Seafish Internal Report IR1468

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Date: March 2005

A Demonstration Project Examining High Quality and Selective Haddock Fishing by Scottish Vessels

Summary:

A detailed project was undertaken to examine the abilities of a group of vessels to selectively target haddock under their normal fishing practices and patterns. The study was carried out by the Sea Fish Industry Authority (Seafish) between August 2003 and September 2004. The data for the study was collected during a number of observation trips undertaken between August 2003 and August 2004.

The focus of the study was to ascertain whether such vessels could successfully target haddock at a commercial level, avoiding the catch of large numbers of the pressurised cod stock. Data was collected from each participating vessel in order to quantify the actual volume of haddock and cod being fished during the observed trip.

The project revealed that the group of vessels studied were able to target both haddock in the manner claimed. They were able to demonstrate that through a combination of correct gear selection, historical knowledge, expertise and seasonal changes that this could be achieved with a minimal uptake of cod bycatch.

From data collected in this study, the volume of haddock caught over a trip ranged from 48.1% to 84.8% of the total number of fish caught. Similarly, volume of cod ranged from 0.0% to 3.0% of the total number of fish caught.

These findings serve to assist in dispelling the common misconception that if a boat is targeting a demersal species in the waters around Scotland, then it must

be having a severe impact on stocks of pressured species such as cod. This study has clearly demonstrated that this is indeed not the case.

In addition, the study reviewed the on-board fish handling systems and regimes operated by these vessels. The handling practices were observed for the duration of each trip and attempts were made, where possible, to assist and advise each vessel in maximising the catch quality in order to supply a premium quality product to the marketplace.

Acknowledgments

The author would like to express his thanks to all the vessel owners who agreed to participate in this study, to the vessel masters who allowed observers to accompany their boats whilst fishing and to the crews who assisted those observers in gathering data.

Thanks are also given to Marks and Spencer PLC for their input at the project design stage and their active support throughout. In particular, for their involvement during a number of discussions involving groups of fishermen from the NE of Scotland, Cavaghan & Gray Ltd and Seafish.

Further thanks are passed on to Cavaghan & Gray Ltd, Aberdeen for their assistance in the identification of vessels for the study also for assisting with the gathering of data from their operation in order to undertake fish quality assessments for the study.

Further acknowledgement is given to both the Scottish Executive and Seafood Scotland through which partial funding and administration was secured from EU FIFG grant allocation.

Thanks are also given to the members of the Seafish Technology Department who have provided advice and guidance in the sampling techniques used for the on-board catch sampling.

A final thank you goes to all Seafish colleagues who have helped in the final presentation of this work.

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1. Introduction

1.1. Background

The exploitation of whitefish species from the mixed fisheries in the North and Irish Seas, the waters West of Scotland and the Skagerrak has resulted in attention being focused on stocks of the Atlantic Cod (Gadus morhua).

This species has been assessed as endangered and close to collapse by bodies such as ICES (The International Council for the Exploration of the Sea; and IUCN (The World Conservation Union). In response, the EU in an effort to reduce fishing pressure has cut quotas of cod by 45% and limited fishing in some of these waters to fifteen days per month.

The North Sea is a mixed fishery with a range of species being caught. Unless fishermen employ specific measures there is a danger that cod will be caught as a bycatch.

Marks and Spencer have drawn up “Principles of Corporate Social Responsibility” for their stakeholders. These state that Marks and Spencer will take care and act responsibly in delivering high quality products and services and that it will strive to achieve the best balance in quality, value for money, social well-being and environmental protection. Therefore the company makes every effort to source raw material from sustainable sources. As a result, they no longer sell cod from the North or Irish Seas but source supplies of cod from stocks such as those in Icelandic waters which are deemed sustainable.

Marks and Spencer is committed to working with the fishing industry in an attempt to reverse the decline in world-wide fish stocks. The company has recognised the high dependency of the Scottish fishing and processing community on the use of haddock. It perceives a clear need to take a leading role in establishing a project which maintains the supply of high quality haddock from the Scottish fleet but in such a way that has a minimal effect on the particularly pressurised cod stock.

In pursuit of this objective, Marks and Spencer has developed close relationships, using one of their key suppliers, Cavaghan and Gray Ltd with a number of fishermen supplying quality Scottish haddock. During discussions with their suppliers, Seafish and a number of fishermen, it was stated that this supply of fish was being caught responsibly with a low or negligible bycatch of cod if the vessels operated in a specific geographic area and manner. It was agreed that Seafish should independently investigate this claim.

1.2. Objectives

The project had a number of objectives: -

- To conduct an initial survey on the fishing activities and methods being undertaken on the MFV “AALSKERE” K373. This vessel had been identified as providing very high quality haddock and landing very little cod bycatch.

- To verify claims by the MFV “AALSKERE” and other vessels that they could fish haddock and catch very low volumes of cod as incidental bycatch.

- To investigate the fishing activities and methods practised on-board a number of key vessels which target haddock as their principle species. The study would look particularly at those vessels that catch haddock for use in Marks and Spencer products.

- To compare and evaluate the source and quality standard of raw material supplied to Marks and Spencer through their major supplier of primary processed products.

- To monitor and review the existing fish handling practices which result in the landing of product of the highest quality. To provide participating vessels with assistance and advice where possible and to improve their fish handling.

1.3. Scope

The study was limited to Scottish white fish vessels landing haddock to Cavaghan and Gray Ltd to be used to manufacture products for Marks and Spencer.

1.4. Resources

This project was undertaken principally by the Seafish Trade & Quality Team. Assistance was provided by Cavaghan & Gray Ltd and by some members of the Seafish Marine Technology team. When Seafish staff where committed elsewhere, fully trained third-party observers were used.

Partners contributing financially to this study included Marks and Spencer PLC, Seafood Scotland and Scottish Enterprise.

Advisory support was provided by the Scottish White Fish Producers’ Association.

1.5. Methods

Observation trips onboard vessels were carried out mainly by Seafish staff.

Over the duration of an observed trip records taken included vessel information, methods of fishing, type and details of gear used. Records of fishing activity were kept throughout the trips. These included fishing area, vessel, speed, tow times and times taken to haul and shoot gear.

In addition, a record of fish handling operations carried out by the crew was taken from the time the catch was emptied from the nets until it had been stowed in the hold. During this period, observations were made on the standards of gutting, washing, icing, boxing, packing and stowage. Fish temperatures were monitored throughout the exercise.

Data was collected by sampling the catch on a haul by haul basis. The minimum sampling rate was every second haul. If resources, time and working conditions allowed, samples were taken on a more frequent basis.

The sampling method was as follows:-

- A catch sample was taken from the haul prior to any selection by the crew. Four baskets were taken from each haul. This typically represented a quantity of mixed fish weighing over 100 kg.

- The crew then split the sample into two lots - those fish that in a commercial operation would normally be retained and all those fish that would normally be discarded.

- Each lot was then taken and further separated into three “species” groups, i.e. haddock, cod and “all other species”. These three groups were chosen to highlight the two species of particular interest to this study plus a group representing the remainder of the catch.

- Once divided, each “species” group was weighed and the fish individually counted and data recorded.

- Records taken on a haul by haul basis were tabulated to provide a record of the trip as a whole. An example can be seen at Appendix 2.

The sampling operation was designed around the working practices of each vessel and had to accommodate such matters as the use of deck handling equipment, location of the sampling area and the positioning of the crew. A balance was struck between ensuring efficient data collection and minimising any disturbance to the working efficiency of the vessel.

Throughout all sampling activity, care was taken to ensure that: -

- As many hauls as possible were measured over the course of the trip.

- All samples were representative of the ‘ocean run’ mix of species hauled in the net.

- All possible precautions were taken to avoid bias when splitting the sampled material.

2. Industry Participation

2.1 Target Vessels

An initial list of vessels targeting haddock in a mixed demersal white-fish fishery was prepared by Cavaghan and Gray Ltd. Individual vessel owners and skippers were consulted to establish whether they believed they could achieve a commercial haddock catch with a minimal incidental cod bycatch. Only those who made this claim were considered for inclusion in the study.

A variety of vessels were sought, both in terms of vessel size and fishing methods to reduce any potential bias.

Participation in the study was entirely voluntary. Once a vessel had been selected, the area to be fished during the trip was left entirely to the discretion of the skipper. Vessels were encouraged to operate in a normal commercial manner throughout a trip.

At the end of the trial period a total of eight fishing trips had been undertaken. The intention to study trips with a variety of catching methods had been successfully accomplished. One vessel had been studied twice as the first trip had been cut short due to poor weather.

2.2 Fishing Methods

The vessels taking part in the study fished a number of different methods including single trawl, twin rig trawl, single boat seining and pair seining. A description of these fishing methods can be found in Appendix 1.

2.3 On Shore Study

This study also provided an opportunity to assess and compare the quality of haddock landed to Cavaghan and Gray by the target vessels with product purchased by them from other sources such as local auction markets. The company was able to provide from existing factory records, their assessments of all incoming raw material. Their quality assessments included fish temperature on delivery, fish freshness, checks on the standard of gutting and washing, checks for evidence of foreign bodies, checks for evidence of physical damage and an assessment of the condition and hygiene standard of the delivery vehicles.

Data for this study could be extracted from these records without placing undue extra workload on the processor.

3. Project Results and Observations

3.1 Presentation of Data

An example of the haul record for one trip is set out in Table 1 below.

Table 1 - Trip Record Example: Haul Record of Numbers of Fish and Weights of Species Groups

Haul No.	HADDOCK				COD				OTHER SPECIES			
	Retained		Discarded		Retained		Discarded		Retained		Discarded	
	No. of Fish	Weight (Kg)	No. of Fish	Weight (Kg)	No. of Fish	Weight (Kg)	No. of Fish	Weight (Kg)	No. of Fish	Weight (Kg)	No. of Fish	Weight (Kg)
1	89	57.6	69	16.9	0	0.0	0	0.0	8	3.1	63	7.7
2	99	49.4	63	10.2	0	0.0	0	0.0	16	7.5	225	20.3
3	103	48.6	101	15.9	0	0.0	0	0.0	21	16.9	72	8.3
4	140	55.0	53	9.2	0	0.0	0	0.0	21	13.1	67	6.8
6	191	68.4	63	9.9	0	0.0	0	0.0	10	5.8	32	3.4
7	121	54.8	103	15.2	0	0.0	0	0.0	5	4.3	52	6.5
8	179	68.5	98	14.9	0	0.0	0	0.0	3	1.2	67	7.9
9	164	61.9	73	9.3	0	0.0	0	0.0	4	1.6	53	6.3
11	118	59.3	40	5.2	1	2.4	0	0.0	5	4.4	79	10.1
12	150	62.6	78	9.1	0	0.0	0	0.0	6	3.1	105	11.6
13	135	56.8	47	5.9	0	0.0	0	0.0	10	5.4	91	11.2
15	128	45.4	61	8.3	1	8.4	0	0.0	11	13.5	75	7.6
Total	**1617**	**688.3**	**849**	**130.0**	**2**	**10.8**	**0**	**0.0**	**120**	**79.9**	**981**	**107.7**

This data can be utilised to provide the percentage of fish for each species group (haddock, cod and 'other species') in terms of both numbers of fish and biomass (Kg). Also the average weight per fish from each species group can be calculated from the total number and weight of fish sampled. An illustrative example of such a data table is shown in Table 2 below.

Table 2 – Example: Calculated Retention Factors and Average Weights

HADDOCK				COD				OTHER SPECIES			
Retained Factor (%)		Discarded Factor (%)		Retained Factor (%)		Discarded Factor (%)		Retained Factor (%)		Discarded Factor (%)	
№ of Fish	Kg	№ of Fish	Kg	№ of Fish	Kg	№ of Fish	Kg	№ of Fish	Kg	№ of Fish	Kg
65.6	84.1	34.4	15.9	100.0	100.0	0.0	0.0	10.9	42.6	89.1	57.4
Average Weight (Kg)				Average Weight (Kg)				Average Weight (Kg)			
Retained		Discarded		Retained		Discarded		Retained		Discarded	
0.426		0.153		5.4		0.0		0.665		0.109	

3.2 Real Catch Ratio

We have chosen to identify the level of species selectivity achieved during a trip in terms of the real catch ratio (RCR). This has been calculated on the numbers of fish caught, not on its biomass (Kg). It must also be stressed that this ratio is calculated prior to any selection for commercial or legal requirements.

The RCR for each of the eight trips is tabulated below.

Table 3 - The Real Catch Ratio: [RCRs] (Calculated on the numbers of sampled fish caught)

Observed Trip No.	Date/Duration (days)	Fishing Method	Haddock RCR % (No. Fish)	Cod RCR % (No. Fish)	Other Species RCR % (No. Fish)
1 (a)	10-2003 (10)	Twin Rig	67.0	2.5	30.5
1 (b)	10-2003 (10)	Single Trawl	52.1	14.1	33.8
2	11-2003 (9)	Pair Seine	61.9	2.6	35.5
3	01-2004 (9)	Seine Net	66.9	0.5	32.6
4	05-2004 (10)	Twin Rig Trawl	65.5	0.2	34.3
5	08-2003 (10)	Single Trawl	67.4	3.0	29.6
6	03-2004 (10)	Twin Rig Trawl	46.8	0.0	53.2
7 (i)	11-2003 (1½)	Seine Net	82.9	0.5	16.6
8 (ii)	08-2004 (3)	Seine Net	78.6	0.3	21.1

Notes

1(a) During the first part of the trip vessel 1 is targeting haddock.
1(b) Vessel 1 notifies the observer that there will be a break in fishing. The vessel steams to another area, changes gear set-up to accommodate new ground and states that for this section of the trip a mixed catch of haddock and cod is to be targeted.
7(i) Trip abandoned due to poor weather
8(ii) A repeat trip with the vessel from trip 7.

This table clearly shows that most vessels were successful in operating a catching policy which had good capture ratio of haddock. The ratio ranged from almost 83% haddock (trip 7i) down to 46.8% (trip 6). However, regardless of their degree of selectivity in capturing haddock, one clear overlying trend is that the % ratios of captured cod is minimal at 3.0% (trip 5) to zero (trip 6).

Trip 1 has been split into two sections; (a) and (b). During the first part (a) the vessel targeted haddock, during the second part (b), the skipper changed his fishing activity to actively target cod as well as haddock. With this intention clearly stated, the observer was able to separate the data sampling and show the different ratios for the two areas fished. When changing area, the gear was also changed. In this case following a deliberate decision, the capture ratio of cod is seen to increase up to a level of over 14%. This is significantly higher than on other trips.

A critique of the accuracy of the sampling achieved during this study is to be found in Appendix 2.

3.1 Vessel Report

Following the completion of a trip, a short report was produced for most but not all vessels. Reports were written on a confidential basis. They took the form of a short document summarising the observations made during the time aboard. Where possible, recommendations were made to help the vessel

improve standards of quality and hygiene with a view to achieving best practice.

Specific information fed back to vessels included:

- The observed catch ratio data.
- Quality of fish observed on landing.
- Standard of gutting, end result by hand and/or machine where appropriate.
- Standard of washing, the end result, duration in washers, temperature of water.
- Standard of icing, procedures observed and consistency.
- Standard of packing, overall presentation, consistency through the container
- Standard of weighing, procedures observed where applicable
- Temperature profiles records of time, temperature and cooling of fish packed on ice. This was used to help illustrate the standards of icing. Profiles were also recorded for the hold temperature over the duration of the trip. In some cases it was also possible to record the temperatures of product to the point of processing.
- Standard of hygiene observations on the cleaning schedule, in some cases feedback on simple swabbing tests for key contact surfaces in the fish handling and hold areas.
- Catch ratio data (RCR) as calculated for the trip together with retention factors.

At the end of a trip or shortly after, the observer would normally advise the skipper of the main findings and outcomes. This was considered to be particularly important if a written report was not requested.

An abbreviated example of a report appears in the Appendix 4.

3.2 Onshore Quality

The main aim for this part of the study was to investigate the quality of haddock being used at the factory of Cavaghan & Gray, Aberdeen for its business with Marks and Spencer. In particular to assess the quality of raw material being received from the vessel MFV “AALSKERE” and that purchased regularly from other vessels. Raw material from the MFV “AALSKERE” was perceived to be of a consistently high quality, this part of the study would serve to verify this. An evaluation of the quality standard of

purchased raw material carried out in this way could then be used as a benchmark to which all other supplies would strive to attain.

Following purchase from either a market or a vessel, physical checks on the quality of raw material are carried out immediately on arrival at the factory. As part of the quality assurance role within the company, these raw material checks take place on a daily basis. This information was then passed to Seafish personnel to collage and analyse the data.

The assessment focussed on the haddock raw material under three attributes; quality (freshness) indicators, temperature and size and handling indicators. The checks were carried out formally using a standard format as prescribed by the QA Department within Cavaghan and Gray Ltd.

- *Fish Quality (Freshness):* A freshness score incorporating the eyes, gills, odour, appearance and colour of the skin and firmness of the flesh.

- *Temperature and Size:* A score relating to the suitability of the size range of the fish together with the physical temperature of the fish on arrival at the factory, this score combined the presence and amount of ice in the fish containers.

- *Handling:* A score relating to the standards of the washing and gutting of the fish together with the presence of physical damage and foreign bodies.

The data was collected between September 2003 and February 2004.

The assessments were all carried out by trained staff within the QA department of Cavaghan and Gray. The individual assessments were split into two groups, those made on fish purchased directly from vessels and those made on fish purchased at auction from markets around Scotland.

A scoring system (Appendix 3) was applied to the identified attributes.

The results are tabulated in Table 4 below.

The scoring system devised was entirely arbitrary. It was put together purely to provide a means by which to evaluate and quantify the quality assessments being carried out by Cavaghan and Gray as part of their management controls concerning the procurement of raw material. Table 1 in the Appendix illustrates the scoring policy for this quality evaluation.

Table 4 - Onshore Quality Evaluation

Origin of Raw Material	Temperature/ Size Score *	Quality Score *	Handling Score *	Overall Rating	Overall Rating (%)
Market Purchase	8.9	13.9	10.5	**33.3**	**85.4**
Direct Purchase	8.9	16.1	12.0	**37.0**	**94.9**
M.F.V. "Aalskere"	9.0	16.2	12.0	**37.2**	**95.4**

* Maximum score for Temperature/Size = 9; Maximum score for Quality = 18; Maximum score for Handling = 12.

From the above table, it can be seen that there is no significant difference in the scores for fish temperature and size specification between the fish purchased directly or from fish purchased from markets.

The fish supplied by the M.F.V. "AALSKERE" showed a marginally better temperature score compared to these two groups as a whole. It is likely that this slightly higher score was achieved due to the fact that the temperature of fish was consistently good and showed no variations. The vessel uses liquid ice as the cooling medium for all of the catch. Liquid ice has shown to be extremely effective in rapidly cooling and stabilising the temperature of the catch.

Marginal differences were seen to occur between the two groups. The scores obtained from fish purchased directly, including the fish from the MFV "AALSKERE", are slightly higher than material purchased from the markets.

The final part of the overall quality assessment considered how well the fish had been handled prior to arrival. None of the groups showed any evidence of crushing or foreign bodies in the raw material. Some of the raw material from the markets varied a little in the quality of washing and gutting compared to the raw material obtained directly.

When the three parameters were put together as an overall score (%) it can be seen that the average score for market purchased fish was 85.4%, the average score for directly purchased fish was 94.9%. The average score for the MFV "AALSKERE" which made up part of the direct purchase group was 95.4%, bearing out claims for this vessel.

4. Outcomes

4.1 Summary of Findings

The results of this small study have revealed a number of key findings. The first is to indicate clearly the ability of boats to successfully catch haddock by a number of different fishing methods without seriously impacting on cod stocks.

From the observed trips over the duration of this study the following points can be clearly noted:

- Real Catch Ratios of haddock, calculated for vessels over the duration of the trips studied, ranged from 48.1% to 84.8% of the total number of fish caught.
- Real Catch Ratios of cod, calculated for vessels over the duration of the trips studied, ranged from 0.0% to 3.0% of the total number of fish caught.
- On changing fishing tactics during a trip, one skipper was able to consciously increase the ratio of cod caught. In changing both the area being fished and the type of gear being used, the ratio of cod being caught rose from 1.5% to 14.6%. At the same time, the ratio of haddock only dropped from 53.9% to 51.4%.
- The boats in the study used a variety of gear types, fished in a wide range of waters but all displayed the ability to fish selectively for haddock and have minimal catches of cod.
- Although there were significant differences in the ratios of haddock caught by these vessels, the ratio of cod caught did not vary by such a wide degree.
- The study period for the trips involved in this project commenced in August 2003 and ended in August 2004, over this 12 month period all exhibited similar findings.
- The retention rate of haddock by weight, on these trips ranged from 53.5% to 99.5%. The average retention rate was calculated to be 85.3% of all haddock caught.
- The retention rate of cod by weight, on these trips ranged from 36.2% to 100.0%. The average retention rate was calculated to be 85.2% of all cod caught.

The quality evaluations made on haddock purchased for primary processing at Cavaghan & Gray Ltd, Aberdeen showed that:

- The overall quality rating ranged from 85.4% for raw material bought at auction, to 94.9% for raw material purchased directly from vessels.
- There was no difference in the suitability of the raw material in terms of the size specification and temperature of purchased fish from either source.

- There was a minimal difference in the handling score for material bought at auction (10.5) and for material bought directly from boats (12.0).

- The quality score was slightly better for raw material bought directly from boats (16.1) than from fish bought at auction (13.9).

- The M.F.V. Aalskere, one of the vessels from which fish was bought directly, showed an overall rating of 95.4%. This is marginally above the average score for fish purchased directly as a group.

4.2 Conclusions

It must be remembered that all the vessels selected for this study were fishing for haddock as their target species. In doing so, they were actively attempting to avoid the incidental bycatch of cod. Not all vessels when working in mixed demersal fisheries are taking the same measures to fish as selectively.

The results of the study show that these vessels achieved a high level of species selectivity during normal fishing activities. This could be attributed to a number of different factors i.e. the suitability of the gear to the ground being fished, the suitability of the gear to target haddock on the ground being fished, the fishing area or ground itself, the season within the year, personal or local knowledge gained with years of experience and the local fishing conditions at the time of each trip, i.e. the weather and state of tide.

More often than not, the strategy of this group of vessels will be a complex and dynamic relationship between most or all of the above factors in determining their success in achieving a high degree of haddock selectivity trip after trip. Nevertheless, whatever the individual boats preferred strategy may be, this study has showed that boats can be extremely selective in targeting a single species, in this case haddock, within the parameters of what is generally regarded as a mixed fishery. This serves to dispel the common misconception that if a boat is targeting a demersal species in the waters around Scotland, it must be having a severe impact on stocks of pressured species such as cod. This study has clearly demonstrated that this is not the case.

This study also examined the quality of haddock available to a large processor in the north east of Scotland. The core business of this processor is the primary processing of haddock as a raw material for further value adding. The quality of this raw material is paramount to meet the needs of their customer. The company purchases haddock either directly from boats or through fish markets around Scotland. This study found that the quality of raw material from both sources was high. It was noted that fish purchased directly from boats was of a marginally higher standard. This is to be expected as the company selects vessels which have historically provided haddock having a high standard of quality. Currently, not all procurement is made through direct purchase. Fish obtained through the auction system also displayed a good overall standard, presumably due to the individual skills of the company buyers. However, raw material purchased at auction was seen to be slightly more variable in quality than that which was purchased direct. This study

confirms that the company has adopted a proactive approach in securing as high a quality raw material as possible from supplies throughout Scotland.

During the course of this study the opportunity was taken to advise vessel crews of ways of improving yet further the standards of the catch they land. This has assisted a small sector of the fleet to improve the overall standard of raw material available to the processing sector.

This study has given added confidence that good quality haddock, is not only available from many dedicated vessels but that it can be fished in a responsible manner having minimal effect on the pressured stocks of cod. This will help maintain a positive perception of haddock with processors, retailers and consumers alike. It demonstrates that haddock, as one of the principle species currently being fished by many vessels around Scotland, can be fished successfully, responsibly and if properly managed, sustainably. It thus allows the industry to continue to supply a high quality and valued product to the consumer; in the knowledge that the fisherman has responded to the demands of the market by revising his catching approach with a high degree of selectivity.

Appendix I

Fishing Methods

Appendix 1

Fishing Methods

Trawl methods use a large net, which is towed behind the boat. The net is weighed down at the underside of the mouth to keep it close to or on the seabed. The upper side of the trawl mouth is fitted with floats which help to keep the mouth of the net open as it is towed along. Trawl doors or otter boards are attached to the wire ropes which tow the trawl. They are set at an angle to the direction of tow and help keep the net spread out over an optimum area. The fishing boat will tow the gear at a slow speed but at a speed which will overtake the fish swimming ahead of it. The fish tire and fall back from the mouth into the main body of the net. The net narrows as it reaches the end, this section is known as the bag or cod-end. This section of the net is used to lift the catch from the sea to the vessel once the trawl is complete.

Twin rig trawling involves a vessel using two nets running parallel to each other during the trawl operation. Larger vessels generally use this technique, as the degree of effort is far greater and requires much more power to operate. The two nets used for twin rig trawling are connected by a third towing wire which instead of having a trawl door attached, will have a large weight (clump) affixed to keep it weighed down. Trawl doors are still required to keep the outer sides of the trawl nets open in the same way as they keep the single trawl open.

Seine net fishing uses a completely different type of net and gear. To fish using the seine net, a boat will steam around the chosen catching area following a large 'triangular' track. When it commences this operation it first drops a buoy with a rope attached. As it steams around the fishing area it releases one rope which in turn is attached to the net. The net is usually then paid out over the second side of the 'triangular' area, and finally the second rope is released as it covers the third side which brings the boat back to the buoy. Once this has been done, the vessel hauls both ropes in simultaneously. It is hoped that the gear will have surrounded the fish. As the net nears the vessel the mouth narrows and again it will overtake the fish, leaving them caught in the cod-end.

Pair seine techniques involve two vessels using one set of seine net gear. The two vessels first release the net. Both then steam in opposite directions shooting the seine net ropes in a similar pattern as above. Once in position they will haul in the gear together. Vessels will usually take it turns to haul the catch from the net onto the boat. This method is almost identical to one vessel using the seine net however, with two boats the size of the gear and consequently the area that it covers will be far greater.

As a general rule, seine net gear is a lot lighter to use than trawl gear. Fuel usage is lower hence vessel running costs are lower. However, the use of the seine net can often restrict the vessel to areas of ground which are relatively free from serious obstruction. Trawl nets are far more flexible. They can be rigged in different ways and with large discs at the footrope, keep the net clear of obstructions when fishing rougher grounds.

Appendix II
Trip Comparison and Sampling Accuracy

Appendix 2

Trip Comparison and Sampling Accuracy

The sample data can be used to compare how well it reflects the actual catch over a whole trip. Using the forecasted average weight of each species group, the retention ratios of each species group together with the total amount of fish landed of all species at the end of the trip, the real catch ratio can be recalculated to reflect the total number of fish caught based on the actual landing of fish.

In the following table the real catch ratios have been recalculated in this way which reflects the projected ratio as applied to the landed volume of fish.

Table 1 - The Real Catch Ratio for the trip. [RCRt] (Number of fish caught projected using landed volume; sample retention rates; calculated average fish size)

Observed Trip	Date / Duration (days)	Fishing Method	Haddock RCR % (№ Fish)		Cod RCR % (№ Fish)		Other Species RCR % (№ Fish)	
1 (a)	10-2003 (10)	Twin Rig	53.9	(-13.1)	1.5	(-1.0)	44.6	(+14.1)
1 (b)	10-2003 (10)	Single Trawl	51.4	(-0.7)	14.6	(+0.5)	33.9	(+0.1)
2	11-2003 (9)	Pair Seine	49.2	(-12.7)	3.0	(+0.4)	47.8	(+12.3)
3	01-2004 (9)	Seine Net	71.3	(+4.4)	0.5	(-)	28.2	(-4.4)
4	05-2004 (10)	Twin Rig Trawl	67.1	(+1.6)	0.1	(-0.1)	32.8	(-1.5)
5	08-2003 (10)	Single Trawl	70.8	(+3.4)	2.8	(-0.2)	26.4	(-3.2)
6	03-2004 (10)	Twin Rig Trawl	48.1	(+1.3)	0.0	(-)	51.9	(-1.3)
7 (i)	11-2003 (1½)	Seine Net	84.8	(+1.)	0.2	(-0.3)	15.0	(-1.6)
8 (ii)	08-2004 (3)	Seine Net	71.7	(-6.9)	0.5	(+0.2)	27.8	(+6.7)

*(± %) Shows the variation of this RCRt as compared to the RCRs.

Generally, it can be seen that there is a very good correlation between the RCRs and RCRt. This reflects that the ratios of sampled species groups were a good representation of the overall retained fish for the trips on which they were calculated.

Where higher variations in the RCR occur, specifically on trips 1(a) and 2 this indicates there is some aspect of the sample data which does not wholly reflect the true proportion of the catch for the trip.

This may have been caused by: -

- The ratio of fish caught were of a significantly different mix on the hauls that were monitored compared to the ratios caught on un-monitored hauls.
- The ratio of the species groups sampled is in some way skewed from the true proportion caught.
- The ratio of fish species retained in the haul sampling is skewed from the true amount of fish retained by the crew.

The most likely explanation would probably be a combination of the latter two factors. It would be very unlikely that the proportions of the catch on the hauls that were not monitored were significantly different to the ratios of species caught on those that were. The variances would have to be enormously different to result in swings of 12 to 13% for the trip overall.

It should be noted that whatever the reason, these variations occur between the ratios of haddock and other species not between the ratio of cod and the other species groups. This reinforces the fact that even with some variation between the RCRs and RCRt the volume of cod caught remains very insignificant, any variance on the calculation for the RCR of cod is minimal.

Appendix III
Scoring of On Shore Handling and Quality Parameters

Appendix 3

Scoring of On Shore Handling and Quality Parameters

Standard Classification	Good	Satisfactory	Poor
Arbitrary Score	**3**	**1**	**0**
Standard			
Gutting	Viscera removed from all fish.	Some viscera remaining	Significant viscera remaining
Washing	All fish clean. No trace of sand/mud.	Most fish clean. Some sand/mud remaining.	Significant amount of sand/mud remaining.
Condition of fish container	Visually clean, fresh odour. Surfaces in good repair.	Scratched/minor damage presenting no risk to product. No foul odours.	In need of repair or dirty, potential to contaminate product.
Condition of vehicle cabinet	Visually clean, fresh odour, surfaces in good repair.	Minor repairs needed but presenting no risk to cargo. No foul odours.	In need of repair or dirty, potential to contaminate cargo.

Presence of Ice	Within Size Specification	Presence of Foreign Bodies	Presence of Crush Damage	Arbitrary Score
Y	**Y**	**N**	**N**	**3**
N	**N**	**Y**	**Y**	**0**

Product Temperature ºC	< -1ºC	-1 - +1ºC	+1 - +3ºC	> +3ºC
Arbitrary Score	**1**	**3**	**2**	**0**

Appendix IV
Vessel Report

Jess Sparks
Quality Adviser

Vessel Report – Seafish Observation Trip

Background

The observation work carried out on the vessel during the fishing trip between dd/mm-dd/mm. was aimed at satisfying and gathering information in relation to the following project.

Benchmarking & Demonstration Project – Conservation Grade Haddock

This involves the gathering of data to verify the catching ability in terms of haddock to cod together with the discard levels of haddock and cod. Measurement and sampling techniques are used to assess the real levels of capture and discard during a full fishing trip.
The vessel type, size, fishing gear and handling practices are also observed and verified.

Vessel Feedback

This report is designed to give feedback and advice on observations and results obtained from the trip concerning:

- Handling practices
- Temperature profiles
- Calculated catch ratios of haddock and cod
- Calculated discard levels of haddock and cod
- Quality and Hygiene Standards

Where possible, recommendations will be made to help the vessel achieve principles of 'Best Practice' for the handling and use of equipment aboard.

Observations and Recommendations

Handling practices

Standard of Gutting
Generally good for most species.

Hand Gutting
All fish are hand gutted, the standard attained was generally good. Although it is noted that when targeting large quantities of haddock a large proportion of fish are packed away as round.

Standard of Washing Well washed throughout.

The vessel washes product in one of two ways. The bulk of the fish passes through the main washer from the selection bins. Larger selections of haddock and higher value species are washed separately by hand. Both methods were observed to give a well-washed product before packing away. The average wash time was observed to be on average about four minutes.

Standard of Packing Good/Average

Larger selections and higher value species are well packed and presented. The round fish is generally bulk packed into boxes, the crew making efforts to align the fish lengthways in the box. Fish on the upper layers are hand-packed lengthways and belly downward.

Standard Weights

The vessel does not utilise any weighing or labelling system, quantities are measured by counting baskets into boxes to estimate volumes.

Nominal weights are around the 50 kg per box. It was observed that when packing fish to this volume, fish are not proud of the box rim; however, once ice is applied then there is a small degree of crush effect on the product.

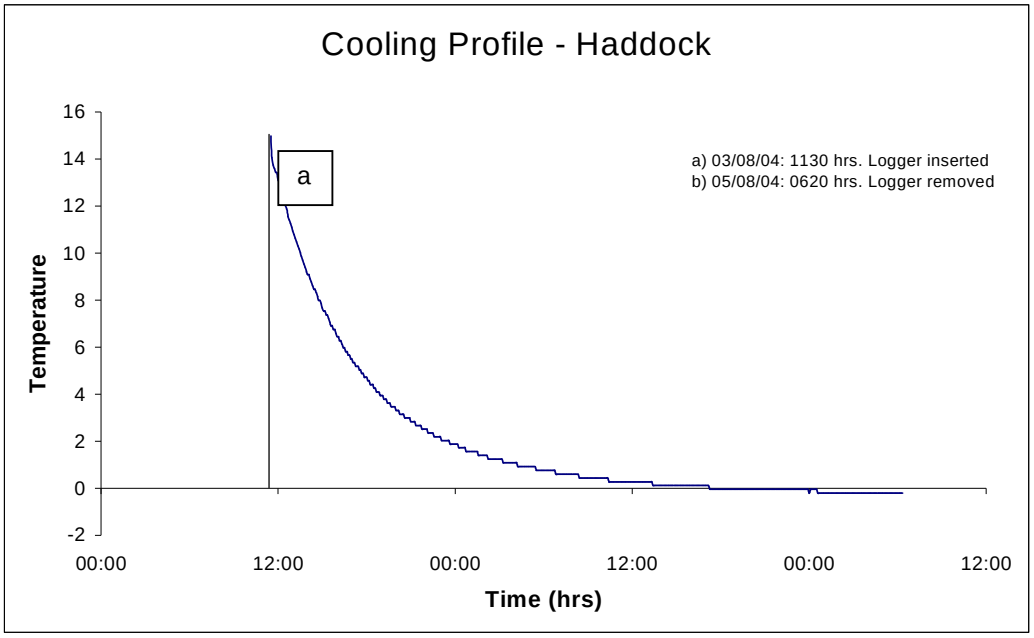
Many processors are finding advantage in having product labelled with at least the date to provide them with a product age. This is helpful in the workplace in identifying the older material, which can be processed first to maximise end product quality. In order to standardise boxweights and provide a traceable age-history for landed fish, many vessels as I'm sure you are aware are now weighing / labelling at sea. If you were to consider this route, then more advice and information can be provided.

Temperature profiles

Icing

Boxes of fish were observed to be iced top and bottom. A quantity of ice is applied to the box before filling, once the box is fully packed a top layer of ice is then applied.

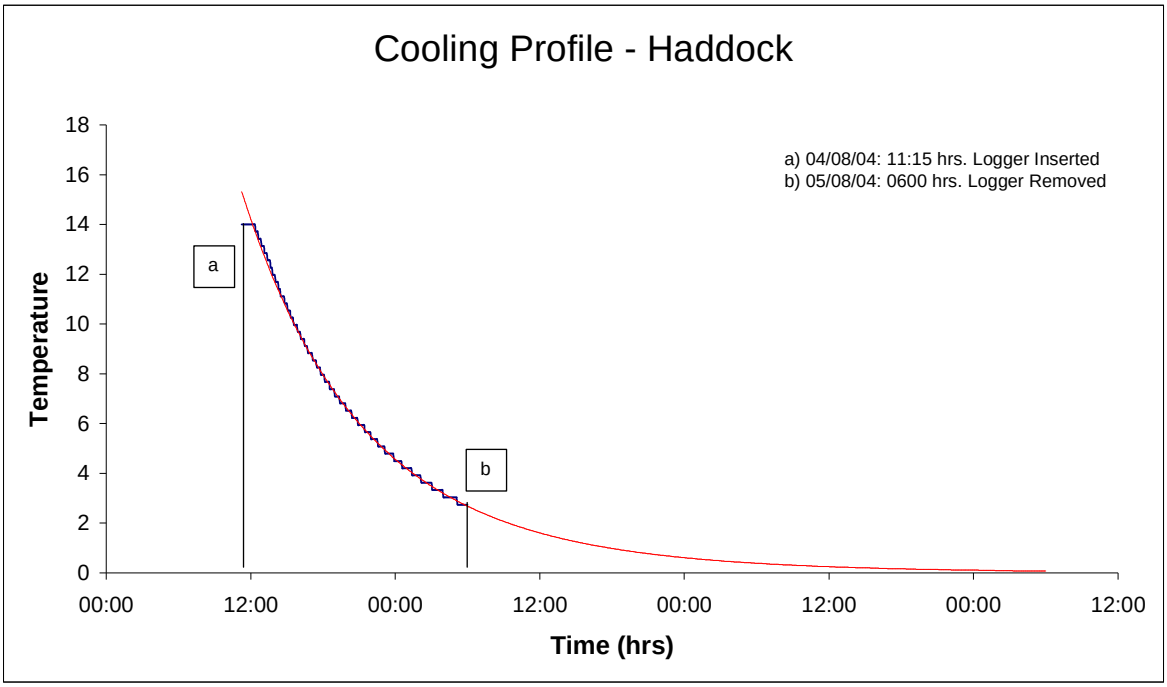
During the duration of the trip, two temperature recorders were inserted into boxes of round haddock, on monitored hauls on two consecutive days.. These record the temperature of the box as it is cooled by the ice melt water. These loggers were inserted into fish which were then placed into the middle of the box when packed.



The above graph illustrates the cooling curve of the fish from the time the box was packed till it was landed for sale. It is noted that :

03/08: 1130 hrs	[Temperature on packing]	= 15℃
03/08: 1730 hrs	(+ 6hrs)	= 5℃
04/08: 0415 hrs	(+ 16 h 45 min)	= 1℃
04/08: 1730 hrs	(+30 hrs)	= 0℃

Minimum temperature attained (stable) = - 0.21℃



The above graph illustrates the cooling curve of the fish from the time the box was packed till it was landed for sale. It is noted that:

04/08: 1115 hrs [Temperature on packing] = 14℃
04/08: 2305 hrs (+ 11 h 50 min) = 5℃

Minimum temperature attained = 2.74℃
(not stable: i.e. the product is still cooling at the time of landing)

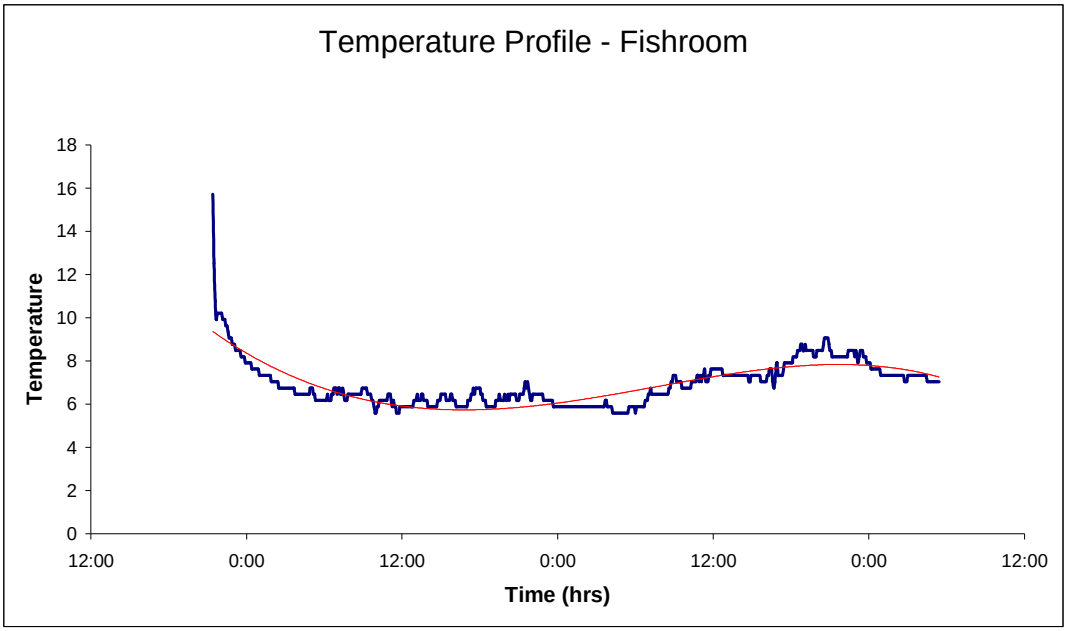
When comparing these two curves, it is apparent that they are both very similar. However, the second box sampled on dd/mm started 1°C cooler at 14℃, but cooled at a slightly slower rate. Initially, it stayed at the boxed temperature of 14℃ for just over an hour before showing signs of temperature loss. This is probably due to a short delay before melt water found it's way to that particular location in the box where the logger was implanted. From that point on, it started to fall in temperature but not at the same rate as the sample from the previous day. On landing, the box still had not cooled to a stable temperature. By projecting the rate of cooling mathematically (red line), it is noted that it would have probably taken approx. 50 hours to reach a temperature of 0℃.

The difference in cooling rate can most likely be explained by the fact that less ice was present to cool the fish in the second sample.

Two points can be considered here to help shorten the cooling times. Firstly, by applying ice to the middle layer of fish overall rates of chilling will be accelerated. Secondly, check that the system of papering boxes, is not restricting the melt water from draining through the box. If a lot of ice is applied over the top of the

paper it cannot drain into the fish in the box and it is the melt water which determines the rate of cool.

Hold
The hold temperature was also logged for the duration of the trip, the resulting profile was graphed and can be seen below. The temperatures recorded were expected to be high as the logger was deliberately located in the warmest section of the hold and it was also noted that this was the first trip after several weeks tied up.



It is noted that the initial hold temperature was 10.2℃.
The hold cooled steadily to a minimum of 5.5℃ then fluctuated between this and approximately 6.7℃.

It is noted that over he last day at sea, the hold temperature for some reason showed signs of warming to over 9℃.

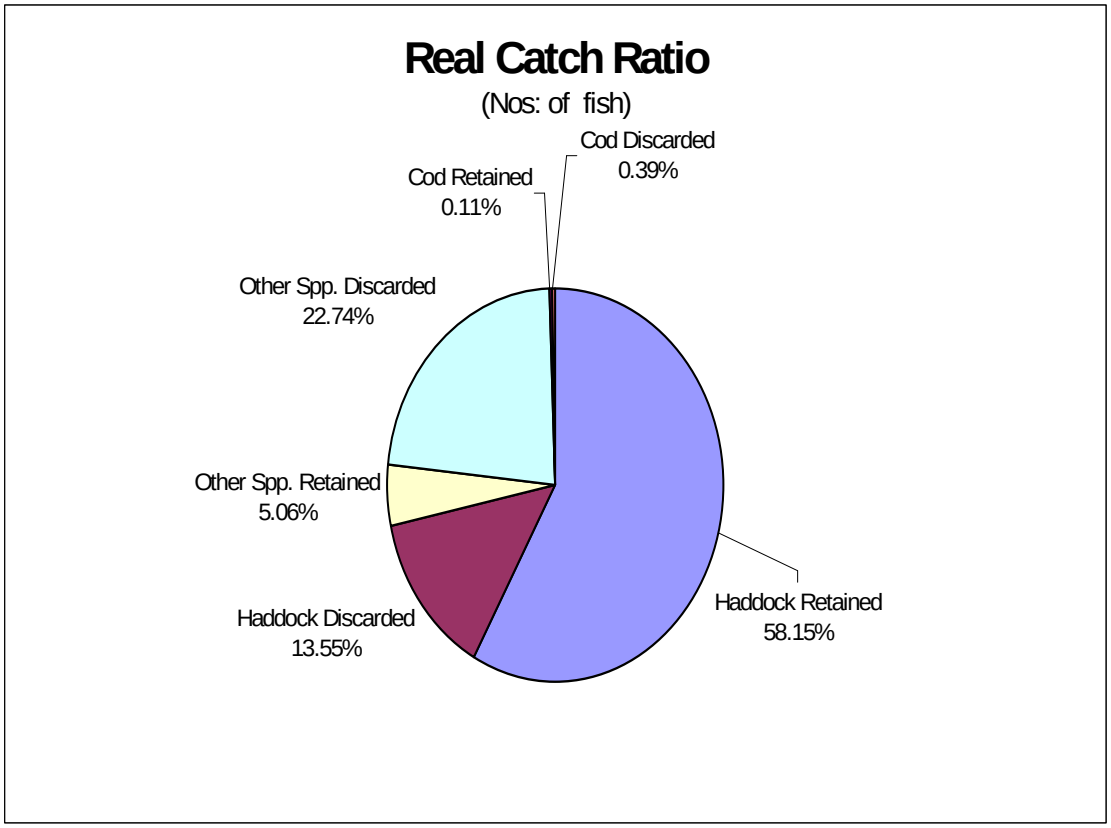
The probe was deliberately located in a warm section of the fishroom and as such has recorded a high range of temperatures. Actual temperatures where fish were stowed are expected to be colder, however this does illustrate the fluctuations in temperature due to hatch opening etc.

Calculated Catch Ratios of Haddock and Cod

During the trip samples were taken from 14 individual hauls. This represented over 2800 individual fish weighing over 1 Mt. From this overall sample, the catch ratio for the trip between haddock and cod can be established and the levels of discard from each species also studied. The results from this sampling procedure showed that before selection; the vessel caught a ratio of:

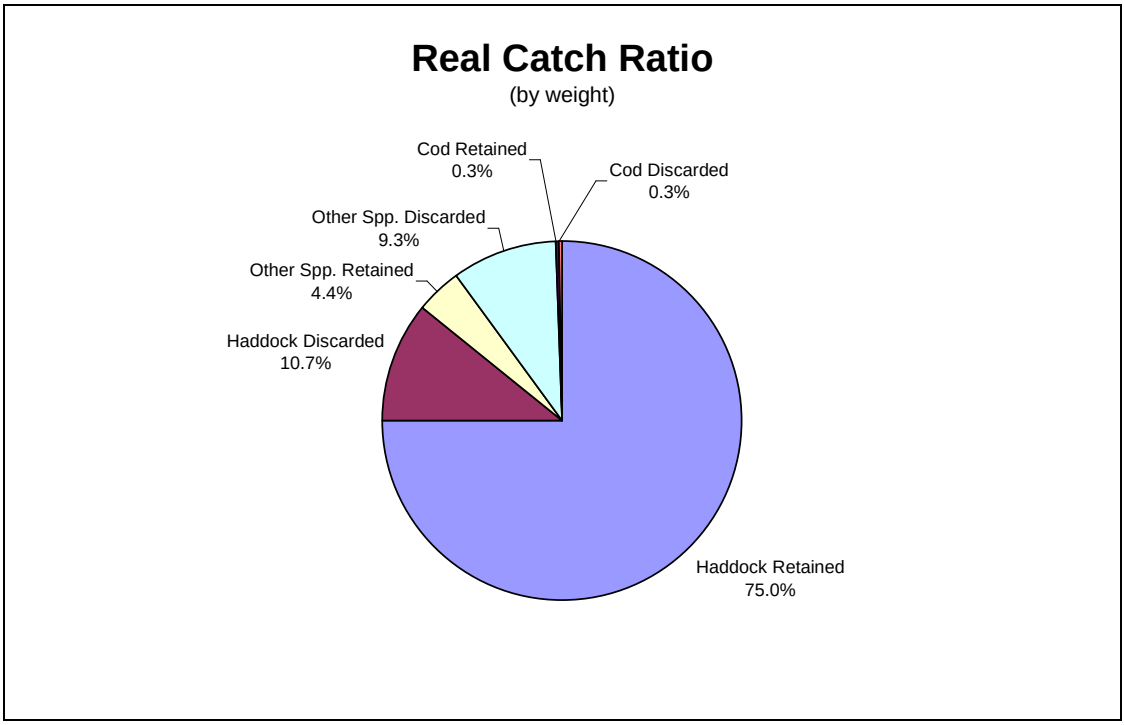
Haddock: 71.7%
Cod: 0.5%
Other Ssp: 27.8%

The Real Catch Ratio (RCR) has been illustrated graphically below. It has been compiled using the sample data acquired, projected against the landed fish at the end of the trip. This represents the projected total numbers of fish caught in the net during the period studied.



This graph reflects the catching capability of the net together with the selectivity measures applied to the fish caught in it. It considers this purely in terms of the number of fish caught.

Alternatively we can consider the percentage of fish retained by the crew species by species in terms of weight (Kg) caught. Similarly, this is a projected ratio based on the data collected on the trip and the volume of fish landed at it's end.



In comparing these two graphs, it can immediately be seen that the volume of fish discarded in weight terms is far less, thus increasing the retained percentages of the species caught. This is logical, as the typical discard of any species will be the undersized material. Generally, these numbers are small. However, when considering the 'other species' it is noted that this figure remains high, this is because this grouping will include all by catch material of no market value. This tends to be very small species such as sand eels, gurnards etc.

Quality and Hygiene Standards

As the vessel was returning to sea immediately after the landing on the trip studied, the vessel did not undergo a full end of trip clean down. Inspection of the vessel indicated that high standards are maintained both in regard to hygiene and maintenance. Good stainless steel/aluminium equipment was noted. It is advised wherever these materials are used to keep them free of paint. The cleaning chemicals used by the vessel were not observed, but it is recommended to use food safe grade detergent/sanitiser rather than marine degreasants.

It is recommended to pursue a tight cleaning regime throughout the deck handling equipment. All the benefits of good handling systems and rapid cooling

can be potentially lost if the work surfaces through which the fish pass are not maintained in a clean state.

It is worth remembering that bacterial contamination on fish from dirty equipment will occur initially on the first fish that passes through the equipment on the next trip. This fish in turn will be the oldest of the catch when the vessel lands, and will have the heaviest contamination through poor cleaning.

Further Summary

This report together with discussion during the trip has attempted to summarise data and recommendations. If you require further discussion or advice please don't hesitate to get in touch.

