forsøgsordningen. Statusrapport for 2. måleår af moniteringsprojektet med væsentlige resultater fra 1. måleår. Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen, Jens Skriver, Søren Erik Larsen, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen og Anne Johanne Tang Dalsgaard.

Nr. 185-08 Erfaringsopsamling for muslingeopdræt i Danmark. Helle Torp Christensen, Per Dolmer, Hamish Stewart, Jan Bangsholt, Thomas Olesen og Sisse Redeker.

Nr. 186-08 Smoltudvandring fra Storå 2007 samt smoltdødelighed under udvandringen gennem Felsted Kog og Nissum Fjord. Henrik Baktoft og Anders Koed.

Nr. 187-08 Tingkærvad Dambrug - et modeldambrug under forsøgsordningen. Statusrapport for 2. måleår af moniteringsprojektet med væsentlige resultater fra første måleår. Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen, Jens Skriver, Søren Erik Larsen, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen og Anne Johanne Tang Dalsgaard.

Nr. 188-08 Ejstrupholm Dambrug - et modeldambrug under forsøgsordningen. Statusrapport for 2. måleår af moniteringsprojektet med væsentlige resultater fra første måleår. Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen, Jens Skriver, Søren Erik Larsen, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen og Anne Johanne Tang Dalsgaard.

Nr. 189-08 The production of Baltic cod larvae for restocking in the eastern Baltic. RESTOCK I. 2005-2007. Josianne G. Støttrup, Julia L. Overton, Sune R. Sørensen (eds.)

Nr. 190-08 User's manual for the excel application "TEMAS" or "Evaluation Frame". Per J. Sparre.

Nr. 191-08 Evaluation Frame for Comparison of Alternative Management Regimes using MPA and Closed Seasons applied to Baltic Cod. Per J. Sparre.

Nr. 192-08 Assessment of Ecosystem Goods and Services provided by the Coastal Zone System Limfjord. Anita Wiethücther.

Nr. 193-08 Modeldambrug under forsøgsordningen. Faglig slutrapport for "Måle- og dokumentationsprojekt for modeldambrug". Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen,Jens Skriver, Søren Erik Larsen, Susanne Bouttrup, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen, Anne Johanne Tang Dalsgaard og Karin Suhr.

Nr. 194-08 Omsætning af ammonium-kvælstof i biofiltre på Modeldambrug. Karin Isabel Suhr, Per Bovbjerg Pedersen, Lars M. Svendsen, Kaare Michelsen og Lisbeth Jess Plesner.

Nr. 195-08 Fangst, opbevaring og transport af levende danske jomfruhummere (*Nephrops norvegicus*). Preben Kristensen og Henrik S. Lund.

Nr. 196-08 Udsætning af geddeyngel som bestandsophjælpning i danske brakvandsområder – effektvurdering og perspektivering. Lene Jacobsen, Christian Skov, Søren Berg, Anders Koed og Peter Foged Larsen.

Nr. 197-08 Manual to determine gonadal maturity of herring (*Clupea harengus* L) Rikke Hagstrøm Bucholtz, Jonna Tomkiewicz og Jørgen Dalskov.

Nr. 198-08 Can alerting sounds reduce bycatch of harbour porpoise? Lotte Kindt-Larsen.

Nr. 199-08 Udvikling af produktionsmetoder til intensivt opdræt af sandartyngel. Svend Steenfeldt og Ivar Lund.

Nr. 200-08 Opdræt af tunge (*Solea solea*) - undersøgelse af mulighederne for kommercialisering. Per Bovbjerg Pedersen, Ivar Lund, Svend Jørgen Steenfeldt, Julia Lynne Overton og Mads Nunn.

Nr. 201-08 Produktion af vandlopper til anvendelse ved opdræt af marin fiskeyngel. Svend Steenfeldt.

Nr. 202-09 Vurdering af markedsudsigter for akvakulturproduktion i Danmark. Erling P. Larsen, Jens Henrik Møller, Max Nielsen og Lars Ravensbeck.

Nr. 203-09 Løjstrup Dambrug (øst) - et modeldambrug under forsøgsordningen. Statusrapport for 2. måleår af moniteringsprojektet med væsentlige resultater fra første måleår. Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen, Jens Skriver, Søren Erik Larsen, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen og Anne Johanne Tang Dalsgaard.

Nr. 204-09 Final Report of Fully Documented Fishery. Jørgen Dalskov and Lotte Kindt-Larsen.

Nr. 205-09 Registrering af fangster i de danske kystområder med standardredskaber fra 2005-2007. Nøglefiskerrapporten 2005-2007. Claus R. Sparrevohn, Hanne Nicolajsen, Louise Kristensen og Josianne G. Støttrup.

Nr. 206-09 Abildtrup Dambrug - et modeldambrug under forsøgsordningen. Statusrapport for 2. måleår af moniteringsprojektet med væsentlige resultater fra første måleår. Lars M. Svendsen, Ole Sortkjær, Niels Bering Ovesen, Jens Skriver, Søren Erik Larsen, Per Bovbjerg Pedersen, Richard Skøtt Rasmussen og Anne Johanne Tang Dalsgaard.

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Nr. 217-10 Åle- og torskefangst ved rekreativt fiskeri i Danmark. Undersøgelsesdesign og fangster i 2009. Claus R. Sparrevohn og Marie Storr-Paulsen.

Nr. 217-10 **(English version)** Eel and cod catches in Danish recreational fishing. Survey design and 2009 catches. Claus R. Sparrevohn and Marie Storr-Paulsen.

Nr. 218-10 Undersøgelse af miljøvenlige dambrugshjælpestoffer til erstatning for formalin. Bedre styring og driftspraksis ved implementering af miljøvenlige dambrugshjælpestoffer til erstatning for formalin. Lars-Flemming Pedersen.

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Nr. 219-10 **(English version)** Farming of Freshwater Rainbow Trout in Denmark. Alfred Jokumsen og Lars M. Svendsen.

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Nr. 221-10 Workshop on Fully Documented Fishery. Jørgen Dalskov.

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