Margin of Tolerance: The Accuracy of Onboard Catch Estimates

Report Submitted to DEFRA

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Contents

1. Executive Summary

There is general concern within UK fishing industry groups regarding the ability of their members to apply the EU-prescribed limit of 8% tolerance between catch estimates recorded and declared on board and those from landings declarations of verified on landing by inspections[1] for certain fish stocks. The basis of the study was therefore to investigate whether the 8% margin is in fact attainable under 'at sea' conditions.

The study was implemented in two phases:

- Phase 1 (pilot project) in November 2005; and
- Phase 2 in the spring and summer of 2006.

Observers were placed on individual vessel trips to collect catch weight data independently of the vessel but using the same estimation techniques. Over the two phases, five vessel trips were observed; two in Phase 1 and three in Phase 2. Data from Phase 1 were presented in a previous report. This report presents the new data resulting from Phase 2 and also re-worked data from Phase 1, based on new information regarding the application of conversion factors.

In Phase 1, the observers' catch estimates on-board were exactly the same as those recorded by the vessel skippers. In Phase 2 there were some differences, which are explained in the main report.

Both the catch weights recorded by the vessel and those recorded by the observers (both representing whole or green weight of fish) were compared with the landed weights (representing processed or dressed weight), once the latter had been converted back to green weights using the appropriate conversion factors.

Over the course of the five trips, a total of 54 of the recorded catches by species were at least 50kg[2]. Both the vessels' and the observers' figures showed that 20 of these catches by species (37%) were within the 8% limit[3] (Table 1). Both the vessels and the observers underestimated the catch by species on board more often than they overestimated it.

> **Recommendation**: The tendency for underestimation of the catch on board should be investigated in more detail; the existing sample size is too small to make firm conclusions at present. Two types of studies could be undertaken: (1) an analysis of historical data records of catch on board compared to landings declarations to investigate whether underestimation of catch is widespread, and (2) further observer studies, including the independent measurement of catch weights to investigate what the possible causes might be.

With respect to the total catch on each trip, three of the five vessels estimated the total catch within the 8% limit. Excluding catches of species that were less than 50kg,

[1] Council Regulation (EC) No 2287/2003 of 19 December 2003 Annex V, Paragraph 18, amended by Council Regulation (EC) No 1928/2004.
[2] Catches below 50kg are not subject to EU logbook reporting requirements (Regulation EC 2804/83)
[3] Note that in Phase 2, there were minor differences between the vessels' and observers' figures with respect to which species catches were within the limit.

it was again three of the five trips that achieved results within 8%, but not the same three trips.

Observer and vessel catch estimates were similar for the majority of **targeted species**, ranging between -0.91% and +4%, with one exception of +12.02% (catches of turbot on the netter). The main differences occurred for bycatch species, in particular catches below 100kg had differences between -50% and 140% with bycatch over 100kg ranging between -12.39 and +12.02%.

If the 8% tolerance margin is applied solely to recovery stocks, namely cod and hake[4], the margin was exceeded four out of the six times where they were caught in an amount of at least 50kg.

The use of conversion factors in the calculation of the standard crate weights and the vessels' on board catch estimates was variable and introduced an element of uncertainty in the process and the opportunity for confusion. This may therefore be a contributory factor in vessels failing to achieve catch estimates that are within the 8% margin of tolerance.

> **Recommendation**: From the perspective of achieving more accurate on-board catch reporting, it would be better to take the conversion factor out of the equation. Vessels would then report processed weights, in the same way as for landings declarations. Conversion factors could be applied with confidence by officials who require estimates of unprocessed catch weights for quota management purposes.

From this limited study it is not possible to conclude with confidence whether or not the 8% margin of tolerance limit is achievable reasonably and consistently across the fisheries observed based on current practice for estimating weights at sea. On a species by species basis, during the observed trips, the limit was exceeded more often than not. For recovery stocks it was achieved 66% of the time (4 out of 6 occurrences). However, the sample size is too small to be regarded as representative of the fisheries that have been observed.

Nevertheless, the information collected during the study points to some areas that might lead to more accurate estimation of catch weights at sea without changing significantly the basic way in which it is done (i.e. using crate tallies and standard crate weights). One of these is the consistent use of conversion factors. In Section 5.3, we suggest that the one solution might be to change the legislation such that on-board catches are reported in processed weight and the conversion factors are applied after the fact by the fishery management authority, since the factors are fixed by the European Commission and supplied to the vessel anyway. This might, however, cause some difficulties with monitoring of quota uptake, which would need to be considered.

There are also other sources of variability and inaccuracy that should be investigated (e.g. calculation and application of standard crate weights, and the influence of species) and potential mitigation strategies considered prior to requiring wholesale changes to the way in which catch is measured at sea, for example through the required use of motion-compensated electronic scales. Additional studies involving observer sampling and data analysis could be undertaken to investigate further the potential for achievement of the 8% limit.

[4] Regulations EC 423/2004 (cod) and EC 811/2004 (hake).

Recommendation: For future studies, the observer protocol could be expanded to include independent weighing of catch on board. For example, a sampling strategy could be developed in which individual crates could be randomly sampled during each haul. Appropriate weighing equipment[5] could then be used to weigh these crates on board and verify *in situ* the accuracy of the assumed standard crate weights under differing conditions. The actual weights of partially filled boxes could also be taken to assess the contribution of this issue to reduced accuracy on board.

2. Background

There is general concern within UK fishing industry groups regarding the ability of their members to apply the EU-prescribed limit of 8% tolerance between catch estimates recorded and declared on board and those from landings declarations of verified on landing by inspections[6].

COUNCIL REGULATION (EC) No 2287/2003 of 19th December 2003

fixing for 2004 the fishing opportunities and associated conditions for certain fish stocks and groups of fish stocks, applicable in Community waters and for Community vessels, in waters where limitations in catch are required

20. By way of derogation from Article 5(2) of Commission Regulation (EEC) No 2807/83 of 22 September 1983 laying down detailed rules for recording information on Member States' catches of fish (1), the permitted margin of tolerance, when estimating quantities, in kilograms retained on board of vessels referred to in point 13 shall be ***8 % of the logbook figure****.*

There is debate within the EU Inspection communities regarding what fishermen can be reasonably expected to achieve consistently in terms of at-sea measurement of catch and therefore what is a reasonable margin of tolerance. Informal reports also suggest that the existing rules have not been uniformly applied across Member States, suggesting there is some uncertainty about their application.

Industry representatives cite that the practices and conditions onboard vessels and the methods available for verifying catches makes it difficult to consistently attain results within the 8% margin for all species. Also, measuring the weight of catches (often by volume) can be affected by seasonal events related to the biology of the fish in the catch. They stress that it is in a vessel's best interests to estimate and record catches accurately to realise their full earning potential.

[5] Ideally a motion-compensated electronic scale, operable by a single observer would be used. Alternative, potentially less accurate methods, such as using a spring balance, could be used, but this would probably require additional manpower to handle the catches.

[6] Council Regulation (EC) No 2287/2003 of 24 October 2004 Annex V, Paragraph 18, amended by Council Regulation (EC) No 1928/2004.

3. Methodology

The basis of the study was to investigate whether the 8% margin is in fact attainable under 'at sea' conditions. Independent observers were placed on five selected fishing trips. Trips were not selected at random. Observer placements were arranged directly with vessel owners through contacts facilitated by producer organisations. The observers collected catch data independently of the vessel but using the same estimation techniques (i.e. counting the number of crates and applying standard weights according to the vessel's methodology). The observers did not carry with them any equipment such as scales to independently verify weights on board.

The observer placements were carried out in two phases as follows:

- Phase 1 (pilot project) in November 2005
  - A 30 metre beam trawler targeting mixed demersal fish in ICES Area VIIg;
  - A 23 metre otter trawler targeting primarily cod and plaice in ICES Area VIIa and the Irish Sea;

- Phase 2 in the spring and summer of 2006.
  - A 18m twin rig bottom trawler targeting prawn in ICES Area Via and VIIa;
  - A 18m netter using gill and trammel nets targeting Hake and Turbot in ICES Area VIIe; and
  - A 21m twin rig bottom trawler targeting mixed demersal species in ICES Area IVb.

All the vessels used similar methods for estimating the amount of catch: the fish were separated by species and stored in identical crates; a tally was kept of the number of crates of each species and a standard weight was applied to each full crate of fish. Only one of the vessels had a set of scales onboard - Nesco drop scales. However, they proved to be unreliable in the sea conditions prevailing during the trip.

Standard crate weights used by fishing vessels are based on prior experience and feedback from the market. These weights are not the actual physical weight of the full crate (i.e. the weight of the crate plus the fish and ice that it contains). They are a figure that represents the weight of whole fish that a crate contains when full. They vary from vessel to vessel due to differences in crate types and sizes, and also vary according to species and presentation.

It is in the best interests of fishers to use the most accurate crate weights possible, firstly so that they are paid correctly for what they have caught (i.e. they should not underestimate their catch) and secondly so that fish buyers do not find that crates do not contain as much fish as the vessel skipper has indicated (i.e. they should not over-estimate their catch).

Catch figures for each vessel trip were calculated by counting up the number of crates filled that day by species and then multiplying by the standard crate weight for that species.

Catch figures were provided to the master by the crew either on a daily basis (as on the 30m beam, 23m otter and 21m twin rig bottom trawlers) or a haul by haul basis. Figures were entered into the European Community (EC) logbook for the preceding 24 hour period.

At the end of each trip the total catch by species on board was estimated separately from the skippers' figures and the observers' figures. The EC logbook requires that the catch by species is recorded in kilograms of live weight, either directly onto the form or by number of units, giving the live weight of each unit concerned. For species that have been processed on board (e.g. gutted etc.) standard conversion factors[7] supplied to the vessel should be used to convert back to the weight of the whole fish ("green" or "live" weight) before it is recorded in the logbook. In order to compare these weights with the landed weights, which represent processed or dressed weight, these same conversion factors were applied to the figures from the landings declaration.

The catches by species results were compared with the landed live weights, and the differences calculated as percentages, as follows:

$$\frac{\left[\text{Vessel or Observers Figure}\right] - \left[\text{Landed Weight}\right]}{\left[\text{Landed Weight}\right]} \times 100$$

A negative value for the percentage difference therefore indicates that the onboard estimate was an under-estimate compared to the declared landed weight; a positive value indicates an over-estimate.

The results were analysed in the following way:

- Comparison between observers' and vessels' catch estimates;
- Comparing the vessel catch estimate with landed weight; and
- Comparing the observer catch estimate with landed weight.

These comparisons were carried out looking at records for individual species as well catches per vessel and at the overall results.

4. Results

Individual reports from each observed trip are appended to this report (Appendix 1 to 5). These reports include details of the standard crate weights and conversion factors applied in each case. The catches by species from the five observed trips are presented in Table 3 (Phase 1) and Table 4 (Phase 2).

[7] Taken from: http://ec.europa.eu/fisheries/cfp/control_enforcement/conversionfactors_by_ms.pdf

4.1. Comparison of vessel and observer estimates of catch by species

During Phase 1 (the Pilot Project) the observers' and vessels' catch estimates by species were identical. The percentage differences between on-board and landed weights were therefore the same. However, during Phase 2, there were differences for all species catches apart from a few major targeted and retained bycatch species e.g. prawn, plaice, cod, spurdogs, squid and ling. Differences between the observers' and vessels' estimates ranged between -0.91% and +4%, with one exception of +12.02% (catch of turbot on the netter). For the most part the differences could be attributed to differences in estimates of the fullness of part-filled boxes and differences in the estimated makeup of boxes containing mixed products [8].

Figure 1 is a scatterplot of the differences calculated from the vessels' and observers' catch figures. This uses data only from phase 2 (since all data from phase 1 were the same for both). Most of the data points are located along the diagonal, indicating the differences were the same for both data sources, however, as indicated above, this was not always the case in Phase 2. Interestingly, differences between the vessel and observer data appear to have arisen more frequently when the catch was underestimated (i.e. the negative values) than when it was over estimated. The reason for this, however, is unknown.

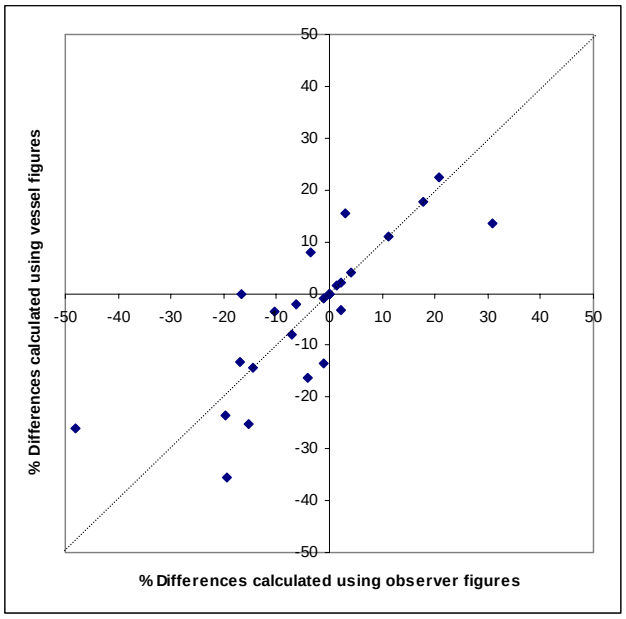

Figure 1 Scatterplot of differences calculated using vessel and observer catch estimates (Phase 2).

[8] On two of the observed trips (one in Phase 1 and one in Phase 2) there were some instances where there was no record of the species in the catch from either the observer or the vessel but the species was later recorded on landing. This produced differences of -100%, but mostly these were small catches, with only one being above the 50kg threshold. The reason for these whole species discrepancies was not clear, although the fish may have not been counted on board because they were part of mixed-catch boxes.

4.2. Analysis of the percentage differences between on-board and landed catch weights

4.2.1. General patterns

- **Catch by species**

Over the course of the five trips, a total of 54 of the recorded catches by species were at least 50kg[9]. Both the vessels' and the observers' figures showed that 20 of these catches by species (37%) were within the 8% limit (Table 1). In Phase 2, because there were some differences between the vessels' and the observers' on-board figures it was not always the same species that were within the limit, however, the general picture from the vessels' and observers' figures were similar in terms of the achievement of catch estimation on board within the limit. Table 1 indicates that both the vessels and the observers underestimated the catch by species on board more often than they overestimated it (negative differences indicate underestimation onboard). This was true for all catches irrespective of whether they were above or below the 50kg threshold.

Figure 2 (vessels' figures) and **Figure 3** (observers' figures) show the frequency distributions of all the individual catches by species across the five deployments over the course of both phases of the project. The plots show the frequency across the range of -50% to +50% in 5% bin ranges[10]. Bin ranges with positive frequencies outside this range are indicated on the plots. A skewed distribution either side of 0% difference would indicate a tendency towards either under or over reporting across the observed trips. These plots show a similar tendency to that shown in Table 1 – i.e. underestimation of the catch on board seems more common than overestimation.

Table 1 Numbers of catches by species in various categories across the five observed trips

	Vessel differences		Observer differences	
	All catches by species	Catches by species at least 50kg	All catches by species	Catches by species at least 50kg
-100% difference	12	2	14	4
Outside -8% difference	30	25	28	23
Within -8% difference	7	7	7	7
Correct (difference = 0%)	3	3	4	4
Within +8% difference	11	10	10	9
Outside +8% difference	10	7	9	7
+100% difference	0	0	1	0
Total	73	54	73	54

[9] Catches below 50kg are not subject to EU logbook reporting requirements (Regulation EC 2804/83)

[10] Note that the allocation of catches to bin ranges does not match exactly the categories in Table 1; for example the zero bin range includes all differences between -2.5 and +2.5. These plots are provided to show general distribution patterns only. The totals in the categories in Table 1 are accurate.

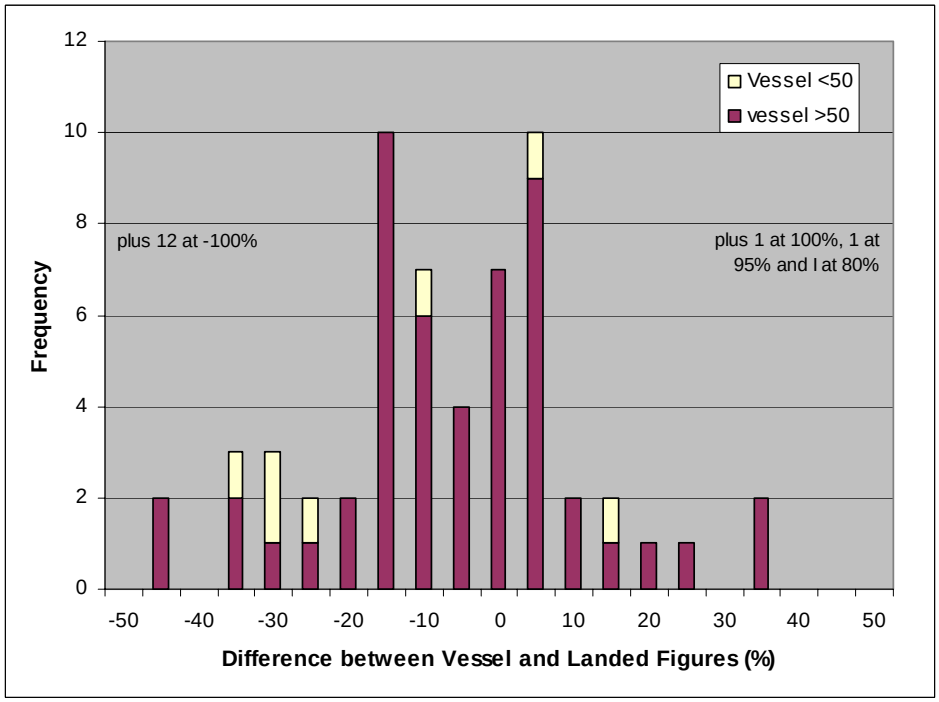

Figure 2 Frequency distribution of the differences between vessel and landed catch figures for all catches by species where the catch was at least 50kg

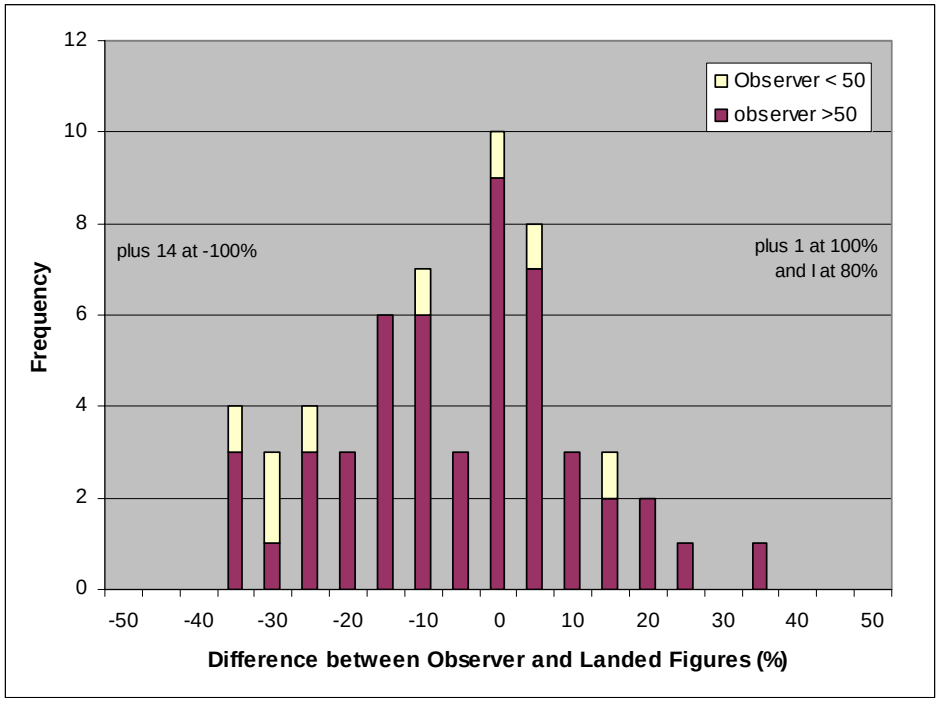

Figure 3 Frequency distribution of the differences between observer and landed catch figures for all catches by species where the catch was at least 50kg

If catches less than 50kg are excluded from analysis:

- 37% (20/54) of remaining catches were within 8%;
- 54% (29/54) were within 15%; and
- 74% (40/54) were within 20%.

This is illustrated in Figure 4.

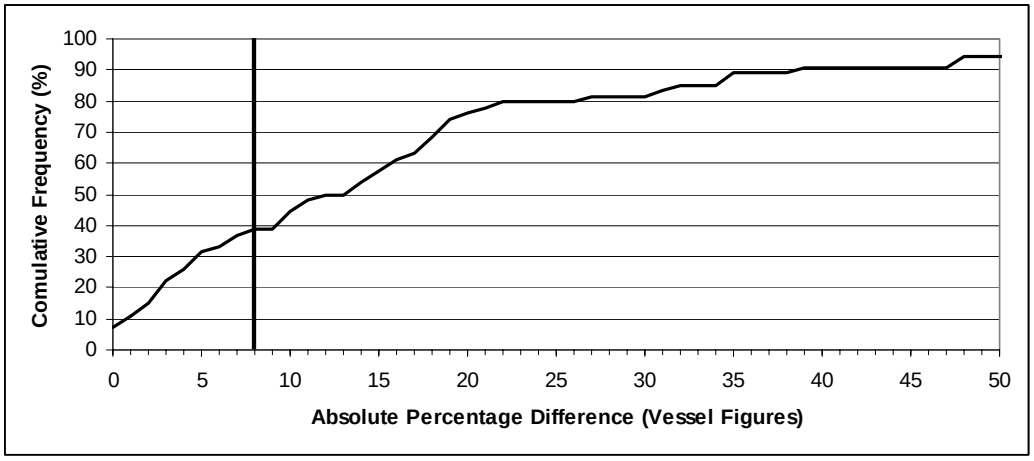

Figure 4 Cumulative frequency curve showing the proportion of catches (at least 50kg) within different levels of absolute difference (vessel figures). The 8% tolerance level is marked with a vertical line.

If the 8% tolerance margin is applied solely to recovery stocks, namely cod and hake[11], the margin was exceeded four out of the six times where they were caught in an amount of at least 50kg.

- **Whole trip catch by vessel**

Table 2 shows the accuracy achieved for estimates of total catch on board by the five vessels in the trials. On three of the five observed trips the total catch was within the 8% limit. Excluding catches of species that were less than 50kg, it was again three of the five trips that achieved results within 8%, but not the same trips. The otter trawler that achieved the 8% limit across all species was outside the limit for just the better represented species, while for the 18m twin rigged bottom trawler the opposite was true. Taking the observers' figures, on only two of the five trips was the total estimate within 8% of the landed figure when species catches of less than 50kg were excluded.

With the exception of the 21m twin rigged bottom trawler, which estimated its overall catch very well, all on-board estimates were lower than the landed figure.

[11] Regulations EC 423/2004 (cod) and EC 811/2004 (hake).

Table 2 Overall difference between Onboard Catch Estimates with Landed Weight for Total catch.

Estimate	% Difference with Landed Weight				
	Beam Trawler	**Otter Trawler**	**18m Twin Rig Bottom Trawler**	**Netter**	**21m Twin Rig Bottom Trawler**
Vessel (all catches)	-6.1	-4.65	- 9.95	- 15.2	0.15
Vessel (excluding species catches of less than 50kg)	-5.09	-12.45	-4.31	-15.15	-0.10
Observer (all catches)	- 6.1	-4.55	- 14.52	-13.5	0.04
Observer (excluding species catches of less than 50kg)	-5.09	-12.45	-10.06	-13.49	-0.21

4.2.2. Results from individual observed trips

- **Phase 1**

Figure 5 plots the individual percentage differences by species for the two vessels observed during Phase 1. Over the two trips in Phase 1, differences between on-board estimates and landed weights for individual species ranged between -39.60% and +34.83%. Figure 5 shows that the larger differences tended to occur for those species that were less well represented in the catch (but still more than 50kg). As discussed previously, there was a much greater tendency for the catch to be underestimated than overestimated on both vessels in Phase 1.

In terms of total weight onboard, the catch estimates were within -6.1% and -4.65% respectively of the landed weight.

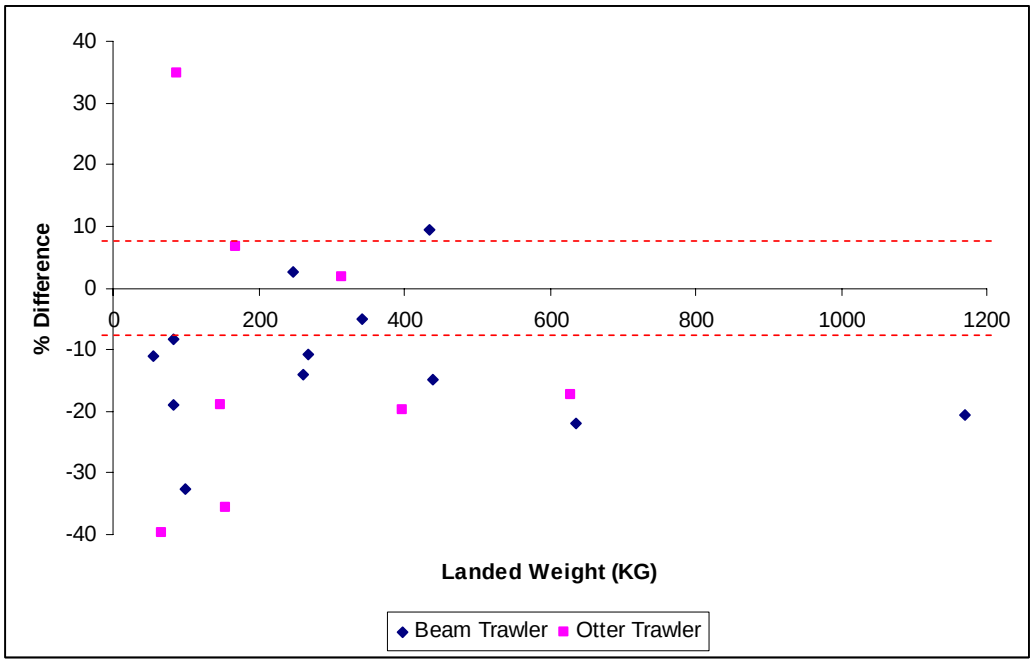

Figure 5 Scatterplot showing differences between onboard and landed weights by total weight of landing per species for the Pilot Project. All landed weights below 50kg have been removed. A single catch of 2 tonnes of monkfish on the beam trawler (4.7% difference) is not shown to provide a reasonable scale for the plot. The dashed red lines represent the 8% tolerance limits.

- **Phase 2**

To illustrate the differences recorded during Phase 2 separate plots were prepared for each trip, showing the vessels' and observers' figures separately (Figure 6 to Figure 8). These graphs should be viewed in conjunction with the data in Table 4.[12]

Figure 6 shows the results from the18m Twin Rig Bottom Trawler targeting nephrops. The catch weight estimated by the vessel and the observer were identical to the declared landed weight for the target species. The main bycatch species were haddock, pollock, hake and gurnard. Catch estimates for pollock and hake were both outside the 8% limit.

Figure 7 shows the results from the gill and trammel netter targeting hake and turbot. Both of the target species were estimated to within the tolerance limit. Most of the other species were outside the limit. As on other vessels, the tendency was for the catch to be underestimated on board. The catch of monkfish was very poorly estimated by the vessel. The difference on landing was +90.5% (outside the scale of the plot in Figure 7) because the vessel estimated a catch of 317kg, but the correct figure was 130kg. The observer estimated 123kg on board. The figure for the vessel may have resulted from the incorrect application of a large conversion factor normally used for monkfish tails.

[12] For the purpose of these graphs, landed weights below 50kg and over 1000kg have been excluded along with differences of -100% where the observer or vessel failed to see or identify a species that was subsequently recorded on landing.

The catch "species" referred to as 'shark' is actually a grouping of tope, dogfish and shark. The underestimate of 50% may therefore be due to confusion of weight estimation for an unfamiliar species.

Figure 8 shows results from the 21m twin rig bottom trawler targeting mixed demersal species. This was the only vessel to apply conversion factors to all the species that were processed . All target species, with the exception of monkfish were estimated to with the tolerance limit, the only exceptions being bycatch less than 100kg and 225kg of 'spurdogs' which were overestimated by 11%.

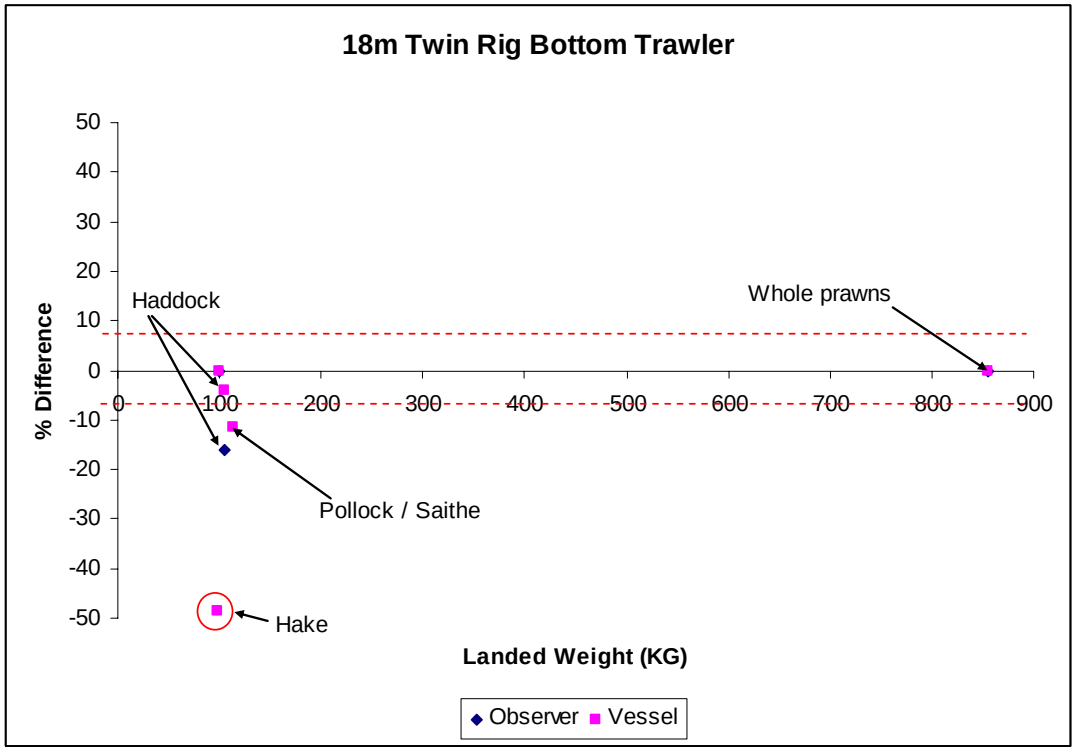

Figure 6 Results from the Twin Rig Bottom Trawler with the main species labelled. The dashed red lines represent the 8% tolerance limits, circled points are recovery stocks.

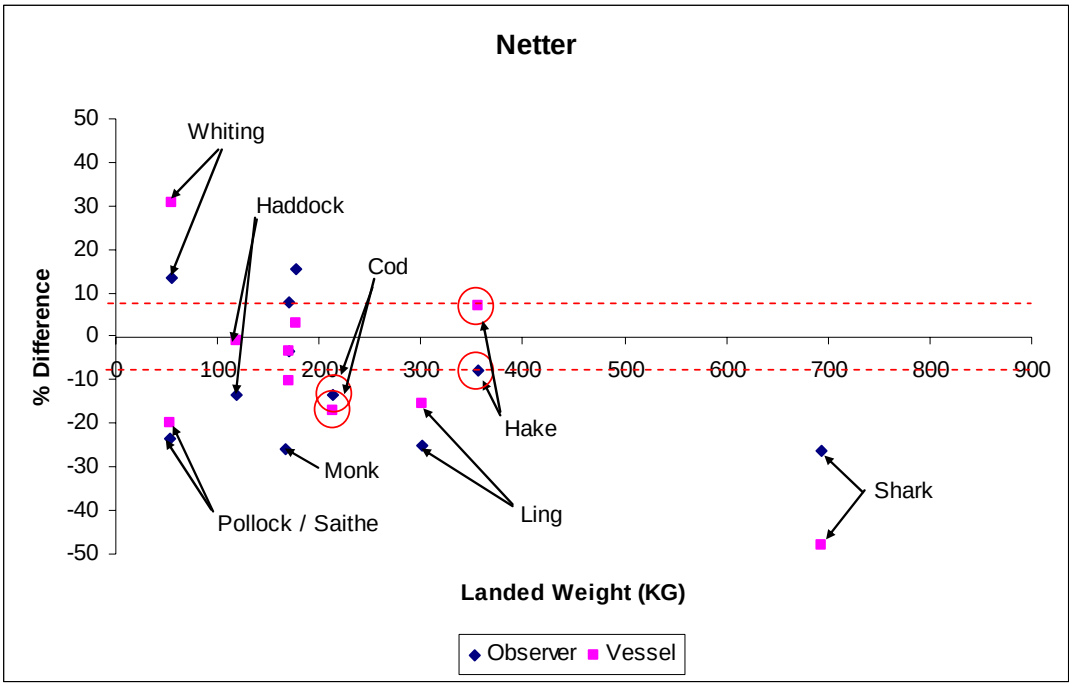

Figure 7 Results from the gill and trammel netter. The dashed red lines represent the 8% tolerance limits, circled points are recovery stocks.

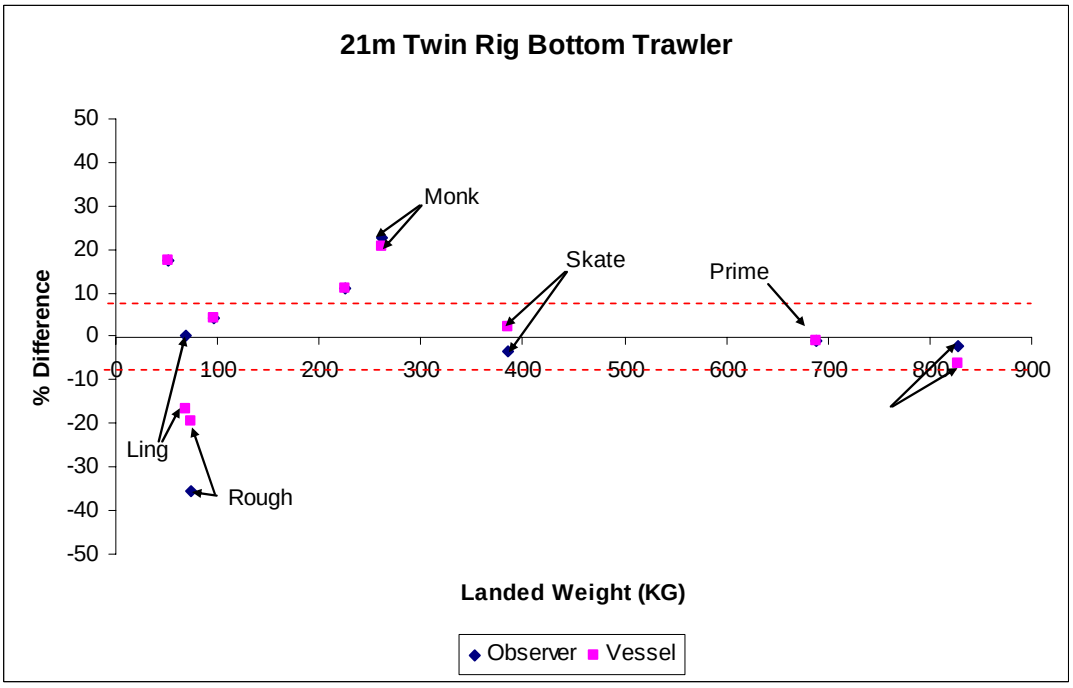

Figure 8 Results from the twin rig bottom trawler. The dashed red lines represent the 8% tolerance limits.

Table 3 Phase 1 (Pilot Project) onboard estimates by the skipper and observer on each vessel, compared to the declared landed weights x Conversion Factor (items where the catch was at least 50kg are shaded).

	Beam Trawler				***Otter Trawler***			
Species	**Skipper (vessel)**	**Observer**	**Landed * CF**	**% Difference**	**Skipper (vessel)**	**Observer**	**Landed * CF**	**% Difference**
Monkfish	2052	2052	1959	4.7	40	40	66.24	-39.6
Sole	475	475	433.7	9.5				
Megrim	1863	1863	1856.4	0.4				
Lemon sole	324	324	341.1	-5.0	10	10	14.	-28.8
Plaice	35	35	31.03	12.8	100	100	155.7	-35.8
Cod	496	496	636.5	-22.1	520	520	628.3	-17.2
Haddock	928	928	1170.4	-20.7				
Ray	255	255	248.2	2.7				
Ling	374	374	440.0	-15.0				
Turbot	49	49	55.1	-11.1				
Brill	14	14	21	-33.3				
John Dory	67.5	67.5	100	-32.5				
Pollock	67.5	67.5	83.3	-19.0				
Red Mullet	N/A	N/A	1	-100.0				
Gurnard	N/A	N/A	7	-100.0				
Witch	225	225	262.1	-14.1				
Conger Eel	240	240	269	-10.8				
Hake	30	30	42.9	-30.1				
Whiting	15	15	23.7	-36.8	320	320	398.3	-19.7
Forked Hake	37.5	37.5	42.9	-12.7				
Squid	N/A	N/A	11	-100.0	320	320	314	1.9
Octopus	76	76	83	-8.4				
Skate					180	180	168.9	6.6
Dogfish					120	120	148.0	-18.9
Shells*					160	160	2.8	
Gurnard					120	120	89	34.8
Prime**					40	40	39	2.6
Total	**7623.5**	**7623.5**	**8118.495**	**-6.1**	**1930**	**1930**	**2024.21**	**-4.65**

*Shells were mainly made up of queen scallops, however only the weight of 1 lobster was recorded (2.75kg)
**Prime was made up from rare, high value fish, in this case we have included bass, brill, John Dory and red mullet as they were not accounted for elsewhere.
***For the purpose of this table the values calculated here do not include 'shells', the weight of which was not recorded on landing.

Table 4 Phase 2 onboard estimate by the skipper and observer on each vessel, compared to the declared landed weights x Conversion Factor (items where the catch was at least 50kg are shaded).

	18m Twin Rig Bottom Trawler					***Netter***					***21m Twin Rig Bottom Trawler***				
	Catch Weights (kg)			% Difference		Catch Weights (kg)			% Diference		Catch Weights (kg)			% Difference	
Species	Obsv	Vessel	Landed x CF	Obs	Ves	Obsv	Vessel	Landed x CF	Obs	Ves	Obs	Vessel	Landed x CF	Obs	Ves
Prawns (whl)	855	855	855	0.0	0.0						1620	1620	1892	-14.4	-14.4
Prawns (tld)	1,500	1,500	1,500	0.0	0.0										
Haddock	87.5	100	104.4	-16.2	-4.2	102.5	117	118.3	-13.4	-1.1	58	57	29	100.0	96.6
Pollock/Saithe	0	100	113.05	-100.0	-11.5	41	43	53.6	-23.4	-19.7					
Hake/Pin	0	50	97.44	-100.0	-48.7	328	331	356.1	-7.9	-7.1					
Gurnard	100	100	100	0.0	0.0										
Cod	25	0	0	100	NA	184.5	177	212.9	-13.4	-16.9	5206.5	5206	5095.4	2.2	2.2
Witch	0	0	26	-100.0	-100.0										
Ling	0	0	57	-100.0	-100.0	225.5	255	301.0	-25.1	-15.3	68.4	57	68.4	0.0	-16.7
Skate	0	0	41.2	-100.0	-100.0	184.5	165	171.0	7.9	-3.5	373.38	395	386.3	-3.3	2.3
Dogfish	0	0	34.25	-100.0	-100.0										
Plaice	0	0	26.75	-100.0	-100.0						10873.9	10860	10711.8	1.5	1.4
Monk	0	0	39.68	-100.0	-100.0	123	317	166.4	-26.1	90.5	320	315	261.1	22.5	20.6
Sole	0	0	3	-100.0	-100.0										
Choice	0	0	6	-100.0	-100.0										
Whiting						61.5	71	54.2	13.4	30.9	0	57	79.1	-100.0	-27.9
Megrim						164	152.4	170.1	-3.6	-10.4					
Turbot						205	183	177.6	15.4	3.0					
Shark						512.5	360	694	-26.2	-48.1					
Mixed						82	0	84	-2.4	-100.0					
Dover Sole											52.5	52	29.4	78.6	76.9
Lemon sole											811.2	775	827.8	-2.0	-6.4
Spurdogs											250	250	225	11.1	11.1
Prime*											682.5	682	688.8	-0.9	-1.0
Red Mullet											60	60	51	17.6	17.6
Rough**											47.6	59.5	73.8	-35.5	-19.4
Squid											100	100	96	4.2	4.2
	2,568	**2,705**	**3,004**	**-14.52**	**-9.95**	**2,214**	**2,171**	**2,559**	**-13.5**	**-15.2**	**20,524**	**20,546**	**20,515**	**0.04**	**0.15**

* Prime (mixed boxes) includes brill *Scophthalmus rhombus,* halibut *Hippoglossus hippoglossoides*, turbot *Psetta maxima* and John Dory *Zeus faber.* Catch by species was calculated by estimating the proportion per full box.

** Rough includes saithe *Pollachius pollachius* and wolf-fish *Anarhichadidae (*Same CF as Saithe)

5. Discussion

5.1. Crate tally and standard crate weights

Both the observer and vessel estimates were derived from the number of boxes recorded for a particular species. The standard crate weights are a representation of the “average” weight of a full crate of a particular species. The actual weights of each full crate are likely to be different (either more or less) from this standard amount (for example, because different crew will pack the boxes differently), but if there are enough crates making up the total, then these differences will tend to cancel out, such that the overall total will be reasonably close to the actual weight, providing the standard weight is well estimated in the first place.

If there are only a few crates making up the total, then the errors in estimation are likely to be greater. In addition, if the estimated weight includes partially full crates, then there is an additional element in the estimation process (estimating the fraction of the standard weight that should be applied to the partially filed crate) which may result in an increased error. One might therefore reasonably expect that overall the onboard estimates of larger catches containing fewer species to be more accurate than smaller catches with more species.

For total catch the technique of tallying crates and applying an average standard crate weight was effective for three out of the five trips. A fourth trip produced an overall estimate within the tolerance if catches less than 50kg are omitted from the total (this was the 18m twin rigged bottom trawler, which had an unusually high number of species that were not recorded at all on board, but were recorded on landing). For one trip (the otter trawler) the estimate was actually worse when catches less than 50kg were omitted, because while the target species tended to be underestimated, the lower volume bycatch species tended to be overestimated (thereby tending to balance out in the overall catch).

Two of the main problems in estimating catch weights on board would appear to be differentiating consistently between species and accounting for partially filled crates, especially if the species catch is relatively small. For recording individual species, the technique proved adequate for target species and if bycatch species are well represented.

The tendency for underestimation of the catch on board (Section 4.2.1) should be investigated in more detail. Two types of studies could be undertaken: (1) an analysis of historical data records of catch on board compared to landings declarations to investigate whether underestimation of catch is widespread, and (2) further observer studies, including the independent measurement of catch weights to investigate what the possible causes might be.

5.2. The influence of the crew

Observers noted that the crew can influence catch estimation system operated onboard. This “crew factor” may be exerted in the following ways:

1. Experience i.e. level of experience is directly proportional to performance;
2. Consistent identification of species e.g. elasmobranch species; flatfish;

3. Consistent technique during processing and storage e.g. using equal volumes of ice per crate; and
4. Grading fish.

5.3. Conversion factors

Conversion factors are used to convert a processed weight back to the equivalent live weight of the fish prior to processing ("green" or "live" weight). They vary depending in the species, the processing method and the way the product is stored (Table 5). The conversion factors reported by vessels during this project ranged from 1.03 for a gutted ray to 3 for monkfish tails. Unprocessed fish have a conversion factor of 1.

Vessels are required to record live weights in their logbooks to facilitate tracking of quota uptake based on reported catches. They do this by applying conversion factors to the standard crate weights, which represent the weight of fish in the crate (i.e. minus the ice and water). Standard weights that already incorporate the conversion factor may also be used.

Landed quantities are recorded in terms of processed weight. To compare the landed figures with weights recorded at sea, the appropriate conversion factor must be used (see Section 3). During the data analysis for this project, all the landing declarations figures were raised by an appropriate conversion factor sourced from the EU (Table 6).

Table 5 shows the various different ways that the fish were processed on the vessels and the conversion factors that were applied for both the pilot and main part of the project. Use of conversion factors by the vessels in calculating the on-board catch figures was variable. The only vessel to record applying conversion factors consistently for all processed species was the 21m Twin Rig Trawler (Table 5, and see Appendices 1 to 5). Of the five trips observed, this vessel had the closest overall estimate compared to the landed live weight. It is difficult to draw form conclusions from only five observed trips, but it appears that the requirement for vessels to use conversion factors introduces an element of uncertainty in the process and the opportunity for confusion in the calculation of on-board catch figures. This may therefore be a contributory factor in vessels failing to achieve catch reports that are within the 8% margin of tolerance.

From the perspective of achieving more accurate on-board catch reporting, it would therefore be better to take the conversion factor out of the equation. Vessels would then report processed weights, in the same way as for landings declarations. Conversion factors could be applied with confidence by officials who require estimates of unprocessed catch weights for quota management purposes.

Table 5 Processing details and conversion factors (where available) from the vessels as used on the project

Species	Processing Method (**Conversion Factor** where used)				
	Beam Trawler	Otter Trawler	18m Twin Rig Trawler	Netter	21m Twin Rig Trawler
Monkfish	HEAD/GUT **(3)**			GUT	GUT **(1.28)**
Sole	GUT			GUT	GUT **(1.05)**
Megrim	GUT			GUT	
Lemon Sole	GUT	GUT			GUT **(1.05)**
Plaice	GUT	GUT			GUT **(1.07)**
Cod	GUT **(1.17)**			GUT	GUT **(1.17)**
Haddock	GUT		GUT	GUT	GUT **(1.16)**
Ray	GUT			WHOLE	GUT **(1.03)**
Ling	GUT			GUT	GUT **(1.14)**
Turbot	GUT			GUT	GUT **(1.05)**
Brill	GUT	GUT		GUT	GUT **(1.05)**
John Dory	GUT	GUT		GUT	GUT **(1.05)**
Pollack	GUT			GUT	
Red Mullet	WHOLE	GUT		GUT	WHOLE
Gurnard	WHOLE		WHOLE	GUT	
Witch	GUT				
Conger Eel	GUT				
Hake	GUT		GUT	GUT	
Whiting	GUT	WHOLE		GUT	GUT **(1.13)**
Forked Hake	GUT				
Squid	WHOLE	WHOLE			WHOLE
Octopus	WHOLE				
Dogfish		WHOLE		GUT	WHOLE
Bass		GUT			
Prawns			WHOLE		WHOLE
Prawns			TAILED **(3)**		
Saithe			GUT	GUT	GUT **(1.19)**
Halibut					GUT **(1.05)**
Wolf-fish					GUT **(1.19)**

Table 6 Conversion factors used for analysis[13].

Species	CF Used	Species	CF Used
Prawns (whole)	1.00	Choice	1.00
Prawns (tailed)	3.00	Whiting	1.13
Haddock	1.16	Megrim	1.05
Hake/Pin Hake	1.16	Shark	1.00
Gurnard	1.00	Mixed	1.00
Cod	1.17	Dover Sole	1.05
Witch	1.04	Lemon sole	1.04
Ling	1.14	Spurdogs	1.00
Skate	1.03	Prime*	1.05
Dogfish	1.37	Red Mullet	1.00
Plaice	1.07	Rough**	1.19
Monk	1.28	Squid	1.00
Sole	1.04		

5.4. Catch storage on board

Another possible source of uncertainty and inaccuracy in the recording of on-board catch estimates is the way in which the fish are stored. A number of different methods of storage and their weight fluctuation are shown in Figure 9.

Fish stored in boxes with ice tend to retain the same weight during storage periods few days. The length of each observed trip was about a week, hence it appears that weight change during cold storage had little impact during this study.

[13] Taken from: http://ec.europa.eu/fisheries/cfp/control_enforcement/conversionfactors_by_ms.pdf

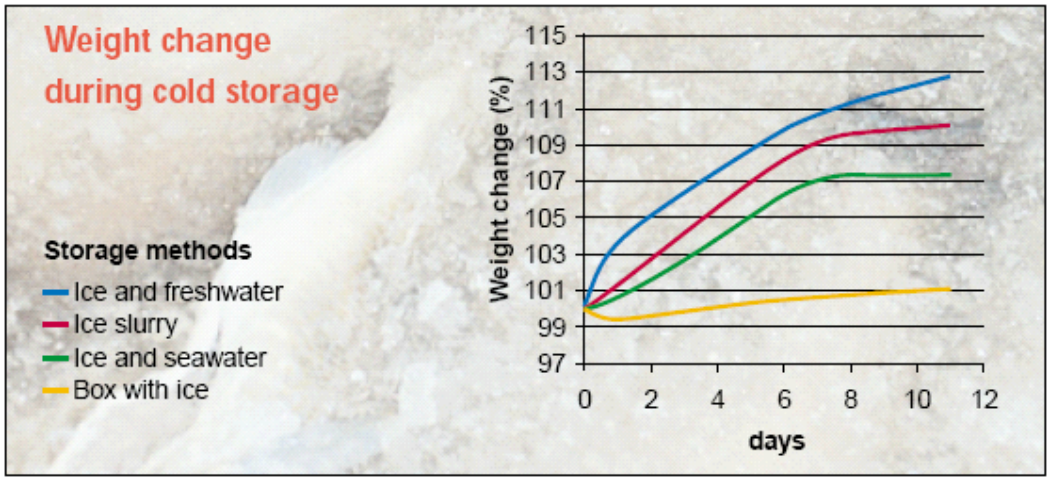

Figure 9 Weight change during cold storage (Fiskeriforskning, No.1, and February 2001)

5.5. Future work

Anecdotal comments recorded during observer deployments suggest that the vessel crews were expecting some validation by the observer of the figures they were using to calculate catch weights. This was not part of the terms of reference for this study; it was agreed at the outset that the observer protocol for catch estimation should be the same as that of the vessel on which they were deployed, and no independent weighing would be undertaken on board.

Nevertheless, one vessel in the study was equipped with on-board weighing equipment: a set of Nesco drop scales. The observer attempted to use them to confirm the crate weights applied by the vessel. However they proved impossible to use by a single observer in the sea conditions experienced during the trip.

In all cases the weights estimated by the observers were based on figures provided by the vessels for each crate per species/product. Given the methods used, the only opportunity for any differences to arise would be if the crate tallies were different, or estimates of the weights of partially filled crates (particularly important for species with small amounts) were different.

For future, more detailed studies the observer protocol could be expanded to include independent weighing of catch on board. For example, a sampling strategy could be developed in which individual crates could be randomly sampled during each haul. Appropriate weighing equipment[14] could then be used to weigh these crates on board and verify *in situ* the accuracy of the assumed standard crate weights under differing conditions. The actual weights of partially filled boxes could also be taken to assess the contribution of this issue to reduced accuracy on board.

The anticipated outputs would have been the variability of crate weight per species and the amount of ice added during a trip.

[14] Ideally a motion-compensated electronic scale, operable by a single observer would be used. Alternative, potentially less accurate methods, such as using a spring balance, could be used, but this would probably require additional manpower to handle the catches.

To provide some perspective on the type of vessels that might participate in such a study, it would be advantageous to have an idea on the number and type of vessels that use weighing equipment onboard and the rationale behind their use, since it is currently not obligatory for vessels operating in the EU to use at-sea weighing equipment:

- Unilateral Member State condition;
- Ensure accurate economic return on catch;
- To satisfy specific regulatory measure for the fishery;
- As the result of a marketing tool e.g. the role of traceability in ecolabelling;

Motion compensated scales provide the most accurate means of weighing fish at sea. The main factors for considering their use are space and cost. These factors may be prohibitive for their universal use.

The EU's structural policy, through the Financial Instrument for Fisheries Guidance (FIFG) for the equipment or modernisation of fishing vessels may have provided funding for the introduction of weighing scales on suitable vessels i.e. "…the improvement of the handling/processing and quality of products onboard". Funding may become available dependent on the scope under the European Fisheries Fund criteria and priorities of the National Strategic Plan (NSP) and an Operational Programme (OP) under Axis 4[15]

In order to improve the representativeness of future studies, fishing trips should be classified according to their fleet and fishery, e.g.:

- The number of vessels in the same size class;
- Type of gear used; and
- The Fishery.

Access to historical data would be extremely valuable in designing a trip sampling protocol and provide an indication if how the outputs might be applied to other classes of vessels in other areas. One area that was not investigated in this study due to the low volume of data was the accuracy achievable by species – i.e. are at-sea catch weight estimates harder to achieve for some species than others? There was insufficient overlap across the five observed trips in terms of species covered to make such an analysis viable during this study, but additional data, including from repeat observer trips on the same vessel(s) should make this possible.

6. Conclusion

From this limited study it is not possible to conclude with confidence whether or not the 8% margin of tolerance limit is achievable reasonably and consistently across the fisheries observed based on current practice for estimating weights at sea. On a species by species basis, during the observed trips, the limit was exceeded more often than not. For recovery stocks it was achieved 66% of the time (4 out of 6 occurrences). However, the sample size is too small to be regarded as representative of the fisheries that have been observed.

[15] Department for Environment, Food and Rural Affairs Marine Fisheries Stakeholder Forum 3rd April 2006: Paper for DEFRA items Paper for agenda item 4 European Fisheries Fund (EFF) Policy Priorities.

Nevertheless, the information collected during the study points to some areas that might lead to more accurate estimation of catch weights at sea without changing significantly the basic way in which it is done (i.e. using crate tallies and standard crate weights). One of these is the consistent use of conversion factors. In Section 5.3, we suggest that the one solution might be to change the legislation such that on-board catches are reported in processed weight and the conversion factors are applied after the fact by the fishery management authority, since the factors are fixed by the European Commission and supplied to the vessel anyway. This might, however, cause some difficulties with monitoring of quota uptake, which would need to be considered.

There are also other sources of variability and inaccuracy that should be investigated (e.g. calculation and application of standard crate weights, and the influence of species) and potential mitigation strategies considered prior to requiring wholesale changes to the way in which catch is measured at sea, for example through the required use of motion-compensated electronic scales. Additional studies involving observer sampling and data analysis could be undertaken to investigate further the potential for achievement of the 8% limit.

Appendix 1: Report of Observer Trip 1

Report of the Independent Observer Onboard the FV 'Billy Rowney'

Vessel and Trip Details

Vessel Name:	FV *Billy Rowney*
Vessel Type:	Trawler (30.54m)
Port:	Penzanze, UK
Gear:	Chain Mat Beam Trawl (TBB); Mesh 80 to 85mm
Target Species:	Mixed Demersal
Areas Fished:	ICES Area VIIg
Dates:	09/11/2005 – 15/11/2005
Observer:	P. McCarthy

Introduction

A fishing trip was observed on the demersal trawler '*Billy Rowney*'. The role of the observer was to monitor the methodology employed by the vessel to estimate catches; make independent estimates of the same catches; and note any factors that may influence the respective methodologies.

Trip Summary

Fishing operations were conducted over 6 days within ICES Statistical Division VIIg in the area between 50º40" and 50º30" N and between 06º48" and 06º00"W. A total of 37 tows were conducted representing a total effort of 101 hours 45 minutes. Catches were mixed demersal species: monkfish, megrim and other flatfish, plus haddock and cod making up the majority of round fish. Every haul was observed from the point of landing to storage in the hold.

Landing and Processing the Catch

Catches were emptied from the codends onto the deck and the composition of the catch sorted by hand (figure 1). Targeted species were separated from fish and invertebrate by-caught species, and debris. Juvenile fish and damaged catch were discarded and the remaining target species retained in baskets (figure 2). Turbot *Psetta maxima* and brill *Scophthalmus rhombus* were separated from the catch, bled and hung prior to processing to prevent bruising of the product.

During processing, the baskets of fish were emptied onto a sorting table and processed manually (figure 3). All roundfish and flatfish species were gutted, with the exception of gurnards *Triglidae sp*, red mullet *Mullus surmuletus*, and cephalopods; squid, octopus and cuttlefish, which were retained whole. Monkfish *Lophius piscatorius* were headed and gutted. The catch was washed immediately after processing, roughly sorted by species into baskets (figure 4), and then passed into the fish hold.

The catch was then transferred into separate boxes by species and stored on ice. They were not graded by size. Each box contained a bottom layer of ice on which the fish were placed on top of (figure 5). When full, the box of fish was left to settle, before a top layer of ice was added (figure 6) and each box stacked on top of one another.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Dimensions of the fish hold, the layout and storage capacity are presented in Annex I. The hold capacity was 124.21m^3, which represents the gross internal volume with no deduction being made for pound boards, stanchions, hoppers, chutes, coolers or ice plants. The box capacity was 414 units, which was estimated using the box size dimensions (800mm x 460mm x 265mm). Temperatures of the fish hold were maintained between a minimum of 0-1º Celsius.

Vessel Catch Estimation
The live catch for each species was calculated on a 24 hour period to satisfy EU logbook requirements and represented the catches from the trawls during this period. No scales were used during the process. Catch weights were calculated by counting the number of full boxes per species and multiplying by the weight of the box. The weight was provided by the master of the vessel. This figure was entered into the logbook. Boxes which were less than quarter full after an individual haul were topped-up from the following haul's catch. This system was adopted to avoid inaccurate estimates of partially filled boxes.

The observer assumed that the weight attributed to each box of a particular species was derived from vessels / crew experience. This was confirmed when the observer asked the crew. Conversion factors were only applied to monkfish *L. piscatorius* (c.f. 3.00) and to cod *Gadus morhua* (c.f. 1.17) to calculate the live weight. The conversion factor for other species was considered to be insignificantly small.

Observer Catch Estimation
There were three opportunities to estimate the catch. These were:

- In the net as it was being landed;
- Following processing and initial sorting into baskets; and
- When the catch is sorted by species into boxes for storing.

The first two opportunities may provide an estimation of total weight but as the fishery was mixed the level of resolution would not be at species level. Also, by-catch, discards and debris would also present difficulties for providing accurate estimations.

The method adopted by the observer was the same as the vessel i.e. to count the number of full boxes per species every 24 hour reporting period; and then multiply by the weight allocated for that box/species.

The estimated weight of the box would vary depending on the species and ranged between 28kgs for the turbot and brill up to 38kgs for monkfish, this was to take into account the numbers of a particular fish that could be packed into one box.

Landing Catch Estimation
On entering port after the voyage, the catch was landed in the iced boxes, separated, spray washed and graded automatically into boxes. The net weight was determined using electronic weighing systems; Hopper and Floor scales.

The declared set of weight estimates for the retained catch by species and the actual landed weight recorded in the logbook are summarised in below in Table 1. A copy of the EU logbook is appended in Annex 1 with the observers completed logbook in Annex 2 and the landed declaration in Annex 3.

Table 1 Catch Estimations

Species	Presentat[n]	Vessel / Obsv Box Wt. (kg)	No. of Boxes (n)	Vessel / Obsv Catch Wt (kg)	Landed Wt. (kg)	% Diff
Monkfish	HEAD/GUT	114	18	2052	1959	4.53
Sole	GUT	38	12.5	475	417	12.21
Megrim	GUT	36	51	1836	1768	5.10
Lemon Sole	GUT	36	9	324	328	-1.23
Plaice	GUT	35	1	35	29	17.14
Cod	GUT	32	15.5	496	544	-9.68
Haddock	GUT	32	29	928	1009	-8.73
Ray	GUT	34	7.5	255	241	5.49
Ling	GUT	34	11	374	386	-3.21
Turbot	GUT	28	1.75	49	51.5	-5.10
Brill	GUT	28	0.5	14	20	-42.86
John Dory	GUT	30	2.25	67.50	100	-48.15
Pollack	GUT	30	2.25	67.50	70	-3.70
Red Mullet	WHOLE	30	N/A	N/A	1	NA
Gurnard	WHOLE	30	N/A	N/A	7	NA
Witch	GUT	30	7.5	225	252	-12.00
Conger Eel	GUT	30	8	240	269	-12.08
Hake	GUT	30	1	30	37	-23.33
Whiting	GUT	30	0.5	15	21	-40.00
Forked Hake	GUT	30	1.25	37.50	38	-1.33
Squid	WHOLE	30	N/A	N/A	11	N/A
Octopus	WHOLE	30	2	76	83	-9.21

Influencing Factors

The main factors that affected the accuracy of catch weight estimations were:

- Ice thawing: Ice contained in the boxes preserving the catch inevitably thaws. To compensate, a greater volume of ice was added to each box in the earlier stages of the trip than to those in the latter. This may introduce variability in actual fish weight contained in the box between those boxes filled at the beginning of a trip and those at the end. The standard box weight is set for the trip, hence if a trip is cut shorter than usual, there may be some overestimation of the catch, since the boxes will contain more ice and less fish than the average that might be expected for a normal length trip.

- Weight loss by dehydration: Between the time of storage onboard the vessel and the time of landing fish may lose weight by dehydration depending on prevailing conditions during the trip. Flatfish were considered to be the most susceptible. Any loss was compensated for by allowing the boxed fish to settle which permitted further amounts to be added prior to the final icing process.

- To attain greater precision of catch weights, the use of motion compensated scales could be employed after periods of processing during the transfer of catch by species from the basket to the hold.

Appendix 2: Report of Observer Trip 2

Report of the Independent Observer Onboard the FV 'Artemis'

Vessel and Trip Details

Vessel Name:	*Artemis*
Vessel Type:	Trawler (23.3m)
Port:	Fleetwood, UK
Gear:	Stern Trawl OTG; mesh 80mm
Target Species:	Cod and Plaice
Areas Fished:	ICES Area VIIa / Irish Sea
Dates:	13/11/05 09:00 – 17/11/05 22:30
Independent Observer:	R. Gater

Introduction

In November 2005 a five-day research trip was undertaken on the 23m trawler '*Artemis*' in order to independently investigate the methodology and equipment employed by the vessel in making at-sea estimations of the weight of fish caught as detailed in the landing declaration. In making an independent assessment of at-sea working practices and influencing factors, it is hoped to assist in clarifying whether the current 8% margin of tolerance is a realistic figure to expect between declared weights and those confirmed at the point of landing.

Trip Summary

On Sunday 13th November *Artemis* departed Fleetwood to fish for cod and plaice using light ground trawls. The nature and quantity of trawls and warps aboard effectively restricted the vessel to operating within a small area in ICES VIIa enclosed to the north by the Solway Firth, to the west by the Isle of Man and to the south by Anglesey. *Artemis* returned to Fleetwood late on Thursday 17th November and landed her catch early the following day on 18th November. The trip duration was approximately five days, which was unusually long for the time of year as poor weather often ends operations prematurely. A total of eighteen tows were conducted at depths between 40-50 m (20-25 fathoms), with an average duration of 273 minutes (4hr 33min). Total fishing effort was 81 hours 50 minutes from 18 trawls. Catches were characteristically mixed, with cod, whiting, squid and skate representing the majority of retained species. Catches were considered as poor by the skipper, a fact attributed to problems caused by the weather and limitations of gear aboard. The skipper is an experienced fisherman and mariner who had recently taken command of *Artemis* after a long spell working abroad. The remaining three crewmen were all familiar with the vessel. Weather conditions were generally good apart from a period on Monday 14th November when Beaufort force 6 westerly winds halted fishing operations for 3 hours. Every haul was witnessed throughout all stages of capture, processing and weight estimation.

Landing and Processing the Catch

At the end of hauling, the cod-end was brought round to the starboard side where it was lifted free of the sea and positioned above a holding pond. The catch was then transferred to the sorting area by conveyor, where fish are sorted into species. However, apart from plaice, individual species were not routinely sorted into size grades. Unmarketable species and undersize fish are discarded at this point. All fish were then washed, but each species was processed differently. For example the target species of cod and flatfish were gutted, whereas whiting, squid and dogfish

were retained whole, reflecting the particular value and market for each species. The loose fish were then lowered into the fish room for packing into boxes by species. They were not graded.

Vessel Catch Estimation
It was normal procedure for the skipper to record catches in the European Community (EC) logbook at midnight for the preceding 24 hr period noting the number of events and total catch of completely full boxes. Each full box of fish was given a weight of 40kg, irrespective of the weight and quantity of ice used and species of the fish. The practice implemented for the amount of ice used and the density with which fish are packed into boxes was dependent on the individual crewman tasked to this. Incomplete boxes were only recorded once filled to avoid mistakes. This was particularly important when catches were poor from individual trawls resulting in several partially filled boxes.

Observer Catch Estimation
The vessel method was employed by the observer because it offered the most accurate means of estimating catches. In the absence of weighing equipment, the observer had no means of verifying the box weight (40kg) and was reliant upon the figure allocated by the vessel.

Other opportunities for estimating the catch weight to a species level were not possible. When the codend was hauled aboard, unknown quantity of by-catch, discards and undersize fish would make cod-end volumetric estimations unreliable. This was also the case when the catch was emptied into the holding pond; only an estimation based on a volumetric assessment for total catch once the boxes had been filled could be made.

Landing Catch Estimation
On entering port after the voyage, the catch was landed in the iced boxes. The remainder of the process was not observed.

The declared set of weight estimates for the retained catch by species and the actual landed weight recorded in the logbook are summarised in Table 1.

Table 1 Catch Estimations

Species	Present[n]	Vessel Box (n)	Obsv Boxes (n)	Vessel / Obsv Catch Wt (kg)	Landed Wt. (kg)	% Diff
Squid	WHOLE	8	8	320	314	1.9
Cod	GUT	13	13	520	537	-3.2
Skate / Roker	NA	4.5	4.5	180	164	9.8
Whiting	WHOLE	8	8	320	352.5	-9.2
Prime*	GUT	1	1	40	39	2.6
Plaice	GUT	2.5	2.5	100	145.5	-31.3
Monkfish	NA	1	1	40	48	-16.7
Dogfish	WHOLE	3	3	120	108	11.1
Shells**	NA	4	4	160	2.75	n/a
Gurnard	NA	3	3	120	89	34.8
Lemon Sole	GUT	0.25	0.25	10	13.5	-25.9

*Prime = rare high value fish e.g. Bass, brill, John Dory, red mullet
**Shells = primarily queen scallops - the landed weight was not recorded. However 1 lobster was recorded (the weight of which is given above).

Influencing Factors
The main factors that affected the accuracy of catch weight estimations were:

- The crew member responsible for storing the catch in the fish room is of vital importance to the accuracy and consistency of estimated weights declared by the vessel. More experienced individuals and those with a longer working relationship with the skipper and the vessel would be more likely to produce more accurate estimates.

- Non-deliberate errors in catch declarations were most likely to result from mis-counts of boxes in the fish hold when levels of catches and crew fatigue are high.

- The weight of fish in a crate will depend on how densely the fish are packed, which in turn is affected by species type and size grade. The level to which this task is completed consistently by the crew throughout a trip will influence catch estimations. The fish were not graded on this vessel because of limited working space and because of the implications for workload for the crew.

- The *Artemis* did not carry any weighing equipment. Weighing fish was considered impractical in poor sea conditions. In introducing weighing technology there would be issues of space on a small vessel, the slowing down of operations on board and the associated cost implications involved in purchase, installation, training, maintenance and operation.

Appendix 3: Report of Observer Trip 3

Report of the Independent Observer Onboard the FV 'Oceanus'

Vessel and Trip Details

Vessel Name:	FV *Oceanus*
Vessel Type:	Trawler (18m)
Port:	Kilkeel, UK
Gear:	Twin rig bottom trawl
Target Species:	Prawn (*Nephrops norvegicus*)
Areas Fished:	ICES Area VIa/VIIa
Dates:	02/04/2006 to 08/04/2006
Observer:	A. Williams

Introduction

A fishing trip was observed on the demersal trawler *FV Oceanus*. The role of the observer was to monitor the methodology and equipment utilised by the vessel to estimate catch live weight, make independent estimates of the same catches; and note any factors that may influence the respective methodologies.

Trip Summary

Fishing operations were conducted over 6 days within ICES Statistical Divisions VIa and VIIa. Fishing commenced within several hours steaming time of the harbour but catches were poor and the vessel moved further to the northeast, to the west of the Isle of Man and then to the north on Ailsa Craig fishing grounds. Initially catches were again poor which was attributed to the spring tide of the previous week. However catches improved during the trip and as the vessel fished further north and the *FV Oceanus* returned to Kilkeel early on 8th April.

A total of fourteen tows were undertaken, with the average tow time being in the region of 6 hours. Total fishing effort was approximately 84 hours. All hauls were dominated by the target species (*Nephrops*), with an observed estimate between 5% and 10% of incidental bycatch. Bycatch consisted primarily of Spurdog (*Squalus acanthius*), and a variety of marine invertebrates such as crabs and jellyfish. Occasionally, Haddock (*Melanogrammus aeglefinus*), Gurnard (*Triglidae*) or Cod (*Gadus morhua*) were caught. Every haul was observed from the point of landing to storage in the hold.

Generally poor sea conditions, Beaufort Force 6 winds and associated sea-states, were experienced throughout the trip.

The skipper was a very experienced fisherman and mariner. The three senior crewmen were also very experienced and capable fishermen. The fourth member of the crew was from Lithuania, was less experienced and had minimal English language abilities.

Landing and Processing the Catch

At the end of each haul both cod-ends were emptied into a holding pond on the starboard side of the vessel. The catch was then transferred to the sorting table by a conveyor where the catch was sorted manually.

Large whole prawns were picked and placed in baskets. Medium sized prawns were either tailed or retained whole in separate baskets. Sorting was dependent upon market requirements and the skipper received updates by telephone. Fish bycatch were also retained in separate baskets. Undersized fish and other incidental bycatch were discarded.

Once the catch had been sorted it was washed thoroughly in a drum washer, one basket at a time. Once washing was completed, the catch was lowered into the hold in baskets, transferred to an individual boxes and iced.

Vessel Catch Estimation
The live catch for each species was calculated on a 24 hour period to satisfy EU logbook requirements and represented the catches from the trawls during this period. It was normal practice for the skipper to receive a tally of weights and presentation (whole or tails), from a member of crew after each haul. This was based on the number of boxes of each product and applying the respective raising factor.

Members of the crew estimated one full box (plus ice) of whole prawns to be approximately 19kg. A box of prawn tails (plus ice) was estimated at 25kg. A conversion factor of 3.00 was applied to obtain a live weight figure. Box weight of fish products were 25kg.

Attempts were made to confirm these weights using a set of Nesco drop scales. However, vessel motion in heavy seas made accurate readings unattainable. Generally the practicalities of processing, sorting and storing the catch were exacerbated by poor sea conditions.

Observer Catch Estimation
There were three opportunities to estimate the catch. These were:

- In the net as it was being landed;
- Following processing and initial sorting into baskets; and
- When the catch is sorted by species into boxes for storing.

The first provided an opportunity to roughly estimate the total catch; the latter for retained catch. Therefore, the observer worked alongside the crew in order to assess working practices and the catch weight estimation technique.

The method adopted by the observer was the same as the vessel i.e. to count the number of full boxes per species every 24 hour reporting period; and then multiply by the weight allocated for that box/species. A weight was not allocated to baskets because they were not uniformly filled by the crew during the sorting and washing process.

Several attempts were made to pack and weigh the boxes of prawns and ice. However, sea conditions resulted in imprecise readings.

Landing Catch Estimation
On entering port after the voyage, the market was not open for business and it was therefore not possible to assess the process by which the various buyers confirm landed weights.

Summary of Catches

Table 1 provides a summary of the catch reported by the vessel (EC logbook) and the observer. The last column presents the percentage difference between the figures recorded in the vessel's EC logbook and those by the observer. Negative values indicate the observer estimation was below that of the vessels.

Table 1 Catch Estimations

Species	Presentat[n]	Box Wt (kg)	Observer		Vessel	Diff
			Boxes (n)	Catch Wt (kg)	Catch Wt (kg)	(%)
Prawns	whole	19	45	855	855	0.00
Prawns	tailed	75	20	1500[16]	1500[7]	0.00
Haddock	gutted	50	3	75	100	-25.00
Saithe	gutted	50	2	50	100	-50.00
Hake	gutted	50	0	0	50	-100.00
Gurnard	whole	50	4	100	100	0.00
Cod	gutted	50	1	25	0	100.00
			73	**1,555**	**1,705.00**	**-8.80**

[16] A conversion factor of 3 was applied to give the live weight.

Table 2 shows a comparison between catches recorded by the observer and by the vessel with the landing declaration provided by DARDNI.

Table 2 Catch Estimations

Species	Catch Weights (kg)			Diff (%)	
	Obsv	Vessel	Landed	Obsv vs Landed	Vessel vs Landed
Prawns (whole)	855	855	855	0.00	0.00
Prawns (tailed)	1500	1500	1500	0	0
Haddock	75	100	90	-16.67	11.11
Pollock / Saithe	0	100	95	-100.00	5.26
Hake / Pin Hake	0	50	84	-100.00	-40.48
Gurnard	100	100	100	0.00	0.00
Cod	25	0	0	100.00	-
Witch	0	0	25	-100.00	-100.00
Ling	0	0	40	-100.00	-100.00
Skate	0	0	40	-100.00	-100.00
Dogfish	0	0	25	-100.00	-100.00
Plaice	0	0	25	-100.00	-100.00
Monk	0	0	31	-100.00	-100.00
Sole	0	0	3	-100.00	-100.00
Choice	0	0	6	-100.00	-100.00
	1,555	**1,705**	**1,919**	**-18.97**	**-11.15**

Influencing Factors

The actual box-weight of prawns was observed to be dependent on:

- Prawn size and density within the basket;
- Experience of the individual crew men working in the fish hold;
- Amount of ice added; and

The use of scales to weigh prawns at sea was impractical due to the aforementioned heavy pitching and rolling often experienced in vessels of this size class. At times it was often difficult to stand or work in the fish hold during heavy seas.

During the course of observations the skipper and crew attempted to record live weights per box as accurately as possible to ensure the best market price on landing.

Appendix 4: Report of Observer Trip 4

Report of the Independent Observer Onboard the FV 'CKS'

Vessel and Trip Details

Vessel Name:	*FV CKS*
Vessel Type:	Netter (18m)
Port:	Newlyn, UK
Gear used:	Gill nets (128 mm mesh), Trammel nets (10.5 inch inner screen/38 inch outer walls)
Target Species:	Hake (*Merluccius merluccius*) & Turbot (*Psetta maxima*)
Areas Fished:	Southwest approaches (ICES area VIIe)
Dates:	18/04/2006 to 24/04/2006
Independent Observer:	A. Williams

Introduction

In April 2006 a five and a half day research voyage was undertaken on the 18m netter *FV CKS* in order to assess and independently investigate the methodology and equipment utilised by the vessel in making 'at sea' estimations of the live weight of catches.

Trip Summary

On Tuesday 18th April, *FV CKS* departed Newlyn harbour and steamed overnight to fishing grounds, approximately thirty nautical miles southwest of the Isles of Scilly.

Two gear types were deployed: gill and trammel nets, which were used to target Hake and Turbot respectively. A total of twelve gill net tiers were set, with a soak time between 17 and 20 hours. Three Trammel nets were set with a soak time of approximately three and a half days. Fishing depth was approximately 120m, with gill nets set over 'hard ground' and the trammel nets set in a parallel pattern over known Turbot (*P. maxima*) grounds.

One target species, Hake, was largely absent and catches were dominated by a variety of whitefish: Ling (*Molva molva*), Pollock (*Pollachius pollachius*), Haddock (*Melanogrammus aeglefinus*), Whiting (*Merlangius merlangus*), Cod (*Gadus morhua*), Saithe/Coley (*Pollachius virens*), and other species including Megrim (*Lepidorhombus whiffiagonis*), Sole species (*Soleidae*), Gurnard species (*Triglidae*), Plaice (*Pleuronectes platessa*), Anglerfish/Monk (*Lophius piscatorius*), Skate (*Raja batis*), Thornback ray (*Raja clavata*), Spotted ray (*Raja montagui*), smoothhounds (*Mustelus mustelus*), Tope (*Galeorhinus galeus*), Spurdog (*Squalus acanthius*) and John Dory (*Zeus faber*).

The trammel nets yielded a good proportion of the target species, Turbot (*P. maxima*), coupled with Anglerfish/Monk (*L. piscatorius*), although some whitefish, primarily Cod (*G. morhua*) and Haddock (*M. aeglefinus*) were also caught.

Fishing was initially poor and was attributed to difficult tidal and sea (Beaufort force 6 winds), which affected the deployment of the nets and, according to crew, the behaviour of the target species. Fishing improved slightly as tides slackened off and

the vessel covered different locations. *FV CKS* returned to Newlyn early on Monday 24th April.

The skipper and two senior crewmen were experienced and capable fishermen. The third member of the crew was a relative newcomer to the fishing industry and although a very capable, was less experienced with regard to onboard practices.

Landing and Processing the Catch
All tiers of gill and trammel nets were hauled onto the deck by an automated net hauler located on the starboard side of the vessel. Two members of crew were responsible for removing any catch from the net(s), whilst the third crewman flaked out the net in a holding pen in readiness for the next shoot.

All retained catch were gutted and thoroughly washed, before being stored in boxes. Target and high value species such as Hake and Turbot were boxed separately. Whitefish were generally boxed together on deck and other species were placed in 'mixed' boxes prior to further sorting in the fish hold by species.

Vessel Catch Estimation
It was normal practice for the skipper to receive a tally of estimated box weights by species, from a crew member after each haul. Figures were recorded at midnight in the European Community (EC) logbook for the preceding 24 hour period. A conversion factor was not applied in recording live weights apart from Monk fish.

Crew estimated one box of fish to weigh six and a half stone (41kg), prior to the addition of ice.

Observer Catch Estimation
The observer worked alongside the crew to estimate catches and to assess apparent difficulties encountered. Each haul and all stages of processing and weight estimation were monitored by the observer.

Catches in general were sorted to a species level into boxes either on deck or when they reached the fish hold. Without the means to accurately weigh each box prior to storage, the observer counted the number of boxes per species and multiplied by the allocated box weight of 41kg. The vessel method was employed by the observer because it offered the most accurate means of estimating catches.

These were mixed fisheries with significant amounts of bycatch species. A snapshot estimation of total catch, similar to that possible with trawl gear, was not possible because the gear was hauled aboard and the fish removed gradually. This would not provide an accurate means of estimating composition by species or address amounts of discards.

Landing Catch Estimation
The market was not open and therefore it was not possible to observe the process.

Summary of Catches

Table 1 provides a summary of the catch reported by the vessel (EC logbook) and the observer. The last column presents the percentage difference between the figures recorded in the vessel's EC logbook and those by the observer. Negative values indicate the observer estimation was below that of the vessels.

Table 1 Catch Estimations

Species	Presentat[n]	Box Wt (kg)	Observer		Vessel	Diff
			Boxes (n)	Catch Wt (kg)	Catch Wt (kg)	(%)
Hake	gutted	41	8	328	331	-0.91
Ling	gutted	41	5.5	225.5	253	-10.87
Pollock	gutted	41	1	41	43	-4.65
Haddock	gutted	41	2.5	102.5	117	-12.39
Whiting	gutted	41	1.5	61.5	71	-13.38
Cod	gutted	41	4.5	184.5	177	4.24
Megrim	gutted	41	4	164	152.4	7.61
Turbot	gutted	41	5	205	183	12.02
Monk*	gutted	41	3	123	317	-61.20
Rays	whole	41	4.5	184.5	165	11.82
Mixed	gutted	41	2	82	0	100
Tope / Dogfish**	gutted	41	6.5	266.5	273	-2.38
Shark*	na	-	0	0	87	-100.00
Spurdogs*		41	6	246	0	100
			54	**2,214**	**2,171.40**	**2.07**

*The figure recorded for Monk fish by the observer is conspicuous as a result of not applying the conversion factor.

**Tope / Dogfish / Shark and Spurdog Figures for these species were grouped and recorded differently by the vessel and the observer

Observer figures:

- Recorded Smoothhound and Tope together; and Spurdogs separately
- No Sharks were recorded

Vessel figures:

- Recorded Dogfish and Tope together; and Sharks separately.

Table 2 shows a comparison between catches recorded by the observer and by the vessel with the landing declaration provided by DEFRA.

Table 2 Catch Estimations

Species	Obsv Catch Wt (kg)	Vessel Catch Wt (kg)	Landed Catch Wt (kg)	Diff (%) Obsv vs Landed (kg)	Diff (%) Vessel vs Landed (kg)
Hake	328	331	307	6.84	7.82
Ling	225.5	255	264	-14.58	-3.41
Pollock	41	43	45	-8.89	-4.44
Haddock	102.5	117	102	0.49	14.71
Whiting	61.5	71	48	28.13	47.92
Cod	184.5	177	182	1.37	-2.75
Megrim	164	152.4	162	1.23	-5.93
Turbot	205	183	166	23.49	10.24
Monk	123	317	130	-5.38	143.84
Rays	184.5	165	166	11.14	-0.60
Shark	512.5	360	694.00	-26.15	-48.13
Mixed	82	0	84.00	-2.38	-100.00
	2,091	**2,169.40**	**2220.00**	**-5.81**	**-16.47**

Mixed* Landing declaration recorded figures for the following catches in this category

Species	**kg**
Mixed	8
Brill	1
Red Mullet	0.5
Sole	5
Gurnard	26
Dory	14.5
Saithe	15
Claws (crab)	6
Roe	8
Total	**84**

Shark** The figure for shark represent the respective values of different species. These species were recorded differently by the vessel, observer and upon landing. They are treated separately here and a subtotal for the group is given:

Species	**Obsv**	**Vessel**	**Landed**	**Obsv vs Landed**	**Vessel vs Landed**
Tope	266.5	273	135.00		
Shark	0	87	87.00		
Spurdogs	246	0	472.00		
Total	**512.5**	**360**	**694.00**	**-26.15**	**-48.13**

Influencing Factors
The main factors that affected the accuracy of catch weight estimations were:

- Non-deliberate errors in catch declarations were most likely to result from mis-counts of boxes in the fish hold when levels of catches and crew fatigue are high.

- The weight of fish in a box will depend on how densely the fish are packed, which in turn is affected by species type and size grade. The level to which this task is completed consistently by the crew throughout a trip will influence catch estimations. It is also influenced by the amount level of ice added to each box i.e. is it consistent?

- Some nominal amounts of bycatch were boxed together. The ratio of different species in each box, particularly if they have different anatomy such as flat fish e.g. sole, or fusiform e.g. gurnard will also influence packing density and hence weight per box.

- The *FV CKS* did not carry any weighing equipment. Weighing fish was considered impractical in poor sea conditions. By introducing weighing technology there would be issues of space on a small vessel, the potential of slowing down of operations on board and the associated cost implications involved in purchase, installation, training, maintenance and operation.

Overall, it appears that product weights per box are allocated before fishing operations commence. However, the variability of the technique for processing and storing is dependent on the experience of the crew, the duration of the trip, prevailing conditions and the composition of catches. These three factors will affect the actual weights.

Appendix 5: Report of Observer Trip 5

Report of the Independent Observer Onboard the FV 'Jubilee Quest'

Vessel and Trip Details

Vessel Name:	FV *Jubilee Quest*
Call Sign:	GY 900
Vessel Type:	Trawler (21.2m)
Port:	Grimsby, UK
Gear:	Twin Rig Bottom Trawl
Target Species:	Mixed Demersal
Areas Fished:	ICES Area lVb
Dates:	15/08/2006 to 23/08/2006
Observer:	L. Dalton

Introduction

A fishing trip was observed on the trawler *FV Jubilee Quest.* The role of the observer was to monitor the methodology utilised by the vessel to estimate catch live weight, make independent estimates of the same catches; and note any factors that may influence the respective methodologies.

Trip Summary

Fishing operations were conducted over nine days within ICES Statistical Division lVb. Fishing commenced immediately upon arrival at the fishing grounds after a $7^{1/2}$ hour steam from port. A total of 24 tows were conducted at an average depth of 90m and with an average tow time of six hours and ten minutes. Total fishing effort was 147 hours and 47 minutes. Calm conditions resulted in no interruptions to fishing operations. The trawl was immediately shot after the catch was emptied into the holding pond. The only delay was caused by net damage, resulting in a one hour interruption during which repairs were made.

Catches consisted mainly of the target demersal species plaice *Pleuronectes platessa,* cod *Gadus morhua* and prawns, *Nephrops norvegicus.*

The skipper and four crew members (one more than usual) were all experienced fishermen.

Landing and Processing the Catch

The catch was emptied into a holding pond on the starboard side of the vessel. The hatch to the pond was manually operated and resulted in the catch spilling onto a large conveyor for sorting into baskets.

Unwanted bycatch and undersized target species were allowed to continue along the conveyor and exit via the discard chute on port side. The bulk of discarded fish was made up of dab *Limanda limanda,* grey gurnard *Eutrigla gurnardus,* crab and undersized plaice.

Then followed another sorting stage, during which the catch, with the exception of prawns, spurdogs *Squalus acanthis,* and red mullet *Mullidae*, were gutted and washed in a drum washer. This was performed one species at a time. Baskets of

processed fish were then lowered into the hold where the ungraded fish were transferred into separate boxes by species.

Each box contained a bottom layer of ice on which the fish were placed. When full, the box of fish was left to settle before another layer of ice was added and another box stacked on top. The temperature of the fish hold was maintained at -1°C.

Vessel Catch Estimation
The live catch for each species was calculated on a 24 hour period to satisfy EC logbook requirements. Declared unit weights of 20kg/box for prawns and 50kg/box for all other species were used. These were derived from vessel/crew experience. Scales were not present onboard.

One crew member was responsible for stacking and recording the number of boxes per species in the hold. A daily tally of full boxes was given to the skipper, and entered into the EU logbook. Partially filled boxes were only recorded once full.

Lemon sole were stored loosely for the first three days of fishing so estimates were made from the basket before pouring them onto ice.

At the end of the trip, the skipper calculated the live weight of each species by multiplying the declared box weight by the number of boxes and then applying the appropriate conversion factor to convert the process weight to live weight. The total figure per species was entered at the bottom of the EC logbook.

Observer Catch Estimation
There were four opportunities to estimate the catch. These were:

- In the net as it was being landed;
- In the holding pond prior to sorting;
- Following processing and initial sorting into baskets; and
- When the catch was sorted by species into boxes.

The first and second opportunities may provide an estimation of total catch but was not suitable for estimating catch composition. Significant amounts of discards would also add to the inaccuracy of these methods.

The third opportunity is better but inaccuracies would persist because of the variability that baskets were filled.

The method adopted by the observer was the same as the vessel i.e. to count the number of full boxes per species every 24 hour reporting period; and then multiply by the weight allocated for that box/species.

In the absence of scales with which to weigh a sample of boxes, the only method available to the observer for providing an independent estimate of the box weights was to make an eyeball estimate. This is very difficult to do without a benchmark or prior experience of working with boxes of that specific size, so any estimate made is likely to be fairly inaccurate. For this reason, the observer used the vessels declared unit weights and conversion factors also obtained from the vessel.

Landing Catch Estimation
On entering port after the voyage, the catch was landed in the iced boxes and separated and graded into boxes of the same size. The net weight was determined using electronic weighing systems; hopper and floor scales. The boxes were then

labelled with the net weight, displayed and sold at market the following morning. The observer attended the market.

Summary of Catches

Table 1 provides a summary of the catch reported in the vessel (EC logbook) and by the observer. The last column presents the percentage difference between the figures recorded in the vessel's EC logbook and those by the observer. Negative values indicate the observer estimation was below that of the vessels.

Table 1 Catch Estimations

Species	State	Box Wt (kg)	Conversion Factor	Observer		Vessel		Difference (%)
				Boxes (n)	Catch Wt (kg)	Boxes (n)	Catch Wt (kg)	
Plaice	GUT	50	1.07	203.25	10,873.88	203	10,860.50	0.12
Cod	GUT	50	1.17	89	5,206.50	89	5,206.50	0.00
Haddock	GUT	50	1.16	1	58.00	1	58.00	0.00
Dover Sole	GUT	50	1.05	1	52.50	1	52.50	0.00
Lemon sole	GUT	50	1.04	15.6	811.20	15	780.00	4.00
Prawns	WHOLE	20	1.00	81	1,620.00	81	1,620.00	0.00
Spurdogs	WHOLE	50	1.00	5	250.00	5	250.00	0.00
Prime*	GUT	50	1.05	13	682.50	13	682.50	0.00
Skate/Roker	GUT	50	1.03	7.25	373.38	7	360.50	3.57
Monkfish	GUT	50	1.28	5	320.00	5	320.00	0.00
Red Mullet	WHOLE	50	1.00	1.2	60.00	0.5	25.00	140.00
Ling	GUT	50	1.14	1.2	68.40	1	57.00	20.00
Whiting	GUT	50	1.13	0	0.00	1	56.50	-100.00
Rough**	GUT	50	1.19	0.8	47.60	1	59.50	-20.00
Squid	WHOLE	50	1.00	2	100.00	2	100.00	0.00
				426.3	**20,534.35**	**425.50**	**20,488.50**	**0.22**

* Prime (mixed boxes) includes brill *Scophthalmus rhombus,* halibut *Hippoglossus hippoglossoides*, turbot *Psetta maxima* and John Dory *Zeus faber.* Catch by species was calculated by estimating the proportion per full box.

** Rough includes saithe *Pollachius pollachius* and wolf-fish *Anarhichadidae (*Same CF as Saithe)

There was only one anomaly:

The observer had no record of the vessel reporting Rough.

Table 2 shows a comparison between catches recorded by the observer and by the vessel with the landing declaration provided by DEFRA.

Table 2 Catch Estimations

Species	Catch Weights (kg)			Diff (%)	
	Observer	Vessel	Landed	Observer Vs Landed	Vessel Vs Landed
Plaice	10,874	10,860.00	10,011	8.6%	8.5%
Cod	5,206	5,206.00	4,355	19.6%	19.5%
Haddock	58	57	25	132.0%	128.0%
Dover Sole	52.5	52	28	87.5%	85.7%
Lemon sole	811	775	796	1.9%	-2.6%
Prawns	1,620	1,620	1,892	-14.4%	-14.4%
Spurdogs	250	250	225	11.1%	11.1%
Prime*	682	682	656	4.0%	4.0%
Skate/Roker	373	395	375	-0.4%	5.3%
Monkfish	320	315	204	56.9%	54.4%
Red Mullet	60	60	51	17.6%	17.6%
Ling	68	57	60	14.0%	-5.0%
Whiting	0	57	70	-100.0%	-18.6%
Rough**	48	59.5	62	-23.2%	-4.0%
Squid	100	100	96	4.2%	4.2%
	20,482	**20,546**	**18,906**	**8.3%**	**8.7%**

Influencing Factors
The main factors that affected the accuracy of catch weight estimations were:

- Human error. Tallies of full boxes in the hold easily miscounted when catch levels are high or individual is tired.
- Lack of weighing equipment on board.
- Packing density. Different species and grades of fish pack differently which can make a significant difference to box weights. Also dependent on how well a particular crew member 'straightens' (lays down flat) the fish whilst packing.
- Rare bycatch is boxed together i.e. prime and rough. This makes it difficult to quantify the separate species.
- Levels of ice in boxes. More ice is used earlier in the trip to allow for the ice melting. As a result boxes of fish stored at the beginning are likely to weigh less than the declared weight whereas later boxes weigh more. According to the skipper, this evens out over the course of a trip.

Possible Solutions
The introduction of scales, particularly, the motion compensated variety, at the sorting stage would provide an accurate weighing system. Total weight for catch or individual processed weight per species could be obtained. However, crew cite time, space and weather conditions as reasons against the use of scales.