Catch Quota Trials 2011
Final report: April 2012

marine management organisation

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Executive summary

The Marine Management Organisation (MMO) conducted trials of catch quota management during 2011 in collaboration with fishermen and vessel owners in the North East and South West of England. The project was sponsored by the Department for Environment, Food and Rural Affairs (Defra) to assist the development of UK policy objectives on fish discard reduction and Common Fisheries Policy reform. The project was run in tandem with other fully documented catch quota fisheries projects across Europe and builds upon the UK and European pilots in 2010.

The principal objective of catch quota management is to ensure total catch mortality of designated species is accounted for and create incentives to fish selectively and avoid juvenile fish catches. Under the terms of the trial, discarding of key species, including undersized specimens, was prohibited. Some additional quota was provided, as prescribed by Council Regulation (EU) 57/2011, to participants in place of the requirement to land all catches but set at a level considered to reduce overall fishing mortality. North Sea participants were also provided with additional effort allocations, in terms of days at sea, to allow for more flexible fishing operations.

An interim report based on data collected between April and September 2011 was published in October 2011. This final report sets out results to the end of December 2011 and takes account of data collected over a wider range of seasonal variation in the fisheries tested during the trial.

The main aim of the 2011 project was to test the effectiveness of catch quota management in reducing the level of discards across a range of species and fisheries and to test the operational management and enforceability of remote electronic monitoring with CCTV (REM) as a means of verifying catch documentation and discard levels. REM equipment was sourced from Archipelago Marine Research Limited, Canada.

The trial started in March 2011, with 12 vessels participating for North Sea (International Council for the Exploration of the Sea (ICES) Area IV) cod and 3 vessels for Western Channel (ICES Area VIIe) common sole. One vessel voluntarily trialled catch quota conditions for more than one stock (common sole, plaice and anglerfish) throughout various Western Waters areas (ICES Area VII). Additional quota for plaice and anglerfish was made available for scientific purposes (Council Regulation (EC) 1224/2009).

Minimal quantities of discards, 0.2 per cent of total catches across all species under trial, were observed during analysis of CCTV footage. This figure reduced from 0.25 per cent found at the interim report stage. These quantities were considered so minimal and were not indicative of deliberate discarding. The trial demonstrated the efficacy of the system as a means of monitoring for discarding activity and accounting for total catch mortality for trial species.

Catches of undersized fish were documented on board fishing vessels and verified through REM analysis. Quantities ranged between 0 and 3 per cent depending on the species and fishery. These levels are comparable with results at the interim report stage. The overall low levels of undersized fish caught during the trial are indicative of effective gear selectivity and/or avoidance behaviour. The live weight of undersized fish was accounted for and deducted from vessel quota allocations.

The REM system has proven largely reliable, although it is evident that operating the system on a larger scale will require a formalised maintenance and service infrastructure. Fishing vessel masters were responsible for maintaining equipment to ensure sufficient quality of sensor and image data, there were no indications of deliberate obscuration of cameras or tampering with monitoring equipment during the trial. However, crews needed to be reminded on occasion on matters such as ensuring that camera lens covers were kept sufficiently clean.

Time taken to analyse fishing voyages ranged from 3 hours to in excess of 6 hours with an average analysis time of 4 hours, which is comparable to that found at the interim report stage.

Accuracy in the estimation of catches by both observers and fishing vessel masters on each fishing operation was subject to variation depending on the method of sorting and volume of catches. It is considered that improved methods of quantifying catches should be explored in order to provide greater confidence in catch verification and to reduce the time taken to analyse CCTV footage.

Careful consideration will need to be given to the effective implementation of a system that ensures compliance with catch documentation and equipment maintenance. This will require a well defined and robust methodology for verifying catch records to be developed as part of ongoing trials in 2012. Further trials should continue with a collaborative approach with the fishing industry to test the use of accurate weighing systems and/or more definitive catch handling processes.

Some closely related species were difficult to differentiate, such as common sole and sand sole. In such cases there may be a requirement to prohibit discards of closely related species that cannot be differentiated for subsequent verification on landing.

Valuable information has so far been collected on the use of REM or CCTV to monitor catches of a range of species. There is, though, a need to further understand the impacts of the catch quota principle in mixed fisheries. The potential for future trials will be heavily influenced by EU Council and EU/Norway negotiations.

Artificial caps on the available additional quota (such as 30 per cent) for catch quotas could act as a barrier to fishermen participating for other species in potential future schemes where the discard rate for a stock is higher than the regulatory cap, such as North Sea plaice.

Further work and future trials should examine the impact of a catch quota system on current technical regulations. Some flexibility is likely to be required to allow participant vessels to retain catches that do not conform to these rules. Future trials should also aim to quantify catches of choke species to assess the impact of including such species in a discard prohibition.

REM systems can provide a high level of resolution and have potential uses in a number of fisheries management applications. These could include monitoring for by-catch of protected species and activity in and around marine protected areas. The use of calliper measuring software may also provide the facility to collect length frequency data for scientific use and to establish trigger levels for real time closed areas. It is also considered that data can be collected for use in informing future technical regulatory needs, for example where catch composition rules appear to conflict with prohibitions on discards.

Acknowledgements

The MMO would like to thank the skippers, owners, crews and industry organisations for their co-operation and continued support to this work. We would also like to acknowledge the dedication and expertise of scientific officers seconded to the MMO from the Centre for Environment, Fisheries and Aquaculture Science (Cefas) for the duration of the trial. We would also like to thank Archipelago Marine Research Limited for their support and advice.

Introduction

Current European regulations place restrictions on quantities of fish that fishermen can land and do not necessarily take account of total fishing mortality. As a consequence fishermen may discard part of their catches in order to remain within the rules and are only accountable for the fish that is landed. Therefore, there is often limited incentive for fishermen to acquire sufficient quota for all species in a mixed fishery or to increase the selectivity of their gear in order to avoid discarding. In many cases there is an imbalance between available quotas among stocks in mixed fisheries which can also lead to wasteful discarding.

Catch quota management shifts the focus away from quotas for fish that are landed, towards a system that accounts for all catches through full documentation of vessel fishing activities. CCTV linked to a remote electronic monitoring (REM) system can be used to verify that all catches taken on board a vessel are accounted for. This gives a greater confidence in fishing mortality levels and minimises discarding.

The 2010 pilots of catch quota management for North Sea cod provided evidence that catch quota management can reduce discards and encourage fishermen to fish more selectively. It also showed that the REM technology could potentially work to manage a catch quota scheme for cod. However, further evidence was needed on how this system could be implemented at a larger scale with more vessels and a greater diversity of fisheries. This evidence will also be essential to inform Europe where fully documented catches quotas could be an appropriate management measure to adopt under a reformed Common Fisheries Policy (CFP).

The Marine Management Organisation (MMO) was sponsored by the Department for Environment, Food and Rural Affairs (Defra) to manage the operation of a fully documented catch quota scheme in 2011. The project was run in tandem with other fully documented fisheries projects across Europe and builds upon the UK and European pilots in 2010.

Twelve vessels in the North Sea and three vessels in the Western Channel were selected to take part in catch quota trials in 2011 using a variety of gear types and methods for improved selectivity. Additional quota for International Council for the Exploration of the Seas (ICES) Area IV (North Sea) cod and ICES Area VIIe (Western Channel) common sole were made available to participants to allow the landing of catches that might otherwise have been discarded. One Western Channel vessel also took part in respect of Area VII angler and Area VIId&e plaice, which has provided additional evidence of the implications of a multi-species approach.

Though we consider effort restrictions are unnecessary under a catch quota system as total catch mortality is fixed, the current cod recovery regulations do not allow for effort exemption for participating vessels. Therefore, 50 additional days at sea were awarded to North Sea vessels to enable greater operational flexibility, for example, in allowing vessels more time to avoid high abundance of juvenile fish.

The pilot project for 2011 had the following key objectives.

- To assist and progress Defra objectives to reduce discards.
- To trial operational catch quota management in fully documented fisheries in the North Sea and Western Channel in accordance with Article 7 of Council Regulation (EU) 57/2011.
- To test enforceability of a catch quota system with a discard ban in the context of North Sea and South West England (Western Waters) mixed fisheries.
- To inform Defra policy on the operational use of a catch quota system particularly with regard to the use of REM as a monitoring tool.

It is envisaged that a catch quota system could deliver the following benefits:

- Reducing discards and fishing mortality by encouraging fishermen to fish more selectively while at the same time land more of what they catch.
- Provide improved scientific data in order to make better stock assessments.
- Provide an economic driver to optimise catch selectivity, as all fish counts against quota including juvenile fish.
- Provide greater flexibility for fishers in terms of simplified technical measures and effort restrictions.

Methodology

Legislative basis

The trial was run in accordance with Article 7 of Council Regulation (EU) 57/2011. Specifically this states that vessels participating in fully documented fisheries, using REM technology, can access additional quota for certain stocks (North Sea cod and Western Channel sole for the purposes of this trial). The regulation requires that participating vessels account for catches of these stocks regardless of size and that all catches count against quota. The quantity of additional quota allocated to an individual vessel must not be more than 30 per cent of its allocation and must represent no more that 75 per cent of the expected discard rate for the gear in use.

Once the quota for catch quota species is exhausted the vessel must cease fishing by any means that risks further catches of the stock. The additional quota coupled with the cap on catches provides the incentive for fishermen to avoid catching juvenile and low value fish by fishing more responsibly, through improved gear selectivity, spatial and temporal avoidance and diversification to alternative stocks, or non-fishing activity.

Selection of vessels

Vessel owners were invited to apply to take part in the pilot and were selected on key criteria such as the use of selective fishing gear and the provision of a fishing plan which demonstrated the ability to avoid the capture of juvenile catch quota species. They were also invited to bid for additional quota for catch quota species up to the ceilings provided for in Council Regulation (EU) 57/2011. Details of the participating vessels along with a summary of their proposed selectivity measures are included in annexes 1 and 2.

There was sufficient additional cod quota for all 12 North Sea applicants and all were accepted onto the scheme. Similarly, all three applicants were accepted onto the Western Channel sole scheme.

Terms and conditions (Annex 3) and a duty of care code (Annex 4) applied to participating vessels which reiterated the requirements of Article 7 of Council Regulation (EU) 57/2011 and also set out a duty of care placing an obligation on vessel masters to ensure the REM equipment was maintained to provide adequate data and imagery.

Quota management

Additional quota awarded to participant vessels was drawn down as a percentage of each landing to ensure that it was taken in the correct proportion to overall catches. This ensured that additional quota was not made available to non-participant vessels which could potentially lead to an increase in fishing mortality. The uptake of additional quota was monitored by the MMO and reported to the participant producer organisations. Table 1 outlines the range of quota stocks and gear types involved in the scheme.

Plaice, anglerfish and sole are caught by beam trawls throughout the year subject to seasonal fishery variation. Vessels participating in the North Sea may take cod as a by-catch or as a target species depending on the fishery.

Table 1: Gear types grouped for data analysis

Gear type	Metier	Stocks by area subject to catch quota terms (see Figure 1.)
Towed	Otter trawl	ICES Area IV North Sea cod
Towed	Pair trawl	ICES Area IV North Sea cod
Towed	Beam trawl	ICES Area VIIe Western Channel sole
Towed	Beam trawl	ICES Area VIId&e Channel plaice *
Towed	Beam Trawl	ICES Area VII anglerfish*
Static	Fixed gill net	ICES Area IV North Sea cod
Static	Long line	ICES Area IV North Sea cod

*Increased quota for Area VIId&e plaice and Area VII anglerfish was made available through UK domestic scientific derogation.

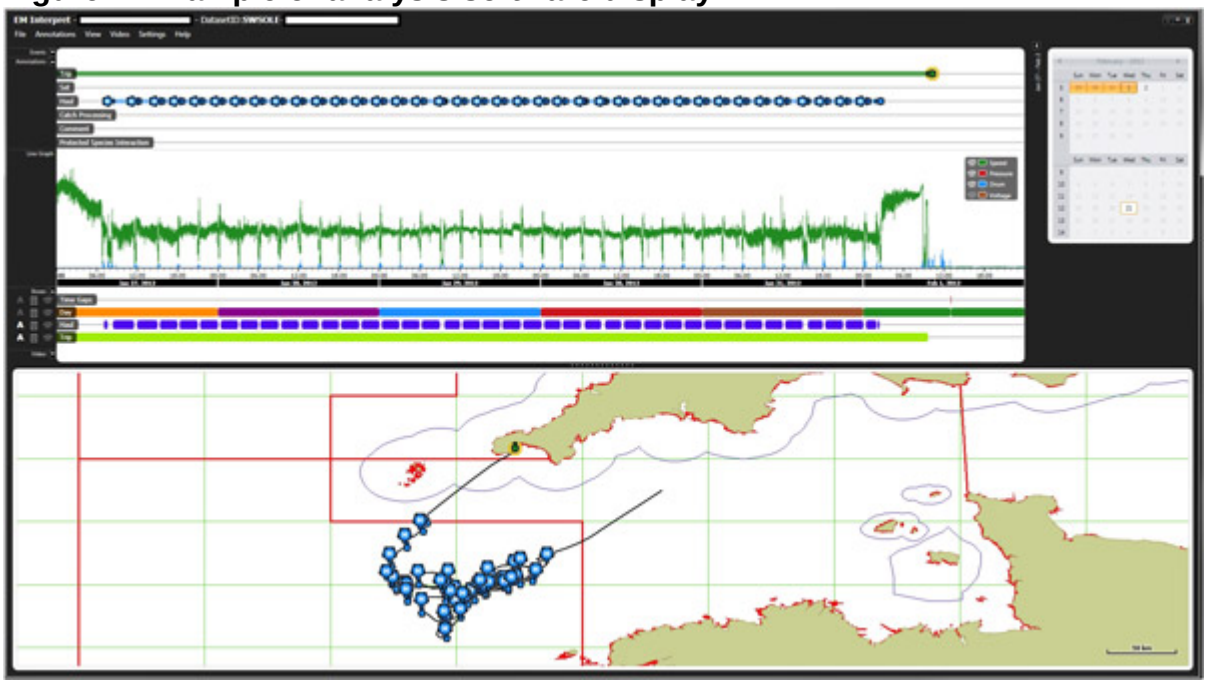
Figure 1: International Council for the Exploration of the Sea (ICES) areas

Equipment and analysis

Vessels were fitted with REM systems developed by Archipelago Marine Research Limited (AMR). The system captures CCTV imagery from four cameras, time, vessel position, vessel speed, winch rotation speed and winch hydraulic pressure.

Analysis software provided by AMR allows observers ashore to monitor relevant CCTV footage by homing in on gear hauling events and fish sorting operations. Figure 2 provides an image of the software used showing gear hauling events during one voyage.

Figure 2: Example of analysis software display



Catches were estimated by CCTV observers from a random 10 per cent selection of hauls and compared to the master's documented estimates. Masters were required to keep statutory logbooks and were also required to keep and submit records of catches of catch quota species for each fishing operation, recording undersized fish separately. Observers also monitored CCTV footage for discards of catch quota species and to check reported catches of undersized catch quota species.

Undersized catch quota species were required to be retained, landed and counted against quota but not offered for sale. Undersized fish were supplied for bait or to fishmeal plants and documentation showing the weight of fish was required for quota uptake purposes. In the case of static gear vessels where hauling operations are continuous, masters were required to keep records of catches on a daily basis and analysis was carried out at a rate of 10 per cent of fishing days.

Data was evaluated from the following sources:

- EU logbook data
- landing declarations
- sales notes by species and grade for all vessel
- masters' haul-by-haul records of catch quota species
- data collected by at-sea observers
- REM and CCTV data for all trips, including winch activity, vessel position and speed and CCTV footage.

Results

Data collection and analysis

The pilot aimed to carry out analysis at a rate of 10 per cent coverage of fishing operations. The achieved analysis rates for each gear type are outlined in Table 2 and the time taken to carry out analysis across the range of gear types and species is provided in Table 3.

Table 2: Analysis coverage for each gear type

Gear type	Number of trips	Number of hauls fished	Number of hauls sampled	Percentage of hauls analysed
Beam trawl	50	3,312	332	10.0
Beam trawl (three species)	30	1,584	153	9.7
Long line	15	142	15	10.6
Gill net	18	222	24	10.8
Otter trawl	139	2,105	223	10.6
Pair trawl	29	254	29	11.4
Totals	**281**	**7,619**	**776**	**10.2**

Table 3: Time taken to analyse hauls and trips

Gear type	Number of trips	Number of hauls sampled	Analysis time (hours)	Average analysis time per haul (hours)	Average analysis time per trip (hours)
Beam trawl	50	332	190.88	0.6	3.8
Beam trawl (three species)	30	153	164.8	1.1	5.5
Long line	15	15	41.75	2.8	2.8
Gill net	18	24	112	4.7	6.2
Otter trawl	139	223	508.67	2.3	3.7
Pair trawl	29	29	95	3.3	3.3
Totals	**281**	**776**	**1,113.1**	**1.4**	**4.0**

Time taken to analyse trips ranged from 3 hours to in excess of 6 hours with an average analysis time of 4 hours. For static gear vessels (long-liners and netters) each fishing day was treated as one hauling event. The vessels requiring the most analysis time were the netters and the beam trawler being monitored for three species. Footage of long-line operations can be speeded up to achieve relatively fast analysis times as the catch is free of debris. For gill net operations the footage is required to be viewed at a slower speed particularly where fish are removed both during the hauling operation and after the haul is complete.

There were a number of variables which dictated the time taken to analyse a single vessel voyage apart from the number of species being monitored. Haul frequency, duration and method of sorting operations were key parameters affecting analysis times.

Table 4 summarises voyages by participant vessels that were not subject to full analysis. This includes fishing voyages in certain areas, gear types or activities that were not relevant to the trial. In such cases REM/CCTV data was checked for full data capture and to verify activity reported in the EU log book. These checks confirmed the reported activities. There were eight voyages that

were not fully analysed because haul-by-haul records (maintained separately from EU log book records) were incomplete or missing.

Table 4: Summary of activity not fully analysed

Activity	Gear type	Number of trips	Number of hauls fished
Fishing	Dredge	4	Not applicable
Fishing	Otter trawl	8	86
Fishing	Beam	2	130 (50 in ICES VIIf&g)
Guard work	None	36	NA
Research	None	16	NA
Transiting	None	8	NA
	Total	**74**	**216**

Species identification

Resolution of CCTV footage was generally of a high enough quality to distinguish between key species. However, some closely-related species were difficult to differentiate. Notable examples were the differentiation between common sole *(Solea solea*) and sand sole (*Solea lascaris*) and between plaice (*Pleuonectes platessa*) and flounder (*Platichthys flesus*). Sand sole and flounder are usually caught in small quantities and can be verified on landing although consideration may need to be given to applying the discard prohibition to similar species in order to provide adequate control of the discard prohibition.

REM equipment

The terms and conditions of the trial imposed a duty of care on the vessel master to ensure the equipment is functioning correctly and to report faults. Throughout the trial, fishing vessel masters reported faults as they occurred and measures to rectify them were put in place.

Hard drives for REM data storage generally had sufficient capacity for one month and in the case of gill netters, where recording only occurred during hauling events, up to six weeks. However, removing hard drives on a more regular basis may minimise the risk of data loss as a result of faults as well as to enable observers to pick up on poor data capture on a more regular basis. The use of real time satellite communications can provide real time information of the operational status of the system although this was not tested during the trial.

The main aspects of service and infrastructure involve installation of REM or CCTV equipment, maintenance and hard drive exchange. Most of the installation work was carried out by the MMO team with outsourced engineering support. Maintenance and repairs were carried out both by the MMO staff and contracted engineers. Vessels were issued with spare formatted hard drives and masters were instructed as to how to replace them – this allowed for continuity in cases where vessels were not accessible by the MMO staff.

Table 5 sets out faults with control boxes and peripheral equipment installed on participant vessels during the course of the trial. Four days of fishing activity data was lost because of RAM card faults. There were also isolated incidents of missing sensor data, reduced image quality and individual camera faults. In one case about ten weeks of data was lost, although by chance this was during a period of non-fishing related activity. This was thought to be because of corruption of the hard drive brought about by a power surge from a faulty alternator. All faults were rectified in port and there were no recorded delays to fishing vessel departures.

It is considered that there are a number of areas where mitigation against faults can be made. For example more recent versions of the Archipelago REM control box have an in-built uninterrupted power supply, which can mitigate against cuts to power supply and protect against power surges. The reliability of vessels' power supplies should nevertheless be assessed for suitability. A greater

frequency of hard drive replacement, such as on each trip, would minimise data loss through hard drive corruption.

The small number of vessels engaged in the trial has allowed a small team of three to manage installations and maintenance by calling for external support on a when needed basis. Applying REM technology to a large number of vessels under a mandatory approach will require a more formalised field service infrastructure to allow for timely maintenance and hard drive replacement. Consideration will need to be given to how this might be implemented and whether it would be carried out from within the MMO resources or through external contracts.

Table 5: Summarising faults, data loss and remedial actions

Fault description	Number of occurrences (number of vessels)	Remedial action taken	Complete data loss (while engaged in fishing)	Partial data loss (including data or video quality while engaged in fishing)	Time taken to rectify (hours)
Complete control box failure*	3 (3)	3 x control box replacements	1 day at sea (steaming to port)	Nil	12
RAM card fault	2 (2)	RAM cards replaced and/or cleaned	1 x 4 day trip	Nil	14
Camera module failure	4 (3)	4 x camera modules replaced		Non-critical loss from individual cameras	10
Camera (moisture ingress)	6 (4)	Cameras checked, dried out and re-sealed. 2 x camera modules replaced.		Image quality compromised (approximately 1 month – 1 camera per vessel) by either condensation or water ingress obscuring view	10
Camera failure (wiring)	3 (3)	Cameras re-wired. Damaged cable repaired.		1 camera view lost (non-critical) for 12 fishing days	12
Global positioning system (GPS) failures	1 (1)			Intermittent loss of GPS data over 1 fishing trip	2
Pressure sensor failures	2 (2)	No action taken		Non-critical sensor data errors	
Rotation sensor failures	7 (6)	3 x sensors replaced. Reflectors re-attached, sensors re-aligned		Partial or intermittent loss of sensor (drum rotation) data, all non-critical	22

Fault description	Number of occurrences (number of vessels)	Remedial action taken	Complete data loss (while engaged in fishing)	Partial data loss (including data or video quality while engaged in fishing)	Time taken to rectify (hours)
Power failures aboard causing significant corruption of data**	3 (2)	1 x control box replacement			15

* Two of the three control box failures occurred while vessels were in port. Repairs (replacement of control boxes) were immediately put in place resulting in no data loss on two occurrences.

** Two of the three power failure events occurred on the same vessel. One instance was due to the power supply connection, the cause of the second power failure event was not found. These two instances caused complete data loss for approximately one week each. By chance these events occurred while the vessel was engaged in guard work. The third power failure occurrence was due to an alternator fault aboard the vessel. In this instance the control box software and all data on the current hard drive were corrupted. The control box was repaired by re-installing software. The data which had been saved to the hard-drive was not recoverable, and amounted to a total period of 2.5 months. All data lost in this instance was while the vessel was engaged in guard work.

Catch estimation

A range of methods for estimating catches was employed by CCTV observers according to the nature of the sorting operation and volume of the catch. As masters are required to report catches by live weight the emphasis was placed on estimating weight through volumetric assessment where standard box or basket weights are applied. Vessels using gill nets and long lines have provided fish counts as well as weight estimates which can be verified by observers. In some circumstances it is possible to count numbers of fish and to apply a visual estimate of average fish weight in order to corroborate total weight estimate. More precise on-screen length measurements would require the use of calibrated software to calculate weight from length frequency data obtained from CCTV footage. The use of this technology will be tested during 2012 trials. Such length frequency data may also be used to compare against catch grading data on landing as a means of verifying that discarding of smaller fish has not taken place prior to landing.

Vessel masters were required to estimate catches for each haul for towed gear and for each day for static gear. It was not prescribed how they should do this and there was no specific requirement to weigh the catch after each haul. Where catches per haul were small, such as beam trawl catches for sole, crew were observed weighing the catch on occasion as a means of quality assurance.

Tables 6 and 7 show that there could be considerable variation between observer and master estimates of marketable and undersized retained catches. The level of agreement to within plus or minus 10 per cent is clearly dependent on the information gathered during the sorting operation, for example the master may have relied on a crewman's estimate by sight on each haul or there may have been a quantified box count made. Generally, the results demonstrated a variable degree of subjectivity on catch estimation which is heavily influenced by the type of catch, gear and sorting operation.

Table 6: Marketable segment of catch

Gear type	Observer less than master		Observer = master (+/- 10 per cent)		Observer greater than master	
	Number of hauls	Percentage of hauls	Number of hauls	Percentage of hauls	Number of hauls	Percentage of hauls
Beam trawl	68	20	148	44	121	36
Beam trawl (three species)	111	24	153	33	195	42
Long line	0	0	14	93	1	7
Gill net	3	13	13	54	8	33
Otter trawl	38	17	90	41	94	42
Pair trawl	6	21	20	69	3	10
Total	**226**	**21**	**438**	**40**	**422**	**39**

Table 7: Undersize and damaged segment of catch

Gear type	Observer less than master		Observer = master (+/- 10 per cent)		Observer greater than master	
	Number of hauls	Percentage of hauls	Number of hauls	Percentage of hauls	Number of hauls	Percentage of hauls
Beam trawl	15	4	319	95	3	1
Long line	33	7	414	90	11	2
Beam trawl (three species)	0	0	15	100	0	0
Gill nets	3	13	18	75	3	13
Otter trawl	53	24	99	45	70	32
Pair trawl	20	69	5	17	4	14
Total	**124**	**11**	**870**	**80**	**91**	**8**

The observer estimation in the case of the long line vessel was aided by the fact that the number of fish could be counted and the boxing of fish, during the catching and grading operations, could be monitored. The observer was therefore able to make a precise box count and to consider the declared box weight in relation to the estimated size of fish being caught.

Observers were also able to carry out box counts during the sorting operation on some otter trawl vessels or counts of baskets of fish delivered to the fish room which also provided a greater confidence in estimated weights.

Catch estimation was considerably more subjective for both very small quantities such as partially filled baskets and for very large volumes which could only be observed en masse on sorting equipment. Figure 3 below is an example of the CCTV imagery that can be used to assess catches.

Figure 3: Example of observer view of sole-sorting operation

Quality control data from at-sea observations

Catches of common sole were monitored by observers on board one vessel to obtain control data on numbers and weight of sole catches. This data was compared to estimates of total weight and numbers of fish for each control haul by four shore-based observers and with the master's estimate. Figure 4 shows the close correlation in most cases between the control data and observer estimates of numbers of fish.

Figure 1: Quality control voyage: numbers of sole

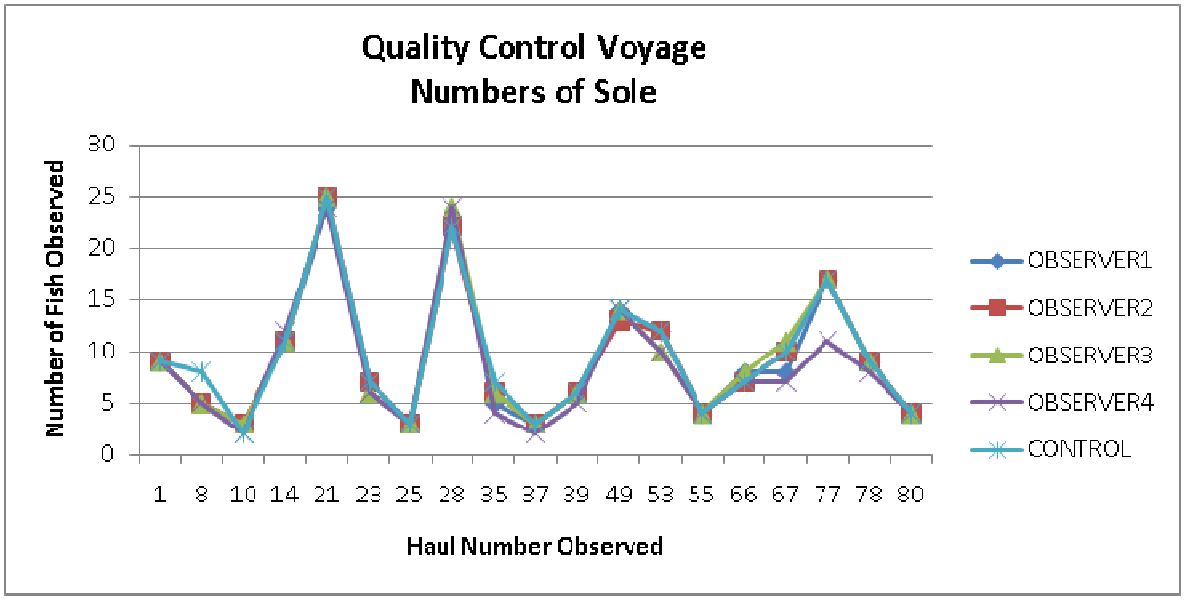
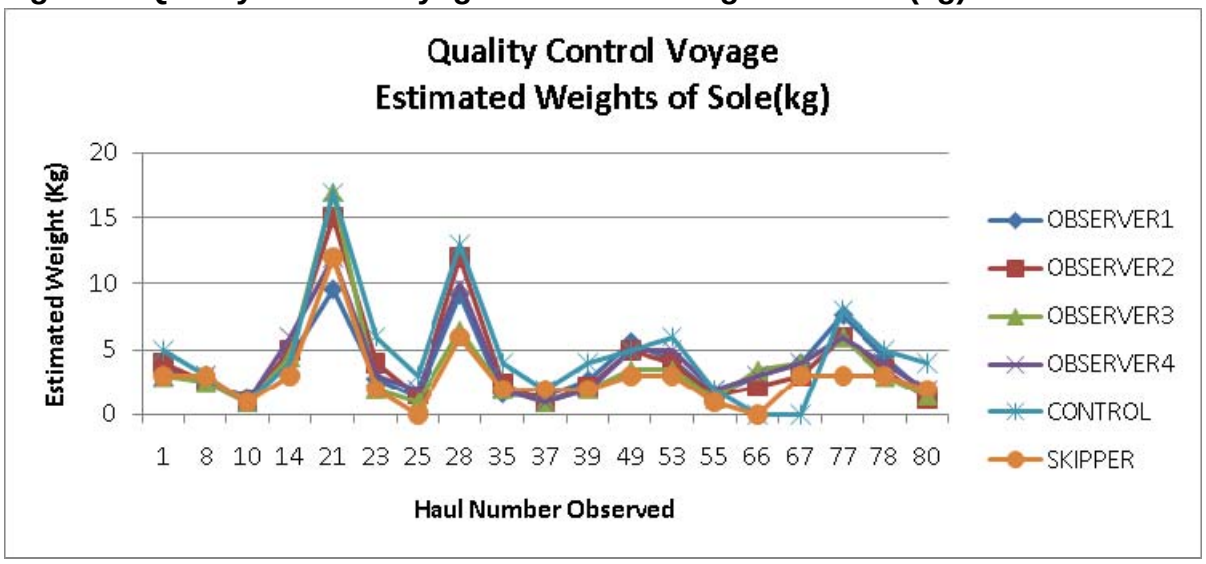


Figure 5 shows the comparison of shore-based observer and master estimates of weight against control data. This shows a wider range of variation which demonstrates the difficulty in estimating weights of small quantities of fish where it is not possible to count a number of volumetric units. It is notable that the master estimates show a trend of lower estimates in comparison to observer and control data.

Figure 2: Quality control voyage: estimated weights of sole (kg)



In the case of low volume catches such as sole, it is evident that there is insufficient accuracy in catch weight estimates to allow for a definitive methodology for the assessment of catch documentation. Estimates vary well beyond 10 per cent from control data by both observers and crew. It is likely that a more accurate weight estimate could be achieved by counting numbers of fish and converting to weight by obtaining a length frequency distribution using on-screen callipers. This methodology will be tested as part of the 2012 scheme. It should be noted however that such a methodology would still leave the question as to how the vessel crew would make more accurate assessments. It is likely that for small quantities to be reported for each haul, the use of accurate weighing systems is required. An alternative would be for vessel masters to report numbers of fish on each haul instead of weight although this is not compatible with current log book requirements.

Catch documentation

Table 9 shows the comparison of total haul records with logbook records and landed weights. In all cases the total logbook estimates were within 10 per cent of landed weights. Similarly, total haul-by-haul estimates with the exception of anglerfish and sole were within 10 per cent of total landed weights. It should be noted that in some cases, such as activity within the Norwegian sector, cod is recorded in the logbook on a haul-by haul basis as well as on trial recording sheets. Total haul-by-haul estimates of sole and anglerfish were more than 10 per cent less than landed weights which reflects greater difficulty in estimating these species on each haul and a higher level of accuracy achieved from 24-hourly fish room assessment using a box count. In the case of sole this is likely to be because of the small quantities caught on each haul. Anglerfish is also likely to be difficult to assess because of the large size variation between specimens combined with variable catch volumes.

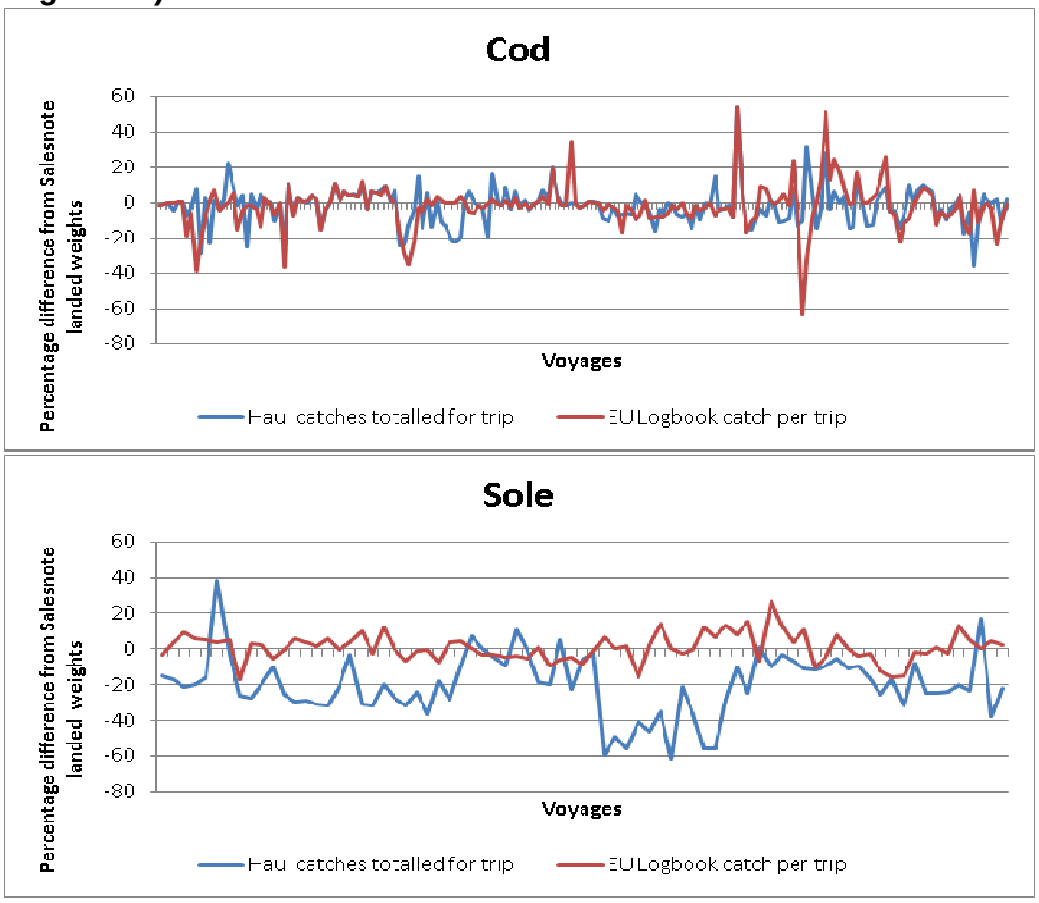
Table 9: Comparison of vessel documentation with landed weights

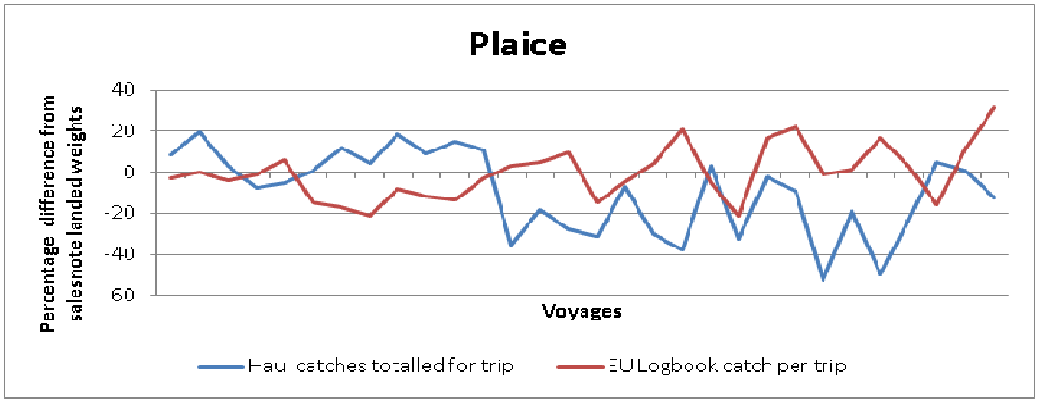
Gear type	Species	Haul-by-haul record weight (live weight kg)	Landed weight (converted to live weight kg)	Logbook weight (live weight kg)	Haul-by-haul total as percentage of landed weight	Logbook weight as percentage of landed weight
Beam trawl	Sole	35,169	42,013	41,955	84	100
Beam trawl	Anglerfish	47,838	55,170	53,518	87	97
Beam trawl	Plaice	25,632	24,393	22,574	105	93
Long line	Cod	18,147	18,350	18,199	99	99
Nets	Cod	132,875	145,773	144,311	91	99

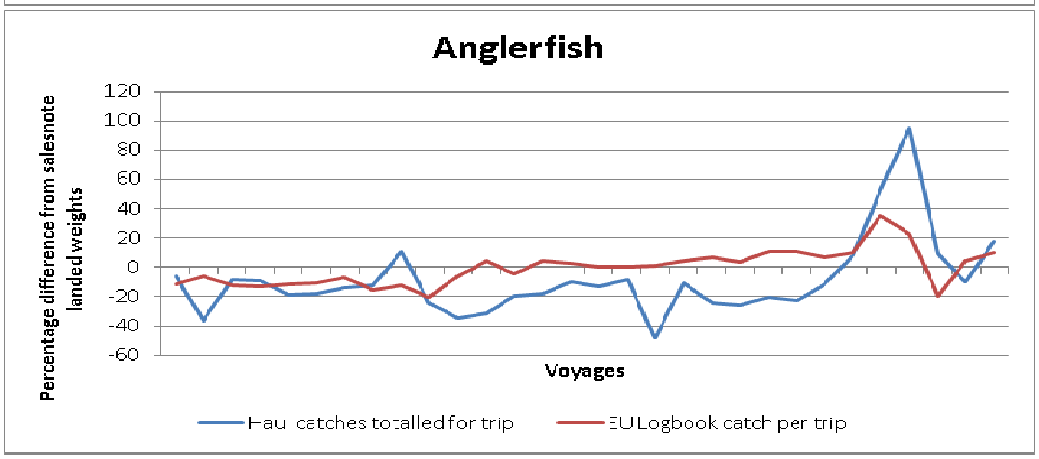
Gear type	Species	Haul-by-haul record weight (live weight kg)	Landed weight (converted to live weight kg)	Logbook weight (live weight kg)	Haul-by-haul total as percentage of landed weight	Logbook weight as percentage of landed weight
Otter	Cod	535,375	557,976	549,931	96	99
Pair	Cod	90,108	95,664	101,197	94	106

Figure 6 shows the degree of variation between landed weights for each voyage and the total logbook and haul-by-haul estimates. These graphical representations show the percentage deviation from known landed weights and should be viewed as trends on levels of accuracy. Large deviations are apparent where total landed weights are very low. The data show a close correlation between haul-by-haul estimates and logbook estimates for cod. There is a larger discrepancy between logbook estimates and haul-by-haul estimates for sole, plaice and anglerfish. This is likely to be a result of inaccurate assessments of relatively small quantities of plaice, anglerfish and sole on a haul basis, with greater accuracy being achieved from estimating stowed quantities at the end of each 24-hour period. However, the level of accuracy varied considerably between vessels. There were a number of occasions where very small catches of sole were reported as zero values on the haul records and there is a clear trend of underestimating haul weights for sole and anglerfish.

Figure 6: Logbook and haul records compared to landed weights (for cod, sole, plaice and anglerfish)







Observed discards

Council Regulation (EU) 57/2011 requires that participating vessels must account for all catches of stocks for which extra allocation has been granted. It was therefore important to assess the efficiency with which observers can identify discards or verify that no discarding has taken place.

Vessels engaged in the trials were equipped with sorting conveyors or tables that lead to a discard chute. Fish which enter the discard chute or were manually thrown overboard were recorded as discards. Table 10 provides a summary of observer assessment as to how confident they were in being able to monitor for discards. Observers applied a confidence rating where:

- good reflects high confidence in the ability to observe any discarding
- medium, where there is a potential for discards to go unobserved, this score being applied on occasions where image resolution is reduced such as where there is glare from sunlight
- poor rating where there may be fish obscured by other fish, debris or benthos, or where image resolution has been significantly reduced.

The highest level of poor scoring was found in the trawl categories for cod. This stems largely from sorting operations involving large volumes of fish and in cases where there are large quantities of mixed species and benthos within which incidents of discards could go unobserved.

This is in contrast to the static gear fisheries where there were no poor scores given.

Observations from beam trawlers suggested a high degree of confidence in being able to monitor for discards of sole species in general, although there is less confidence in identifying specific species, particularly in distinguishing between sand sole and common sole.

Table 10: Observer confidence in discard monitoring

Species	Gear type	Catch segment	Number of hauls*	Percentage good	Percentage medium	Percentage poor
Cod	Long line	Discarded	153	97	3	0
Cod	Nets	Discarded	15	67	33	0
Cod	Otter	Discarded	24	42	54	4
Cod	Pair	Discarded	222	70	22	9
Anglerfish	Beam trawl	Discarded	29	31	62	7
Plaice	Beam trawl	Discarded	153	93	7	1
Sole	Beam trawl	Discarded	329	66	26	9
Sole	Beam	Discarded	153	89	10	1

*Number of hauls where the species was encountered and analysed

Monitoring revealed very low levels of discarding that resulted from fish not being picked off sorting conveyors before they entered the discard chute. Observers noted estimates of discards on sampled hauls which are summarised in Table 11. Although such discards are not allowed under the terms of the scheme, the evidence suggests they are such a minimal level that it does not matter.

Table 11: Observed discards

Species	Estimated discards (kg)	Total catch for observed hauls (from haul documentation) (kg)	Percentage discarded
Cod	125	93,420	0.1
Sole	7	3,902	0.2
Anglerfish	59	5,795	1.0
Plaice	4	2,144	0.2

Undersized fish

Table 12 shows the undersized catch as a proportion of total catch across the gear types. Anglerfish is not included in the table as it is not subject to a minimum landing size. The undersized proportion for sole in the beam trawl fishery is low (0.3 per cent) which suggests effective selectivity while the proportion for plaice is higher (3.4 per cent) as a result of its larger minimum size. The high degree of selectivity of gill nets and long lines is demonstrated by the low and zero values for the undersized fraction. The range of selectivity measures that have been used are reflected in the tables at Annex 1 and 2.

Table 12: Proportion of undersized fish in the catch

Gear type	Species	Minimum landing size (cm)	Mesh range mm	Total catch (kg)	Undersize catch (kg)	Percentage of catch undersize
Beam trawl	Plaice	27	80-99	25,632	871	3.4
Beam trawl	Sole	24	80-99	35,169	98	0.3
Long line	Cod	35	Hooks	18,147	0	0.0
Gill net	Cod	35	160+	132,875	269	0.2
Otter trawl	Cod	35	100-119	25,755	545	2.1
Otter trawl	Cod	35	120+	509,620	13,121	2.6
Pair trawl	Cod	35	120+	90,108	1,099	1.2

Some otter trawlers engaged in the trials targeted plaice, lemon sole and nephrops on a seasonal basis, taking cod as a by-catch using nets of less than 120 mm. There were occasions when the proportion of total proportion of cod catch made up of undersized fish in these fisheries was as high as 43 per cent. The highest quantities of undersized fish were landed over the summer months and contributed to an overall percentage of undersized fish caught by otter trawlers, as reported in the interim report at 4.6 per cent.

Having assessed the total catches of undersized cod to the end of the year, the percentage of undersized cod caught by otter trawlers has reduced to 2.5 per cent. It is interesting to note that overall there were similar levels of undersized cod in catches from the mesh size ranges 120 mm+ and between 100 and 119 mm. It is proposed that more work should be done on analysing the catches of juvenile cod between different mesh size ranges during the 2012 scheme.

Discussion

Discards

Discards have been assessed through CCTV observation as being 0.2 per cent across all trial species which represents a 0.05 per cent reduction overall when compared to the interim results. Despite the prohibition under the terms of the trial these quantities are not considered to be significant. Some incidental discarding during sorting operations is considered to be inevitable. Indeed the results are very encouraging and demonstrate the ability of fishing vessel crews to ensure discards are kept to a minimum.

Enforcing a discard ban

Proposals to phase in an obligation to land all catches of specific species across a range of key species represent a step change in fisheries policy and a new challenge for monitoring and surveillance. Currently there is a ban on high-grading – where fish of legitimate size are discarded in order to preserve quota for higher value catches (typically the larger specimens). Enforcing the high-grading prohibition represents similar enforcement challenges to an outright discard ban, as some form of first-hand witness evidence is generally required.

The lack of small marketable grades within a landed or retained catch can be indicative of high-grading but may be insufficient as evidence. This is also likely to be highly variable depending on the degree of selectivity and type of gear in use as well as fishing area. The use of on-board observers to monitor for discarding is likely to be effective but the cost and practicality is likely to be prohibitive.

The use of REM technology is likely to be more consistent as a means of policing a discard ban particularly as data can be reviewed randomly or through risk-based sampling. The results of the trial show that there is generally a good level of confidence in the ability to monitor for discards. For the system to be used effectively to enforce a discard prohibition there will need to be a clear mechanism to deter deliberate tampering and obscuration of the equipment. The level of discarding, high grading and deliberate slipping of catches is likely to vary considerably across fisheries. Fishermen that are demonstrating compliance will want to know that there are robust mechanisms in place to prevent others from non-compliance.

Enforcement options will need to be considered. It may be, for example, that administrative or legal sanctions should be applied to instances where data is missing or of insufficient quality.

Undersized fish

The quantity of undersized fish that was landed that would previously have been discarded has generally been low, often less than 1 per cent but with a considerable range across species and fisheries. For example, the fraction of undersized cod in individual trips has been as high as 43 per

cent in the North Sea mixed demersal fisheries. Undersized cod landings from pair trawl fisheries have been lower at around 1 per cent. Although catches of undersized fish were high on some individual trips the overall trend, taking account of seasonal fisheries, showed low mortality of undersized fish.

The overall percentage of undersized cod from otter trawl fisheries is a little over 2 per cent compared to the results at the interim stage which showed higher levels at over 4 per cent. This change stems from the fact that the interim data covered the summer months during which most mixed demersal fisheries took place. The ability to avoid catches of juvenile fish is influenced by a number of factors but most significantly by the target fishery.

Masters participating in the mixed demersal fisheries have commented that it was often difficult or impossible to avoid catches of juvenile cod when fishing for other species such as plaice and lemon sole. They have nonetheless landed a small percentage of undersized cod when aggregated over the full trial period. This seems to reinforce the ability of a catch quota system to accurately account for fishing mortality. The use of selective trawl designs which go beyond current technical rules by participating vessels is considered to be an important factor in minimising catches of small fish.

In the South West common sole fishery the trial has shown that catches of undersized sole are very low, with plaice showing a higher proportion as a result of its larger minimum size. The South West beam trawl fleet has demonstrated the successful use of increasingly selective trawls which reduce discards of juvenile fish and other benthic marine organisms. Although improved selectivity and discard reduction is considered very important by the South West industry they also believe that the level of discard mortality is low for some fish (such as sole, plaice and anglerfish) and that more research is required to assess whether a discard ban on some species could perversely increase fishing mortality because of the high survivability of these species. Research into discard mortality for these species is being carried out in 2012.

The trial has demonstrated the ability to largely eliminate discards of certain stocks across a group of volunteer vessels without undue logistical problems in terms of handling and retaining undersized fish. Undersized fish have been supplied to fish meal processors although smaller quantities have either been disposed of or supplied for bait, with the reported quantities counted against quota uptake.

Evidence on discarding suggests that, although part of the overall discarded catch in North Sea fisheries is made up of undersized fish discards also result from insufficient quota, market prices and technical catch composition rules. It has not been possible, at this stage, to assess the proportion of catch that might have been discarded by trial vessels if they were not participating although it should be possible to examine market grade distributions between participating and non-participating vessels.

Quantifying retained catch

This pilot aimed to verify retained catches against catch documentation. Monitoring retained catch reduces the potential risk of under-reporting of catches and discarding out of camera view or when cameras are switched off. Electronic monitoring is used effectively to monitor catches from static gear in Canadian fisheries such as the British Columbia hook and line fishery where precise counts of fish can be made and compared to counts recorded in the fishing log. Quantifying catches where fish is taken aboard en masse or in regular small quantities which are not counted is more challenging and is likely to require the ability to quantify units of volume such as full boxes or to weigh fish on board.

Precise methodologies for verifying catch records will need to be developed in order to implement an effective auditable approach to catch assessment. Such a system would need to be compatible with a suitable means of sanctioning inaccurate catch recording.

A programme of at-sea observer coverage planned for 2012 should help to achieve this by providing quality assurance of catch estimates and promoting improved catch sorting behaviour and adjustments to CCTV equipment.

There can be significant variation between estimated catch on a haul-by-haul basis and logbook estimates with results showing that logbook estimates are often more accurate when compared to the landed weight than aggregated individual haul records. Masters of vessels working outside the Norwegian sector are required to complete catch estimates in the electronic logbook once every 24 hours and often derive this estimate from the quantities boxed in the fish room, rather than a total of the catches in each haul. Where vessels report catches for each 24-hour period it may be possible for CCTV observers to assess the total catch from a random 24-hour period to compare against the log book.

Further trials should seek to integrate catch verification with electronic reporting requirements and relieve the burden on vessel masters of having to maintain separate records as required under the 2011 trial. Electronic log books do not currently have adequate facility to report undersized fish separately and this should be resolved in order to allow for verification of the undersized portion of the catch.

Future work will investigate the potential for weighing catches where practicable and for quantifying volumetric units at the point of stowage. The ability to measure fish length using on-screen calliper software should be explored as a means of providing length frequency data for discarded and retained fish where such data may be of use for corroborating catch records.

Participating masters and crew have welcomed the potential to demonstrate a well documented fishery with minimal discards and there is a need to continue with a collaborative approach in this area. The methodology used to quantify catches will need to be defined in such a way that it is practical for both observers and fishermen alike. If fishermen are confident in the methodology used they are more likely to buy in to the process. Further work during 2012 will therefore concentrate on this with a view to assessing accurate weighing systems and better defined catch sorting protocols.

Industry co-operation

Vessel masters and owners participated on a voluntary basis and consented to adherence to the terms and conditions of the scheme. Despite the incentive of additional quota and effort participants were also incentivised by the opportunity to be able to demonstrate responsible fishing behaviour and to help develop new approaches to fisheries management with reduced discards.

There was generally a high level of co-operation from masters and crew during the trial and faults were reported in a timely manner. Masters were reminded of the need to maintain camera lens covers from time to time to ensure sufficient resolution of imagery. There was no evidence of deliberate tampering or interference with the REM equipment. Evidence of such activity under the terms of the trial could result in dismissal from the scheme and removal of quota and/or effort allocations.

The Archipelago REM system is not fully tamper proof but the terms of the scheme place the burden on the vessel's master to check that the equipment is fully functional at all times and to report any malfunction immediately. Vessels can only go to sea if the equipment is operational and fully able to capture the necessary data. Rolling out such technology on a statutory basis will

require careful consideration on compliance and enforcement of the duty of care code (Annex 4) to maintain equipment. It is evident that crew co-operation is an important element to successful monitoring using REM and co-operation by the wider industry under a mandatory scheme is likely to be influenced by the level of buy-in to new approaches to fisheries management.

Monitoring and surveillance

Vessel position and speed are captured on a 10 second interval and video footage of key catch handling areas is captured at a rate of 2 to 5 frames per second. Unlike vessel monitoring systems (VMS) the data is not transmitted in real time but is stored on a hard drive which is removed in port for analysis. In this respect it does not allow for real time intervention or deterrence although the system can be modified to transmit electronic monitoring sensor data and CCTV still images in real time. CCTV footage could then be analysed subsequently for corroborative purposes.

In terms of monitoring fishing activity we consider that the system offers reliable data on the correlation between fishing activity and vessel position. In the context of fisheries closed areas or gear specific prohibitions CCTV imagery can provide a higher evidential confidence than current VMS technology.

We consider that the integration of CCTV with REM data can provide greater assurance in catch location and prevent the misreporting of catch area. As such it could have the potential to negate the need for restrictive measures such as the single area licensing condition which currently applies to Western Channel beam trawlers and afford greater flexibility in fishing operations.

Potential implications for future management

Effort restrictions

As catch quota management effectively caps the amount of fish that can be caught there is a strong argument for removing effort restrictions applicable to single species management plans. Participating vessels are not able to deploy more effort than their quota allows for and once they have exhausted their quota they must cease fishing. By fixing mortality rather than effort, participating vessels have more flexibility to invest time in the avoidance of juvenile fish. Indeed, restricting the number of days which a vessel can operate may perversely act as a disincentive to locating fishing grounds yielding mature fish and where juvenile specimens are less abundant

Catch composition rules

The prohibition of discarding North Sea cod has the potential to generate breaches of catch composition rules. For example, vessels engaged in plaice or nephrops fisheries with less than 120 mm cod ends cannot discard cod to remain within the 20 per cent limit on retained cod set by EU North Sea technical measures. We consider that introducing catch quotas on a mixed species basis is likely to conflict with some current technical rules including catch composition. The compatibility of a catch quota system with current technical rules should therefore be examined further. Where catch quota trials are expanded in 2012 there is likely to be a requirement for some derogation from existing technical rules, particularly for high discard fisheries. Where the mortality of stocks is fixed under a catch quota system there is likely to be scope for creating less rigid and complex technical rules.

Quota imbalance

Current participants have demonstrated willingness to take part in the trials in order to contribute to the process of Common Fisheries Policy reform and, along with the wider industry, are increasingly looking for ways to improve the selectivity of gear and reduce discards. The nature of the mixed fisheries around the UK are complex and varied and discard rates are often directly linked to imbalances of quota among the mixed fishery species. Such quota imbalance can be as

a result of historically low catch shares (such as Area VIIe-k cod) or rapid changes in abundance and recruitment of species such as cod and haddock.

The provision of additional quota in exchange for an agreement not to discard is a key incentive to participation. The amount of additional quota is set as a proportion of the expected discard rate for each species and there lays a potential inhibitor to applying catch quota management to a wider range of species. Each additional catch quota species potentially represents an increased risk of quota exhaustion leading to a complete stop if sufficient quota cannot be secured or where incidental catches cannot be avoided.

One vessel among the South West beam trawl participants adopted the terms of the discard prohibition in respect of plaice and anglerfish. This has been the first initiative to examine the implications of a multi-species approach. This vessel accessed sufficient quota for all three stocks to continue fishing to the yearend as did all other vessels engaged in single species trials. It is considered that future trials in mixed fisheries should take account of so called choke species for which quota exhaustion may lead to premature mixed fishery closures. It is recommended that such trials aim to quantify catches of choke species in order to inform the impact were such species subject to a discard ban.

Further evidence is needed to understand the impact of catch quotas across larger numbers of vessels, particularly where there may be an imbalance of quota opportunity across entire fleets. Where evidence of choke species are found managers will need to identify whether there are any solutions that could mitigate such stocks having a significant negative impact on the viability of the affected fleet.

Current catch quota regulation places a cap of 30 per cent on additional quota provided to offset a proportion of the amount that might otherwise be discarded. We consider the cap is set at a level that is too low to allow sufficient quota for high discard fisheries to be investigated under future catch quota trials. While improved selectivity measures should be a key driver in reducing discard rates it may be appropriate to raise this cap for some fisheries such as North Sea plaice. The condition for allocations being no more than 75 per cent of the discard rate may need to be maintained as a precautionary measure.

Industry engagement and views

Meetings were held with industry stakeholders to discuss progress with the trials and to get feedback from masters and owners. Participants have been positive about the progress of the trials so far and are keen to engage in future projects.

A key concern from the South West beam trawl industry is that not enough research was undertaken to assess the level of discard mortality in key demersal species such as plaice, angler and sole. If discard mortality is low then compulsory landing of undersized fish could potentially lead to an increase in fishing mortality. Industry members suggest that survival rates for some demersal species are high as a result of improved sorting practices. Tagging projects and post-capture viability tests are currently being considered by the Centre for Environment, Fisheries and Aquaculture Sciences (Cefas). A project examining the survivability rates of flatfish species is being undertaken in 2012.

Masters have expressed concerns about the level of record keeping that is required over and above the official logbook and it is intended, in any future schemes, to reduce this burden as far as possible without compromising the objective of verifying catch records.

There has also been concern about the method of allocating the additional quota. The MMO deemed a percentage of each landing to be drawn from each vessel's additional allocation in order to ensure it was representative of the discard element of the catch. This methodology remained in place for 2011 although a more flexible approach is being taken in 2012 while ensuring the principles of catch quota and reduction in fishing mortality are maintained.

Conclusion

REM technology coupled with some form of verifiable catch documentation should provide a higher resolution of catch monitoring than current control and surveillance methods allow, particularly in the context of a discard prohibition which would be difficult to enforce through conventional means and without on-board observers. It should therefore be capable of being used to contribute to achieving overall objectives to reduce discards in a phased approach and to maintain catch mortality within prescribed limits. It also provides a means for fishers to be able to demonstrate good practice particularly in respect of demonstrating discard reduction or elimination, improved selectivity and avoidance of juvenile fish.

The trial has demonstrated that REM technology can be an effective tool for monitoring a discard prohibition and to account for catches of juvenile fish.

In order to use this technology to verify catch documentation improvements are necessary in the methodology of catch estimation by observers and how this relates to catch reporting requirements. While regulators will require auditable and robust methods of verifying catch documentation, consideration also needs to be given to what is practicable for masters and their crews in terms of providing adequate catch estimation without unnecessary regulatory and financial burden.

There would appear to be scope for the use of REM data for a number of applications beyond the verification of catches and discard monitoring. Such applications may include the monitoring of protected species by-catch, monitoring of activity in marine protected areas and the provision of enhanced scientific data for improved stock assessments and the determination of trigger levels for real time closure areas.

Key findings and recommendations

1. Minimal quantities of discards (0.2 per cent of total catches across all species) have been observed for discard-prohibited species during catch sorting operations and we consider it inevitable that some very small amounts of discards will occur during the sorting operation despite the prohibition under the terms of the trial. This demonstrates the efficacy of the system as a means of reducing and monitoring discards and ensuring that catch mortality is fixed.

2. Overall catches of undersized fish were low (ranging from 0 to 3.4 per cent depending on species and gear type) and indicative of effective selectivity methods

3. Accuracy in estimating catches by both observers and fishing vessel masters on each fishing operation was subject to variation depending on the method of sorting and volume of catches. It is considered that alternative methods of quantifying catches should be explored as part of ongoing trials including the use of accurate weighing systems or agreed catch handling protocols

4. Time taken to analyse trips ranged between 3 and 6 hours with an average analysis time of 4 hours. The vessels requiring the most analysis time were the netters and the beam trawler being monitored for three species. There were a number of variables which dictated the time

taken to analyse a single vessel voyage apart from the number of species being monitored. Haul frequency, duration and method of sorting operations were key parameters affecting analysis times.

5. There can be difficulty in differentiating between certain species on CCTV footage, notably between common sole and sand sole, and between plaice and flounder. In such circumstances a requirement to prohibit discarding of both species could be considered in future trials in order to be able to police a discard ban effectively.

6. REM and CCTV equipment is considered to be generally robust with few faults reported. Where faults have occurred rectification has been carried out without undue delay. There is scope to mitigate the risk of faults occurring. An adequate service infrastructure will be required to support a larger number of vessels.

7. REM analysis software is highly effective. However, quantifying catches can still be time consuming. It is considered that means of reducing analysis time should be explored as part of the ongoing trials.

8. Future trials should examine the impact of a catch quota system on current technical regulations and flexibility is likely to be required to allow participant vessels to retain catches that do not conform to these rules.

9. Future trials should aim to quantify catches of choke species to assist in gauging the impact of including such species in a discard prohibition.

Annex 1: Participating vessels – North Sea and proposed cod selectivity/avoidance measures

Vessel	Overall length	Engine power	Gear type	Additional quota (tonnes)	Species	Start date	Proposed selectivity and avoidance measures
1	14.95	298.4	Otter	18	Cod	15/3/11	Scalloping in May/June. Squid fishery in August. Area VII cuttlefish fishery in October. General avoidance of juvenile cod.
2	9.8	186	Long line	6.8	Cod	15/3/11	Long lining for cod with large hooks. Sole fishery during the summer months.
3	21.5	485	Otter	62.5	Cod	04/3/11	130 mm cod ends. Diversification to flatfish and haddock fisheries or nephrops using large mesh square mesh panel or Swedish grid.
4	40.2	1880	Otter	5	Cod	12/4/11	Targeting deep-water saithe fishery with cod by-catch of less than 5 per cent.
5	18.91	186	Nets	11.4	Cod	02/3/11	170 mm gill nets to select for large cod with short soak time.
6	17.27	142	Nets	15.7	Cod	24/3/11	170 mm gill nets to select for large cod with short soak time. Target Area VII pollack in summer months.
7	18.25	309	Otter	15.8	Cod	18/3/11	Avoidance of juvenile cod. Target plaice over summer months.
8	18.26	309	Otter	18.8	Cod	30/3/11	Targeting saithe in the Norwegian sector and plaice in the summer.
9	18.27	350	Otter	21	Cod	11/3/11	130 mm cod ends for whitefish fishing. Diversification to oil standby work. Target nephrops for part of the year using 99 mm cod ends.
10	21.2	347	Otter	25.7	Cod	24/3/11	Use of large mesh square mesh panels. Avoidance of areas of abundance of juvenile cod, particularly inshore grounds.
11	21.67	448	Otter	27.6	Cod	22/3/11	Use of large mesh square mesh panels. Avoidance of juvenile cod abundance. Plaice and lemon sole fishery over summer months.
12	23.13	354	Pair	32.4	Cod	11/3/11	Diversification to haddock, flatfish and Nephrops fisheries. Use of large mesh square mesh panel and Swedish Grid.

Annex 2: Participating vessels – Western Channel and proposed selectivity measures

Vessel	Overall length	Engine power	Gear type	Additional quota (tonnes)	Species	Start date	Proposed selectivity and avoidance measures
13	30.55	709	Beam trawl	4	Sole	16/4/11	Increased mesh size in headline and belly. Targeting cuttlefish through the winter months. Diversification outside VIIe sole fishery for alternative stocks.
14	28	738	Beam trawl	4.5	Sole	20/4/11	Increased mesh size in cod end and headline panel. Diversification from VIIe sole to other ICES areas and general avoidance of juvenile fish concentrations. Targeting cuttlefish through winter months.
15	23.97	220	Beam trawl	3.3 2.4 0.7	Sole Anglerfish Plaice	29/4/11	Use of square mesh cod ends, increased mesh size in headline panel and belly and improvements to ground gear to reduce overall discards of juvenile fish and benthos.

Annex 3: Terms and conditions

Catch quota management scheme with remote electronic monitoring (REM) for North Sea cod

Overview

1. This is a voluntary scheme. It is based on catch quota management, not on traditional landing quotas. The catch quota management system (CQMS) will operate in the 2011 quota management year and be applicable to cod only.

2. The purpose of this project is to assess the capability of the CQMS to reduce discards, reduce stock mortality, provide better scientific data and encourage fishermen to fish more selectively.

3. The main features for vessels participating in the CQMS are that:

    - all cod caught shall count against quota
    - all cod caught shall be retained on board and landed
    - fishermen will have the responsibility to document that all fish caught are accounted for.

4. The main objectives of the scheme are to:

    - reduce discard levels
    - reduce fishing mortality rates for cod
    - provide evidence and experience from the scheme for the reform of the Common Fisheries Policy (CFP)
    - provide further detailed evaluation of using catch quotas as a fishery management and discard reduction tool
    - enhance our data collection and improve fisheries science and advice.

Eligibility

5. To allow for effective management, monitoring and communication, eligibility shall be limited to English vessels only. For the purposes of the CQMS an English vessel shall be defined as English administered at a Marine Management Organisation (MMO) coastal office.

6. In order to be eligible a vessel must be a member of a producer organisation (PO).

7. A vessel engaged in pair trawl activities shall only be eligible for the scheme if both vessels are signed up to the scheme.

Additional quota and days at sea

8. Each vessel will receive additional quota for cod based on evidence presented on its track record of annual landings (average yearly landings reference period 2007-2009 – fish landed under scientific dispensation schemes will not be included in this track record). The additional quota allocation will be based on the bid made in its application form. The maximum allocation is up to 30 per cent above the track record of cod a vessel has landed according to the reference period.

9. Once a vessel has reached its total quota allocation for cod it will be required to cease all fishing operations which can catch cod in the North Sea (ICES subareas IV, EU waters of IIa, the part of IIIa not covered by the Skagerrak and Kattegat). Vessels are therefore strongly

encouraged to consider the use of highly selective gears and continue avoidance behaviours to ensure this scenario does not arise. While additional quota can be leased in during the year, this additional quota will not qualify for the pro rata increase in quota given at the start of the management year.

10. Vessels fishing in Norwegian waters with gear capable of catching cod must ensure that they have sufficient cod quota to account for any by-catch and so comply with Norwegian discarding rules. If such quota is exhausted then fishing operations must be stopped.

11. Participating vessels will be subject to the days at sea regime, and may be offered additional days at sea to encourage cod-avoidance behaviour. The amount of additional days made available will depend upon the overall constraints of the 2012 days at sea regime. Participating vessels cannot transfer out any additional days at sea.

12. Owners of participating vessels will be issued with a document ("a CQMS participation document") stating that they are part of the project, have had additional quota made available and have dispensation from specified offences that may occur in the routine operation of this scheme. The CQMS participation document must be carried on board the vessel at all times.

Discards and undersize cod

13. Vessels must not discard any cod.

14. Discarding of species other than cod will be allowed providing it adheres to the requirements of the high grading ban (for details of the high grading ban contact a local MMO office).

15. Undersized cod must not be sold or offered for human consumption but should be disposed of by sending for processing into fishmeal or offering as bait to static gear operators.

16. Undersized cod must be kept in separate containers and not be mixed with fish above the minimum landing size. Boxes of undersize cod should be stowed separately. Undersize cod that are landed must be clearly marked with an indelible food dye at the time of discharge in order that it cannot be sold for human consumption. The MMO must be notified of which processors or static gear operators have been nominated to handle undersized cod.

Remote electronic monitoring (REM) system

17. If the vessel is not suitable for the installation of the remote electronic monitoring equipment for any reason, the vessel may not participate in the scheme.

18. Positioning of cameras for the duration of the scheme will be decided in co-operation with the fishing vessel master so as to ensure that observers can monitor the process to obtain a good assessment of the catch. Cameras must not be moved or altered without approval from the MMO. Only personnel authorised by the MMO will be able to carry out repairs and maintenance.

19. Due to the need to cross-verify the effectiveness of electronic monitoring, observers will be required on board participating vessels from time to time.

20. The sorting and handling of all catches must be carried out in full view of the cameras. Defra reserves the right to place additional cameras on board participating vessels as required.

21. The systems must remain switched on at all times regardless of the sea area in which the vessel is operating.

22. In the event of equipment failure the master must notify the UK Fisheries Call Centre (UKFCC) as soon as they become aware of the failure. The trip may be completed before return to port but the vessel will not be allowed to return to sea until the equipment is fully functioning again. Early communication of any equipment problems will allow the MMO to take steps to ensure that the problem can be corrected as soon as possible on the vessel's return to port.

23. In relation to the equipment installed there shall be a duty of care placed on the master as laid out in the duty of care code. It is the responsibility of the master to ensure that crew are aware of and compliant with, the terms and conditions of the CQMS. Failure to do so will result in removal from the CQMS.

24. Skippers and crews must:
    - allow observers on board and make suitable provision for their comfort
    - not tamper or interfere with the work of observers
    - not tamper or interfere with the on-board REM equipment
    - not deliberately block the view from REM equipment to the vessel's catch-handling areas
    - not deliberately attempt to handle or discard catch out of the view of REM equipment
    - not carry out trans-shipment operations (either receiving or donating catch) with other vessels.

25. The MMO will provide regular feedback to vessel masters on their catch handling procedures to ensure that catches can be monitored easily.

26. The REM system is the property of Defra. The master of the fishing vessel must make himself and the vessel available prior to the start of the scheme for a period of up to three days to allow installation of the monitoring systems and for one day after completion of the trial for the equipment to be removed.

Control and enforcement

27. It is important that vessels are inspected to ensure accuracy of data and that the rules of the project are being adhered to. Vessels will therefore be subject to ongoing monitoring and evaluation to confirm this. The master of the fishing vessel must facilitate vessels' inspections whenever requested by a Marine Officer.

28. The MMO will inspect vessels in port and at sea as part of their risk-based control regime.

29. Breaches of the scheme will be investigated by a disciplinary board consisting of the relevant Defra policy lead, the CQMS Trial Manager and the senior MMO official. The board will be responsible for establishing whether a vessel is deemed to have been non-compliant with the requirements of the scheme. The disciplinary board's decision shall be final.

30. Any breach of the scheme that potentially indicates an offence in law will be handed to the relevant authorities for further investigation. Vessels prosecuted for a fishery offence that occurs within the duration of the scheme will be referred to the disciplinary board. The board will review the vessel's continued participation in the scheme in relation to the offence.

Conditions placed on the participating vessel

31. If a participating vessel is sold or exchanged, that vessel will be removed from the project. All remaining quota made available under the CQMS will be removed from the vessel's allocation.

32. In the instance of sudden unforeseen circumstances, such as sinking or disablement of a vessel, a replacement vessel may take part in the scheme providing the replacement is agreed by the MMO prior to any commitment being made. REM equipment must be provided by the project participant.

33. Loss or damage caused by the negligent acts of the master or crew in relation to the REM system will not be the responsibility of Defra or the MMO.

34. Project participants must have sufficient insurance to cover the loss or damage of all parts of the REM system.

35. Defra or the MMO must be compensated for any repair or replacement to the REM system where damage or loss has occurred as above. The master of the fishing vessel shall not repair or replace any part of the REM system.

36. Project participants may be able to change vessel and remain on the project once in the project term. Any potential change should receive prior confirmation in writing from the MMO so that the owner can be sure that the replacement vessel will remain in the scheme before they make any commitment.

37. If a participating vessel is removed from the scheme, or leaves the scheme voluntarily, then the additional quota and days granted under the terms of the scheme will be deducted from their current and/or future allocations.

Data control and handling

38. The MMO and Defra will appoint data controllers. Data controllers will determine dissemination of the recorded data.

39. Footage and data gathered may be used in an aggregated and anonymous form in publications and reports produced by, for and on behalf of the MMO and Defra. All data will be treated as commercially sensitive. The data will be owned by Defra.

40. Enquiries made under Freedom of Information (FOI) legislation will be answered following normal FOI guidelines. However, personal data (which includes CCTV footage and data) will not be released.

41. System hard drives from vessels will be collected at regular intervals from vessels following liaison with the master of the fishing vessel. At this time a replacement hard drive will be fitted to allow the vessel to continue fishing operations.

42. Data from vessel hard drives will be transferred to a secure server for processing. The cleared hard drive will then be rotated back to the vessel.

43. The data/footage on the vessels' hard drives and servers will be erased after six months (from the date recorded), unless required for ongoing enforcement action. Some data may be temporarily retained for up to six months after the end of the project to provide a record of the scheme and allow scientific papers to be written.

44. Information obtained by the REM system and by observers will be retained and used for the purposes of the project only, except that such information may be released to other bodies if it is necessary for the investigation or prosecution of persons, or for any other purpose required by law.

45. Data may be retained for longer periods or for uses other than those listed above only with the express written consent of the vessel owners.

General conditions

46. All vessels operating in the scheme must complete an EU logbook regardless of whether they would complete such a logbook under normal fishing operations. All cod must be recorded in the logbook.

47. Vessels must also complete additional trip details as required by the MMO.

48. Participating vessels must immediately report to the UK Fisheries Call Centre (UKFCC) any catches that meet the catch rate trigger levels of the real time closure (RTC) scheme and/or the juvenile RTC scheme (contact a local MMO office for details of RTC scheme). Project participants are not exempt from the real time closure schemes.

49. Participating vessels can buy-in and lease additional cod quota from other sources outside the CQMS. Bought in and leased cod quota will also be subject to the rules of the catch quota scheme. Participating vessels must not sell or lease out cod quota to vessels within or outside the catch quota scheme.

Penalties

50. Vessels found to have breached the above conditions will be subject to a range of penalties depending on the seriousness of the offence. This will include removal from the scheme and deduction from current or future allocations of all their additional received quota and days.

51. Vessels removed will not be permitted to join any CQMS in the following year.

Change of scheme rules

52. Defra reserves the right to change any of the rules of the scheme at any time.

Annex 4: Duty of Care Code 2011

1. The MMO, or their representative, will fit cameras and sensors to the vessel. The master and crew will not interfere with the positioning of sensors or cameras.

2. The cameras and all equipment fitted remain the property of Defra.

3. The master must ensure that all discards can be monitored by the cameras.

4. The master will be expected to maintain clean lenses on the cameras at all times. We expect that cameras should be washed and dried on a regular basis and at least daily.

5. The master should ensure that the prescribed self test on the system is carried out at the start of each day to ensure that the full system is working correctly and that an action is electronically recorded by all cameras.

6. The master will report any damage, disruption or technical failure to the UK Fisheries Call Centre immediately:

   Telephone: +44 (0)131 271 9700
   Fax: +44 (0)131 244 6471
   Email: UKFCC@scotland.gsi.gov.uk

7. The master will be responsible for maintenance and repair of the REM system. Only engineers authorised by the MMO will be able to carry out repairs.

8. The MMO will endeavour to resolve any technical problems promptly on the vessel's return to port. Early notification of technical failures will expedite that process.