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Cefas

Self-sampling in the inshore sector (SESAMI)

Final Report

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Executive summary

A self-sampling trial, where 30 skippers of under ten metre vessels collected their own data during daily fishing operations was conducted in the south coast of England. The objective was to explore the capability, willingness and practicalities of data collection by skippers, and the feasibility of using these data to document the fishing patterns and catch composition in the inshore sector.

Skippers of participating vessels collected detailed information during their daily fishing trips including the gear they used, species caught, size, proportion of catch retained and discarded as well as the reasons for discarding. Cefas observers accompanied participating vessels on prearranged trips to independently record the catch levels and collect length data.

Results indicate that there were no significant differences in the amount caught, proportion retained and discarded over time for vessels that fish in the south east and those that fish in the south west. However, there were significant differences between gear types on the measures of daily catch, proportion retained and discarded, and the number of species caught with daily catches for gill and tangle net significantly higher than those of drift net, hand line (board), ring net and rod and line. Catches from otter trawls showed a significantly greater number of species caught per trip than all other gear types.

Discard rates varied between the different gear types with tangle net (24 ± 9%) and trammel net (23 ± 9%) showing the highest discards ratios while hand lines (board = 3%, canning = 3%, and gurdy and jigs = 1 ± 1%) the lowest. Overall, data collected by skippers show that 16 ± 5% of the catch from the inshore fleet participating in this study was discarded while the remaining 84 ± 5% was retained. The main reasons for discarding in the inshore fleet in this study include a lack of market (31%), catch was below the minimum landing size (now Minimum Conservation Reference Size (MCRS)) (24%), damaged by seal and lice (21%), lack of quota (15%) and species with zero total allowable catches (TAC) (5%).

Data collected by skippers and observers from the same fishing trips showed a close correlation on all measures of total catch (R^2 = 0.78), retained catch (R^2 = 0.73) and discarded catch (R^2 = 0.80) for vessels in the south west. For vessels in the south east however, skipper-observer data comparisons showed moderate correlations with total catch having an R-squared value of 0.68, retained catch an R-squared value of 0.64 and discarded catch an R-squared value of 0.48. The exact reason for this disparity in the skipper-observer data between the south east and the south west is unknown. However, a greater reliance on quota species (which are covered by the discard ban) by

south east vessels may have led the skippers to misreport the amount of discards, and could therefore explain the difference in correlation between the skipper and observer data. In general, the comparisons show that there were differences in the weight of catches estimated by skippers and the weight estimated by observers. For all vessels, comparisons based on the mean discard rates for the main quota species collected by skippers and those collected by observers indicated consistent differences, implying that the data from skippers could be used to predict those from the observers. However, the regional differences in the level of correlation between the skipper and observer data implies that different weighting factors may be needed to estimate actual catch and discard rates from self-recorded data for different fleets. This weighting factor could be determined by having observer coverage across different sections of the fleet.

In conclusion, under ten metre skippers have demonstrated that they are capable and willing to collect detailed information on their fishing practices, the range of species caught, the varying types of gear, the wide geographical distribution of their fishing effort and the drivers of discarding. Despite the inherent bias with the trial (i.e. participating skippers wanted to take part), this trial has demonstrated that validated self-sampling by under ten metre skippers is potentially, an efficient way of collecting commercial fishery data. Towards the new CFP, the trial has demonstrated that under ten metre skippers could use validated self-sampling as a way to document their catches during daily fishing operations with the potential to quantify the level of confidence in the data. Feedback from the skippers indicate that they see self-sampling as a simple method to use that provides more data cheaply that the fishing industry can trust as they were involved in the collection.

A number of recommendations are made including the need for standardisation in reporting, strict protocols for data collection, good communication, provision of adequate financing and having a project steering group as guidelines for best practice in industry-led data collection.

CONTENTS

1. INTRODUCTION

This report summarises findings from a self-sampling trial in which 30 skippers of under ten metre vessels in the south coast of England collected their own data during daily fishing operations. The objective was to test the capability, willingness and practicalities of data collection by skippers. The project also aimed at generating the information needed to better define the fishing practices and catch patterns of the inshore fleet. In doing so it considers how industry-led data collection could be used to provide the data and information needed for policy formulation and fisheries management plans. This report addresses the following questions.

- What fisheries information can be derived from the data collected by skippers?
- How can data collected by on-board observers be used to validate the data collected by skippers?
- What are the relative costs of data collection by observers and skippers?
- How skippers view self-sampling as a data collection method for science and compliance.

The genesis of the project was a response by the under ten metre fishing fleet in England wanting to gather data that they can trust to provide evidence on their fishing practices. The under ten metre fleet recognised that in the absence of robust information on catch patterns, including discard rates, there is little evidence to support their preferred management option or to dispute the assumptions driving proposals they consider to be unsuitable. Given that the scientific observer programme run by Cefas covers ~2% of all vessels, and with the new Common Fisheries Policy (CFP) in place, there was desire by the under ten metre fleet to work side-by-side with Cefas scientists to collect data to improve understanding of the most important issues affecting the inshore fleet.

The project was funded by Defra as part of MF1002 (Practical steps towards reducing discards by the English and Welsh fleets), and the Marine Management Organisation (MMO) through the European Fisheries Fund (EFF). It was conducted by the Applied Fisheries Science and Technology Group (AFST) at Cefas, and managed by a steering group comprised of representatives from NUTFA (New Under Ten Fishermen's Association), MMO and Defra.

2. BACKGROUND

Effective fisheries management requires many different types of information including data on total catches, marine environment and fishing fleets. Effective and affordable methods of collecting such data are therefore needed to provide information for policy formulation and management plans for the long-term sustainability of the fishery.

One of the most effective methods of collecting data at-sea during fishing operations is by having scientific observers on-board fishing vessels. This is because observers can record a wider range of data on more species than fishermen, and also promote communication and outreach between scientists and fishing industry while on board fishing vessels (Fernandes *et al.* 2011, Faunce 2011). Scientific observer programmes are, however, expensive to run and therefore they suffer from a low coverage. This is compounded by the fact that inshore fleets are so diverse. There are also safety considerations / restrictions on observers boarding under ten metre vessels. For example, in the Cefas Observer Programme (COP) two observers are required when the skipper does not have crew on board, and for vessels below seven metres in length. Relying on data from observers could therefore lead to difficulties such as small effective sample sizes, bias and unrepresentative data for the inshore fleet.

Self-sampling allows for continuous, broad area, high-resolution sampling using large numbers of ships of opportunity. In the inshore fleet, self-sampling enables more samples from more trips to be collected at lower cost than through on-board observer programmes. Further, participation in self-sampling projects encourages fishermen to be proactive as they play a central role in data collection. Many scientists therefore view self-sampling as an essential component to supplement data collection to provide a more complete picture of fishing operations. It is worth noting that the self-collection of data by skippers provides various benefits and opportunities to fishermen as it could support relaxation from some regulatory requirements e.g. days at sea restrictions (Mangi *et al.* 2014).

In the new CFP, fishermen have to implement an accounting system that gives comprehensive, complete and reliable documentation of all catches including discards. The new CFP also states that in order to achieve the obligation to fully document fishing activities, vessels need to be appropriately equipped with the necessary technologies for data acquisition. A wide range of technologies such as vessel monitoring systems (VMS), electronic log-books (e-log) and remote electronic monitoring (REM) techniques such as closed circuit television (CCTV) are now available and have been applied to monitor and collect catch data that could support the fishing industry in meeting the CFP obligations. A number of approaches such as self-sampling and reference fleets are a potential way to fully document fisheries which may, in some cases, be more appropriate.

When fishermen collect their own data during fishing operations then this will increase the quantity and quality of data needed to support traditional scientific data collection and scientific assessments of fish stocks and fishing activity. However, concerns have been raised in the literature regarding the quality and reliability of catch data collected directly by fishermen. Faunce (2011) showed that there are mismatches in species identification between scientific observers and fishermen which may have implications for management. For example, the misidentification of the main rockfish species led to a delay in implementing a fishery closure in the Gulf of Alaska (Faunce 2011). Such studies have resulted in perceptions that scientists and managers should rely less on data collected directly by fishermen, and instead rely more on using data collected by scientists through research-survey assessments.

A number of studies however, indicate that great advances have been made in the methods of collecting and analysing data collected directly by fishermen. In the Irish Sea data enhancement project, Hoare *et al.* (2011) showed that discard rates, and the species composition of discards, from data collected through self-sampling and those by scientific observers were very similar for otter trawls and Scottish seines. Similarly, Uhlmann *et al.* (2011) did not see any evidence that length data collected through a self-sampling project in the Netherlands was biased. The Dutch self-sampling programme involved 12 vessels collecting discards samples for the estimation of discard rates for European plaice, common dab, grey gurnard and whiting. Lordan *et al.* (2011) argue that data collected through self-sampling and scientific observers are complimentary and therefore need to be integrated for scientific and advisory purposes. It is therefore essential that self-sampling schemes put in place data quality control, assurance and validation mechanisms to ensure proper rigour and evaluation.

3. AIMS AND OBJECTIVES

The primary aim of this project was to conduct a feasibility study to assess existing opportunities that would enable under ten metre fishing vessels to collect their own data during fishing operations. The project therefore forms part of the initiative to deliver fully documented fisheries in England, as it explores how self-sampling could enable the inshore fleets to collect their own data so as to enrich current data sets.

Specifically, the objectives of the self-sampling trial were to:

- Ensure sufficient participation of eligible vessels (netters and hand liners) from each of two areas of the south coast: east (ICES area VIId) and west (ICES area VIIe, f, g, and h).
- Design and introduce a log sheet that is usable by the under ten metre fleet and that provides good quality data on fishing effort, gear type, fishing location, species and size composition of catches, catch amount, proportion retained and discarded including reasons for discarding.
- Skippers to use the log sheet to collect their own data during fishing operations. 100 days of data from consecutive trips were sought from each participating skipper.
- Undertake two observer trips on each participating vessel to validate the data collected by skippers.
- Analyse the data using indicators such as catch rate, retention rate, discard rate, number of species caught and species diversity to better understand fishing practices in the under ten metre fleet.
- Compare the relative cost of data collection by observers and skippers.
- Collate views from skippers on whether self-sampling can be used to provide the data needed to fully document fishing activities in line with the new CFP.
- Produce a final project report for NUTFA, EFF and Defra policy-makers.

4. APPROACH AND METHODS

4.1 Selection of vessels

Interested skippers were invited to apply to take part in the trial through press releases placed in the Fishing News, notice boards (MMO, Deep Sea Mission offices, Harbour offices) and websites (NUTFA, Government Contracts Finder). A total of 37 applications were received of which 30 that use gill, trammel and tangle nets, rod and hand lines as their main gear types were selected. In total 13 of these vessels were based at ports in the south east while 17 were from the south west (Table 1). Data collection was initially intended to take place between August 2012 and August 2013 for all vessels in the trial. However, an additional five months (November 2013 to March 2014) was allowed for the vessels in the south east as most of these vessels could not fish during the previous cold season due to poor weather.

4.2 Terms and conditions of participation

The terms and conditions for skippers to collect and provide catch data during the self-sampling trial included:

- Skippers were to provide the Project Team with specifications of the gear they use each time they fished (Appendix 1a).
- Provide catch data from 100 consecutive fishing trips on log sheets provided (Appendix 1b).
- For health and safety reasons, observers cannot board vessels that are under seven metres long, and these vessels therefore could use cameras or other technology as a way to independently validate the data collected by the skipper.
- A daily rate was paid to each skipper as a small incentive for the data collection. Before the trial was undertaken, 21 under ten metre skippers from Looe, Plymouth, Beer, Hartlepool, Scarborough, Bridlington, Ramsgate and West Mersea were consulted through face-to-face interviews to see whether they were willing to collect their own data. One of the questions that were asked during these interviews was what would incentivise data collection? A number of incentives were provided by the skippers including the provision of extra quota, direct payment and more days at sea. A daily direct payment was therefore used in this trial as it was more feasible.
- Skippers were also provided with white board in the wheel house where they could take notes of any information and later transfer this to formal paperwork.

Table 1: Number of vessels that took part in the trial showing the main ports they are based and the main gear types they used.

Area	Port	Number of vessels	Gear types	Start and end of data collection
South East	Hastings	5	Rod and line, Gill net, Trammel net, Drift net	August 2012 to August 2013;
(ICES VIId)	Hythe	1	Gill net, Trammel net, Tangle net	(Extended for 5 months
	Newhaven	3	Gill net, Trammel net, Tangle net, Drift net, Otter trawl, Hand line (gurdy and jigs)	between November 2013
	Poole	3	Gill net, Tangle net, Trammel net, Drift net, Rod and line, Ring net	and March 2014)
	Weymouth	1	Rod and line	
South West	Axmouth	1	Rod and line	August 2012 to August 2013
(ICES VIIe, f, g, h)	Cadgwith	1	Gill net, Tangle net, Rod and line	
	Falmouth	1	Hand line (board), Hand line (canning), Hand line (gurdy and jigs), Rod and line	
	Hayle	2	Hand line (gurdy and jigs), Rod and line	
	Helford River	3	Gill net, Tangle net, Trammel net, Hand line (board), Hand line (gurdy and jigs), Rod and line	
	Looe	1	Gill net, Hand line (gurdy and jigs), Rod and line	
	Mevagissey	1	Drift net, Gill net, Hand line (board), Hand line (canning), Hand line (gurdy and jigs), Rod and line	
	Newlyn	3	Gill net, Tangle net, Trammel net, Hand line (canning), Hand line (gurdy and jigs), Rod and line	
	Newquay	2	Gill net, Tangle net, Hand line (board), Hand line (gurdy and jigs)	
	Port Isaac	1	Gill net, Tangle net, Hand line (board), Rod and line	
	Torquay	1	Gill net, Trammel net, Hand line (gurdy and jigs)	

- Other information that was provided to each skipper includes a list of three-letter codes for each species (Appendix 1c) and a map of the local area with the ICES rectangles split into nine sub rectangles (Appendix 1d). This was to obtain a more disaggregate level of the fishing location as skippers indicated that recording the latitude and longitude of their fishing locations on a daily basis would be cumbersome.

4.3 Data analysis

Based on the grading used at their local landing port, skippers recorded the size (large, medium or small) of each species, and amount caught using the units of measurements they felt most familiar with to reduce the burden of taking part in the trial. Some therefore used count (by recording the number of individuals caught), some used stones or pounds, while the majority expressed the amount caught in kilograms. The amount caught for each species recorded by the skippers was therefore converted to weight in kilograms using established conversion rates from stones or pounds. For the catch that had been recorded as count of individual fish, conversion to weight for the different sizes of the catch was based on the fish grades used at the nearest landing port (Table 2). The number of fish caught was therefore multiplied by the average weight for each size category. It is worth noting that while these conversions led to a standardization of the data on which to perform the analyses, some of the information was lost in the process. Inconsistencies in the grading system used at each port therefore could have introduced errors in the final data set.

Table 2: Example of weight for different fish grades that was used to convert the number of individuals recorded by skippers into weight.

Newlyn Fish Grades

	Dover Sole	Lemons	Megrim	Plaice	Witches	Red Mullet	Whiting	Haddocks
1	600-2500	600-200	800-200	900-2500	500-2500	1000-2000	1000-3000	2000-4000
2	400-600	500-600	500-800	700-900	300-500	750-1000	500-1000	1000-2000
3	280-400	350-500	350-500	450-700	150-300	500-750	350-500	570-1000
4	220-280	200-350	200-350	330-450		300-500	250-350	300-570
5	170-220	70-200	50-200	50-330		20-300	110-250	170-300
6	50-170							

	Monk Tails	John Dory	Hake	Cod	Pollack	Bass	Grey Mullet		Mackerel
1	4000-7000	2000-5000	4000-5000	500-1000	500-1000	500-1000	500-1000	L	2-3 fish kg
2	2000-4000	1000-2000	3000-4000	1000-2000	1000-2000	1000-2000	1000-2000	LM	3-4 fish kg
3	1000-2000	500-1000	2000-3000	2000-3000	2000-3000	2000+	2000+	M	4-6 fish kg
4	500-1000	300-500	1000-2000	3000-4000	3000+			S	6+ fish kg
5	250-500	100-300	500-1000	4000+					
6	50-250		250-500						

The gear descriptions provided by the skippers also varied widely as skippers described the gear they use based on the species they target e.g. sole nets, mackerel nets, mackerel feathers, squid jigs, drift herring, drift bass etc. These were therefore standardized during the analyses with the final gear list comprising of drift nets, gill nets, trammel nets, tangle nets, ring nets, otter trawls, rod and line, hand line (trolling board), hand line (canning), and hand line (gurdy and jigging).

To analyse the catch composition for each site and gear used, the following measures were used: total catch, proportion retained, proportion discarded, number of species caught and species diversity. Total catch, and the proportions retained and discarded were expressed as the weight per month, while species abundance was computed as the average number of species caught per gear per day of sampling. Species diversity was calculated using the Simpson's Index $D = 1-\sum pi^2$ where D is diversity, p is the proportion of total weight belonging to each species divided by the total weight in the sample, and i is the number of individual species.

Comparisons were made based on the vessels that took part from the south east versus those from the south west. Similar comparisons were made for the data that were collected by the skippers with those that were collected by observers. The skipper-observer comparisons were based on data collected by both observer and skipper from the same fishing trips. One-way analysis of variance (ANOVA) (a statistical technique used to compare means of two or more samples) comparisons were used to test for site and gear differences to highlight significant effects of gear and site. When overall significance was found then pair-wise comparisons (a process of comparing the gears in pairs to judge which gears differ significantly) were computed using the Tukey's HSD test to determine which gears were different.

4.4 Perceptions of skippers towards self-sampling

A questionnaire was developed (Appendix 2) and used to collect feedback from the participating skippers on how the self-sampling trial was set up and run. The questionnaire was also designed to elicit the skipper's views on the merits of self-sampling as an approach to fully-document fisheries. Questions asked included: What are the advantages / disadvantages of collecting your own data during fishing operations? and, can self-sampling deliver the information required to fully-document fisheries? The questionnaire was carried out through a postal survey towards the end of the project. In total 24 (80%) participating skippers returned their completed questionnaires.

5 RESULTS

5.1 Skipper data versus observer data

5.1.1 Sample sizes

A total of 93 observer trips were conducted during the course of the trial covering 3% of the total skipper self-recorded trips. These include 54 trips on vessels in the south east, and 39 trips on vessels in the south west (Table 3). Apart from seven single-handed vessels that were under seven metres long (and therefore could not be sampled by observers for health and safety reasons), the majority of vessels were sampled by observers with the exception of five over seven metres long vessels that were not sampled. These included three vessels that stopped collecting their own data as they had changed fishing methods, and two that changed fishing vessels during the trial. Those that had changed gear were potting more than netting or hand lining. Unfortunately, some skippers did not submit data on the trips sampled by observers, as they thought that the data for that fishing trip had already been collected by the observer. Therefore, of the 93 observer trips only 49 (53%) had matching data from both observer and skipper.

Table 3: Number of observer trips conducted during the trial

Area	Gill net	Hand lines	Otter trawl	Tangle net	Trammel net	Total
South east	3		8	6	37	54
South west	12	4	0	18	5	39
All vessels	15	4	8	24	42	93

5.1.2 Validating data from skippers

The data collected by skippers were compared with those from the observers on all matching trips. Univariate correlations were computed and the R-squared (a statistical term that describes how good one term is at predicting another) for each measure of catch noted. The R-squared value is such that if it is equal to1.0, then given the value of one term one could perfectly predict the value of the other. Therefore the closer the R-squared value is to 1.0, the closer the observer and skipper self-recorded data were. Results show that there was a close correlation on all measures of total catch (R^2 = 0.78), retained catch (R^2 = 0.73) and discarded catch (R^2 = 0.80) between the self-collected data from skippers and observers in the south west (Figure 1a). Results from the south east however, showed moderate correlation between observer and the self-recorded data on all measures (Figure 1b) with the amount discarded showing the lowest R-squared value (0.48).

a) South west

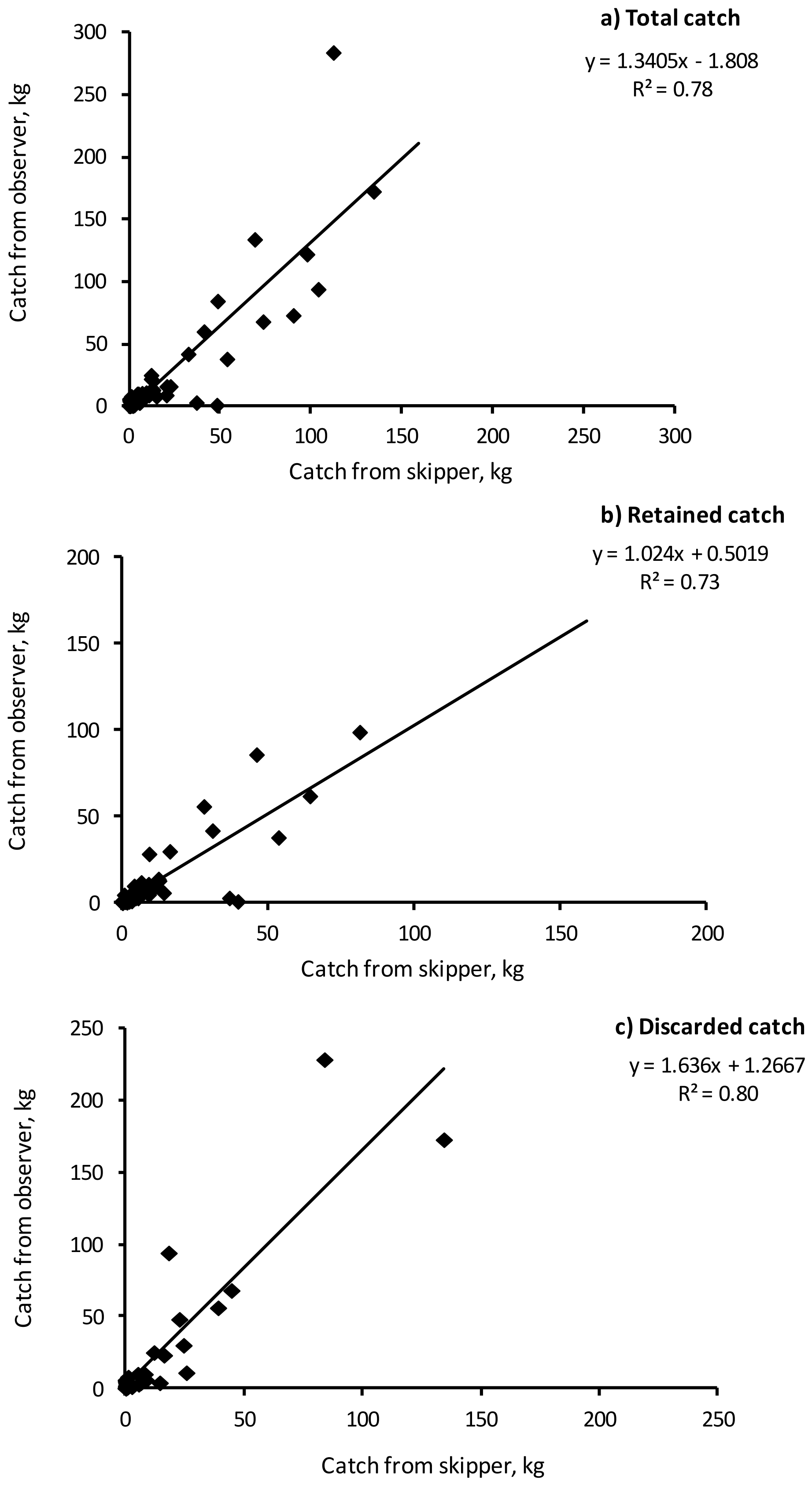
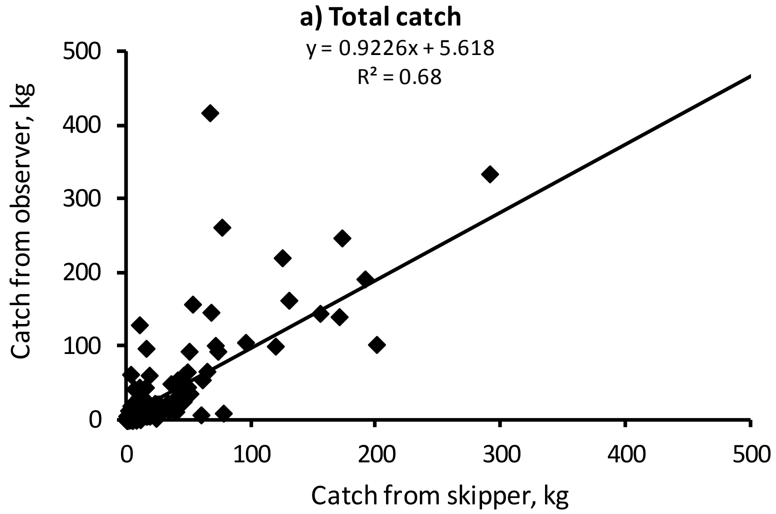
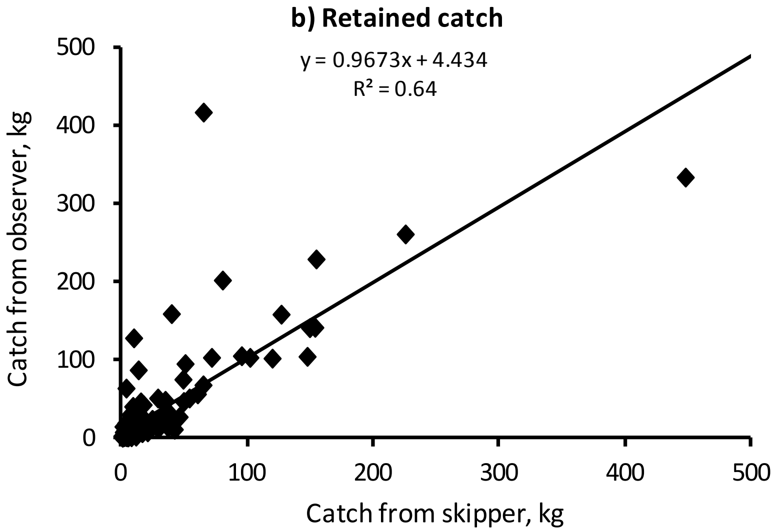


Figure 1: Scatterplots showing univariate correlations between the data collected by skippers and those collected by observers for three measurements of catch: total catch, proportion retained and proportion discarded for all vessels combined and for south east and south west vessels separately.

b) South east





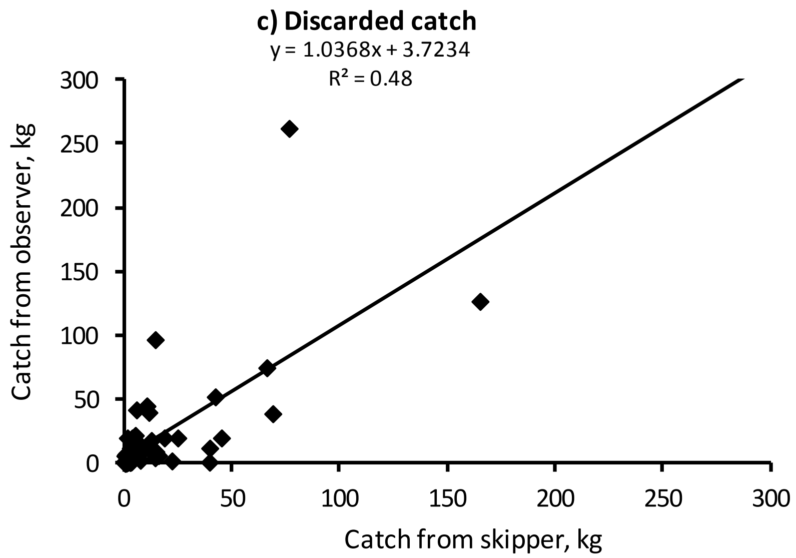


Figure 1 continued

Accurate discard rates are important as they are applied to landings data to estimate total catch and therefore total fishing mortality. For the main quota species it was found that the skippers consistently underestimated the discard rates when compared to the observer data (Figure 2). This was evident in both the south east and south west vessels (Table 4). This suggests that to estimate the actual rate of discarding a weighting factor could be applied to the skipper self-recorded data.

Table 4: Comparison of the data collected by skippers and those collected by observers from the same fishing trips for the measures of total catch, proportion of catch retained, proportion of catch discarded, number of species caught and species diversity. Statistical analyses showed that there were no significant differences between the data collected by skippers and those by the observer for all measures.

		Observer		Skipper	
Area	Measure	Mean	SEM	Mean	SEM
S East	Total catch	455	238	217	48
	Retained catch	387	216	169	38
	Discarded catch	68	23	67	20
	Number of species	14	4	11	4
	Species diversity	0.75		0.82	
S West					
	Total catch	220	28	274	46
	Retained catch	163	18	190	36
	Discarded catch	61	17	102	33
	Number of species	13	6	11	6
	Species diversity	0.91		0.92	
All vessels					
	Total catch	357	140	241	34
	Retained catch	294	127	178	27
	Discarded catch	65	15	83	18
	Number of species	14	5	11	5
	Species diversity	0.85		0.93	

The method of estimating discards used by the skippers and observers were however, not consistent. Observers usually measure the length and number of individuals of each species in the catch and use established length-weight relationships to convert the catch into weight. Some of the data from the skippers also had to be converted into weight since the skippers recorded the number of individuals caught per species. Estimating the catch weight through these conversions could have imposed an error to the data and therefore could explain some of the differences between the two data sets.

The differences in the correlation between skipper and observer data in the south east and the south west could be due to the species targeted by each fleet. Most of the skippers in the south east target species which are managed by quotas, while the participating skippers in the south west relied more on non-quota species. Quota species will be subject to a discard ban between 2015 and 2019 while non-quota species will not. The greater reliance on quota species (e.g. cod, sole, skates and rays) may have led some skippers to misreport the amount they discard. This observation is similar to findings from New Zealand, where self-sampling was reported as being a dynamic data collection method which ensures that the fishery is well sampled (Starr 2000). Examination of the data collected through self-sampling shows considerable internal integrity and provides confidence that the information is reliable. Starr (2000) however, concludes that self-sampling does not work well for monitoring contentious, rare or protected species as there is an incentive to misreport. It could also have resulted from differences in the recording methods used by the skippers and observers (detailed above).

These regional differences, which may have resulted from the differences in the fleets, imply that to estimate the actual volume of fish caught and discarded from skipper self-recorded data across England may require different weighting factors. The weighting factor could be estimated by having a degree of observer coverage across these different fleet segments.

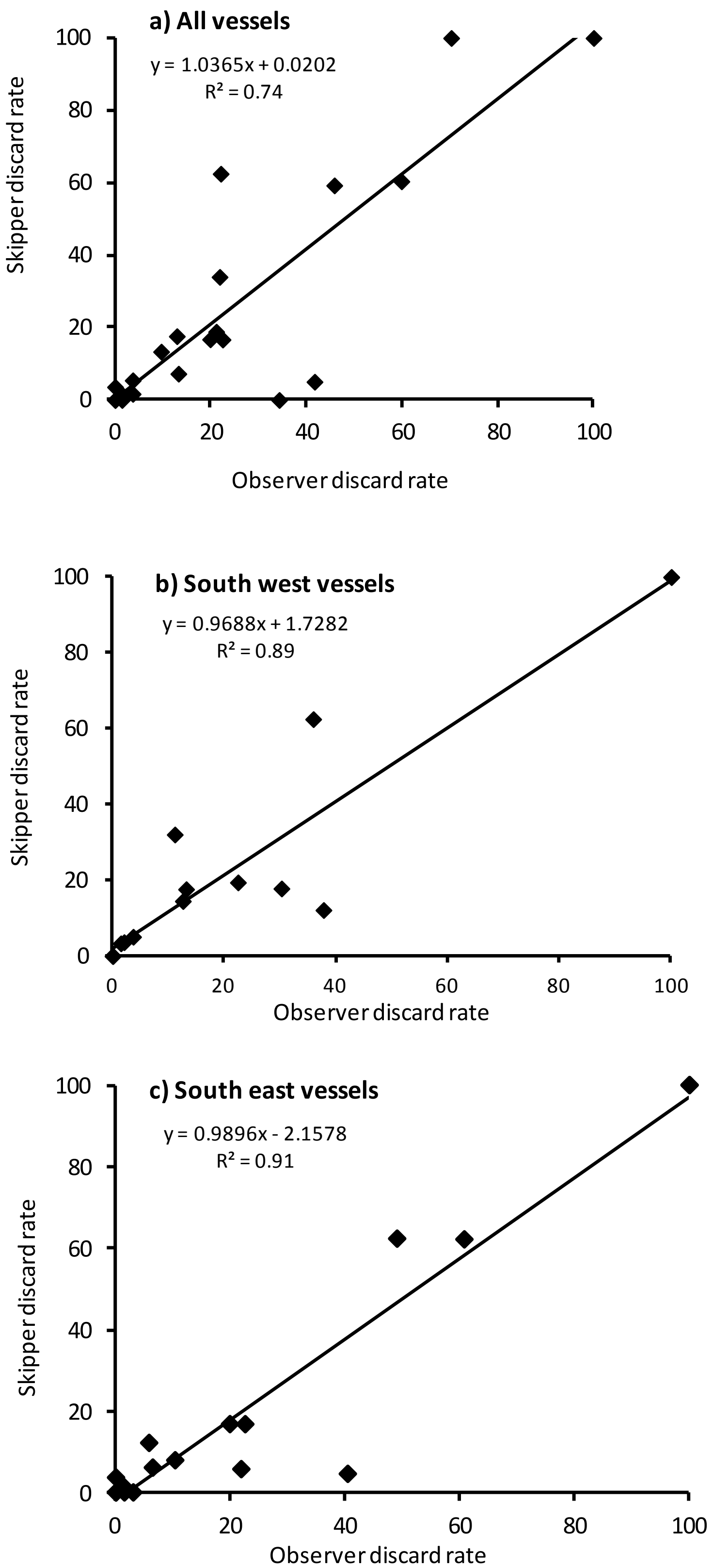


Figure 2: Scatterplots showing univariate correlations between mean discard rates for the main quota species from the data collected by skippers and those collected by observers for all vessels combined and for south east and south west vessels separately.

5.1.3 Comparing the cost of data collection by observers and skippers

While both observers and skippers are competent in collecting information on a range of fishing activities and catch, their capability to capture different categories of data differs. For instance, both observers and skippers could easily measure catch based on the number of individuals and species caught (Table 5). In most cases, observers and skippers are both competent in identifying all species in the retained catch. However, identification of species in the discarded catch is poor among skippers as they do not pay a lot of attention to this portion of the catch. Skippers are also either limited or not able to measure the lengths and age of fish in the retained or discarded portions of the catch. This is because they lack time, and sometimes there are simply too many fish to measure. Observers, on the other hand, routinely measure the lengths and collect otoliths for aging of both the retained and discarded catch. In terms of sampling frequency, both observers and skippers are capable of sampling all the hauls during a fishing trip (Table 5). However, given that observers only go onboard vessels in specified trips, they can only sample a few trips whereas skippers are available to sample each trip during their fishing operations. In addition, skippers can estimate weight by grade (to which length profiles can be applied) which provides better resolution than single weight estimation by species.

Table 5: Comparison of observers and skippers based on their capability and availability to measure different categories of catch.

Category of data	Observer	Skipper
Counts	Yes	Yes
Lengths	Yes	No
Age	Yes	No
Sample every haul in trip	Yes	Yes
Sample every trip	No	Yes
Trips sampled	Few	Many

As stated earlier, the lower cost of data collection by skippers compared to observers is one of the main reasons for considering the use of self-sampling in enriching current data sets. In order to illustrate how the cost of data collection by observers differs from skippers, the expenses related to observer trips incurred in this project were compared to the payments for skipper self-collected data. In this project, data collection by observers cost around £57,200 (40%) for the 93 trips while the 3,079 trips conducted by the skippers were at a cost of around £87,500 (60%) (Table 6). These costs include payment for observer time, transport, data collection equipment, daily payment to skippers and purchase of cameras for single-handed vessels under seven metres long. Data entry, analysis and reporting was estimated at ~£32,200 while project management at ~£23,000.

Table 6: Comparisons on the cost (£) of observer and skipper in data collection

	Observer	Skipper	Total
Number of trips	93	3,079	3,172
Cost of data collection	57,250	87,500	144,750
Data entry, analysis and reporting			32,200
Project management			23,050
Total			200,000

It is worth noting that while it cost around £615 per observer trip as opposed to £28 per skipper trip in this project, observers used one standard protocol for data collection whereas skippers had different protocols, which presented issues with data quality. Moreover, the data collected by observers can be directly used in stock assessments while the data collected by skippers need to be supplemented with data from other sources e.g. observer data (as was used in this project). For skipper's data to be used in stock assessments, then numbers at age for the various species in the catch need to be derived. This requires lengths and otoliths which necessitate observer trips and/or market sampling. In conclusion, it is recognised that there are strengths and weaknesses when data are collected by observers and skippers alone, and therefore the most useful method is a combination of the two as without the observer work the accuracy and confidence in the skipper's data is unknown.

5.2 Data from skippers

5.2.1 Sample sizes

Overall, catch data from 3,079 daily trips were submitted by the 30 skippers during the trial, of which 51% came from vessels in the south east and 49% by vessels in the south west (Table 7). The data collected by skippers shows that the majority of trips were from vessels that had used gill, trammel and tangle nets followed by vessels that had used rod and line. Vessels that had used drift nets and hand line (trolling board) had the least number of trips/data submitted. Drift netting was used more by participating vessels in the south east than those in the south west, while hand lining (both trolling board and canning) was used more by vessels in the south west. Given that this was part of the eligibility criteria (i.e. to target netters and hand liners), the trial managed to get a good representation of the targeted main gear types in the inshore fleet.

Table 7: Summary of number of trips conducted by skippers during the trial showing the number of trips by gear type each month for vessels in the a) south east and b) south west. Includes the total number of trips conducted during the entire trial by all vessels.

a) South East

Year	Month	Drift net	Gill net	Hand line (gurdy and jigs)	Otter trawl	Ring net	Rod and line	Tangle net	Trammel net	Total
2012	Aug		7	3	4	5	22	12	6	59
	Sep	1	17	3	2	11	39	34	20	127
	Oct	8	13	2	14	23	25	23	68	176
	Nov	9	50		12	15	18	16	62	182
	Dec	9	24		5	2	9	5	21	75
2013	Jan	1	17		7		13	5	27	70
	Feb	1	14		1		0	8	26	50
	Mar	1	26		11		2	11	48	99
	Apr	1	30		12	5	4	18	69	139
	May	11	24		19	7	7	11	56	135
	Jun		7		12	13	9	22	18	81
	Jul	1	13		17	14	11	45	27	128
	Aug		8				2	11	31	52
	Nov	1			13			3	16	33
	Dec	3	9		7				14	33
2014	Jan		21		6			2	10	39
	Feb		3		6				1	10
	Mar		38		15			2	41	96
South East total		47	321	8	163	95	161	228	561	1584

b) South West

Year	Month	Drift net	Gill net	Hand line (board)	Hand line (canning)	Hand line (gurdy and jigs)	Rod and line	Tangle net	Trammel net	Total
2012	Aug		26	5	10	13	43	31	14	142
	Sep	1	29	4	17	21	70	29	16	187
	Oct	1	47	1	10	34	41	34	9	177
	Nov		46	11	4	28	28	26	9	152
	Dec		40	3	1	13	10	14	8	89
2013	Jan		60	6		7	19	37	15	144
	Feb		39	2		9	9	20	10	89
	Mar		22	3	1	15	9	25	7	82
	Apr		19	4	5	24	12	32	12	108
	May		8	8	8	12	20	51	0	107
	Jun		6	8	10	10	22	18	1	75
	Jul		7	15	11	14	17	26	0	90
	Aug			6	12	10	24	1	0	53
South west total		2	349	76	89	210	324	344	101	1495
All vessels		49	670	84	252	305	485	572	665	3079

5.2.2 Catch patterns

In general, due to the small size of the fishing vessels most under ten metre skippers tend to fish in the same areas throughout the year. Some skippers occasionally travel to far areas when the weather conditions are bad or when targeting specific species (Figure 3, Table 8).

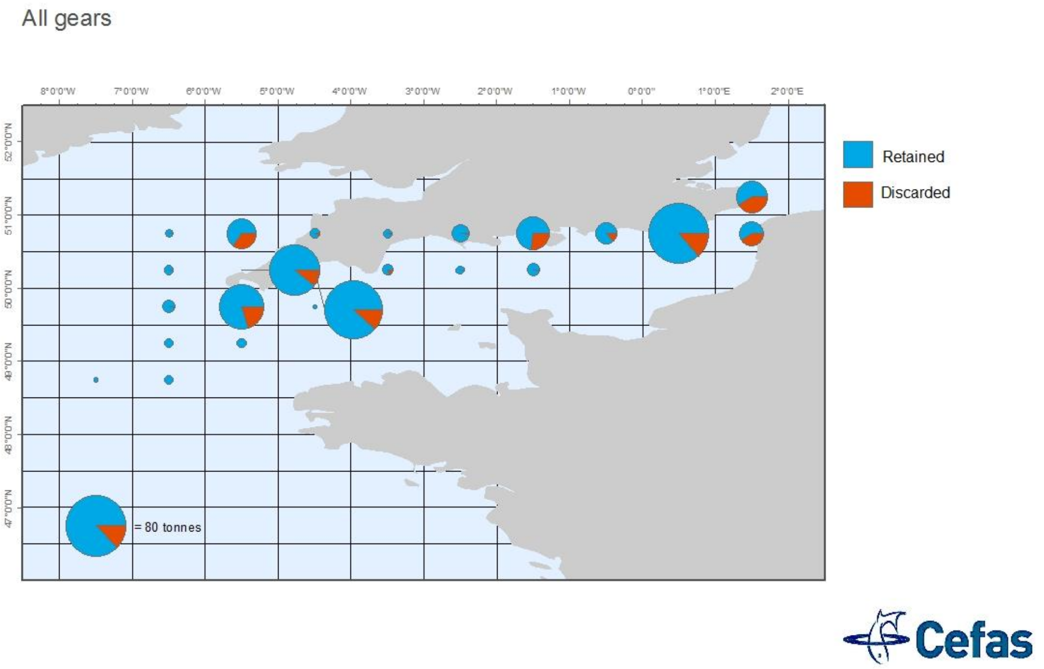


Figure 3: Fishing grounds visited by skippers during the trial showing the proportion retained and discarded.

Table 8: Fishing grounds visited by skippers during the trial showing the number of times each ICES rectangle was visited each month.

Year	Month	26E2	26E3	27E3	27E4	28E3	28E4	28E5	29E3	29E4	29E5	29E6	29E7	29E8	30E3	30E4	30E5	30E6	30E7	30E8	30E9	30F0	30F1	31F1
2012	Aug						28			32	39	8	4	8	1	7		8	13	11		29		
	Sep			1		4	34	1		55	48	4	5	13		6	2	10	11	28	7	47	4	
	Oct				2		27			64	42	11		1		3	9	2	16	52	25	60	3	
	Nov					1	13			62	29	3				2	9		15	63	11	60		4
	Dec						21			26	23	2					1		9	18	2	24		7
2013	Jan						22			55	34					9	2	2	12	6		38	3	4
	Feb						7			29	25					9				5	4	25	1	5
	Mar					1	14			33	9		2			11				6	17	47	5	8
	Apr			1		3	9		1	45	17		4		2	15		3	2	18	15	76	9	8
	May			1	3	1	24	1	2	59	8		1	4	1	10	1	1		25	20	66		10
	Jun			1	2	3	15		1	40	8		2	7	1	6				14	6	35	11	3
	Jul	1	3	3	2	2	14			28	20			8		8		7	3	17	2	68	10	15
	Aug			3	1	6	2		2	9	15			1		1		5	12			43		7
	Nov																				2	30		
	Dec																				11	16		5
2014	Jan																				2	29	1	7
	Feb																				1	7		2
	Mar																				15	66		15

Comparison of data collected by the south east and south west vessels showed no significant differences in the amount caught, proportion retained, and proportion discarded (Figure 4). Monthly catches however, varied with catches peaking in the months of May, June and July.

There were significant differences between gear types on the level of daily catch, proportion retained and discarded, and number of species caught (Figure 5, Table 9). The daily total catch per gear for gill net and tangle net was significantly higher than those of drift net, hand line (board), ring net and rod and line (Table 9). Similar differences were evident for the proportion of catch that was retained by each gear (Table 9b). Based on the proportion discarded by each gear type, tangle net and trammel net had significantly higher discards than rod and line (Table 9c). Catches of otter trawl showed a significantly greater number of species than all other gear types (Table 9d). Catches of gill nets, followed by catches of trammel net and tangle nets also had a greater number of species than hand lines. In terms of selectivity therefore, otter trawl was the least selective gear followed by gill, trammel and tangle nets while hand lines were more selective.

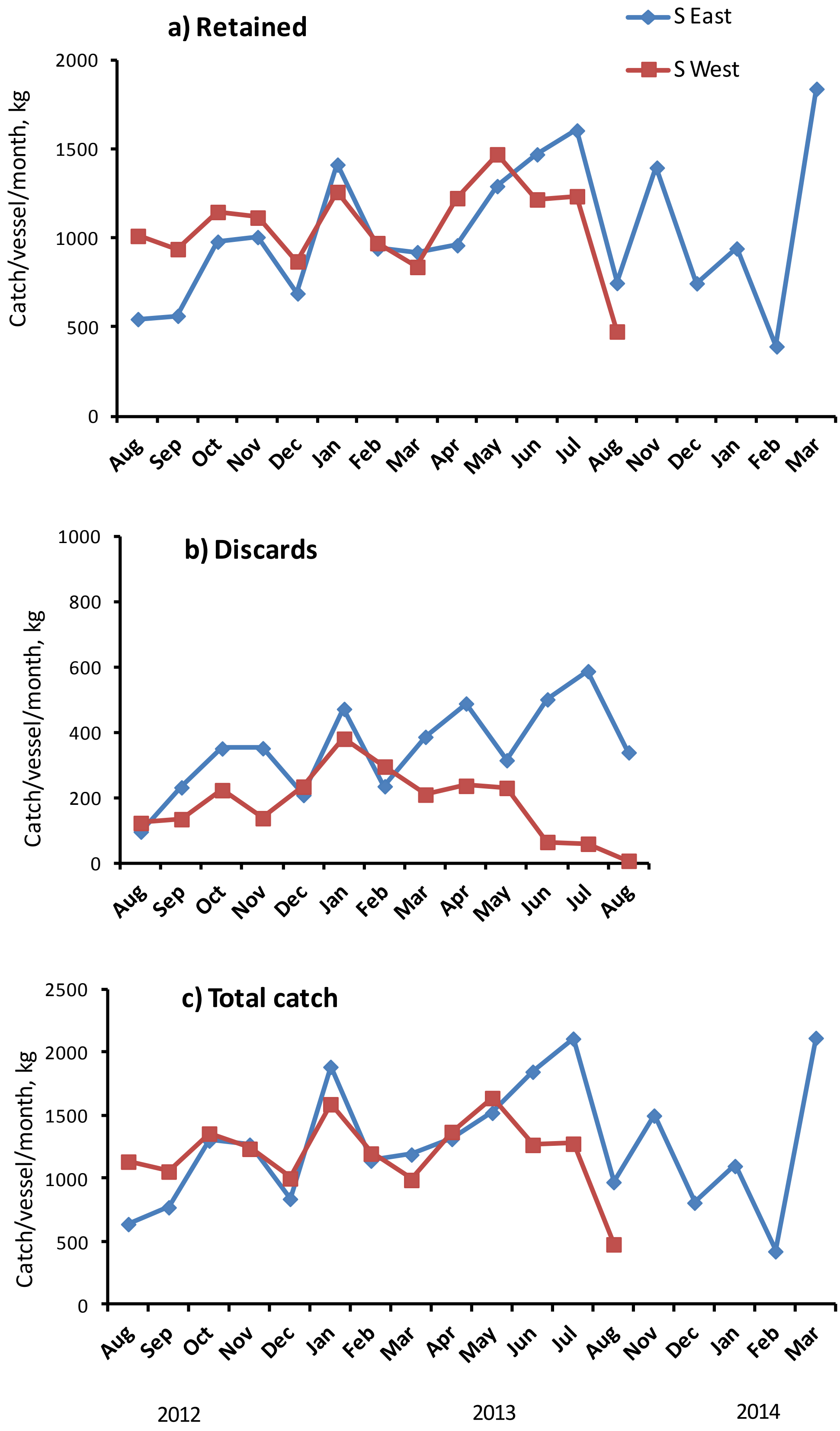


Figure 4: Changes in total catch, proportion retained and discarded over time for vessels in the south east and south west.

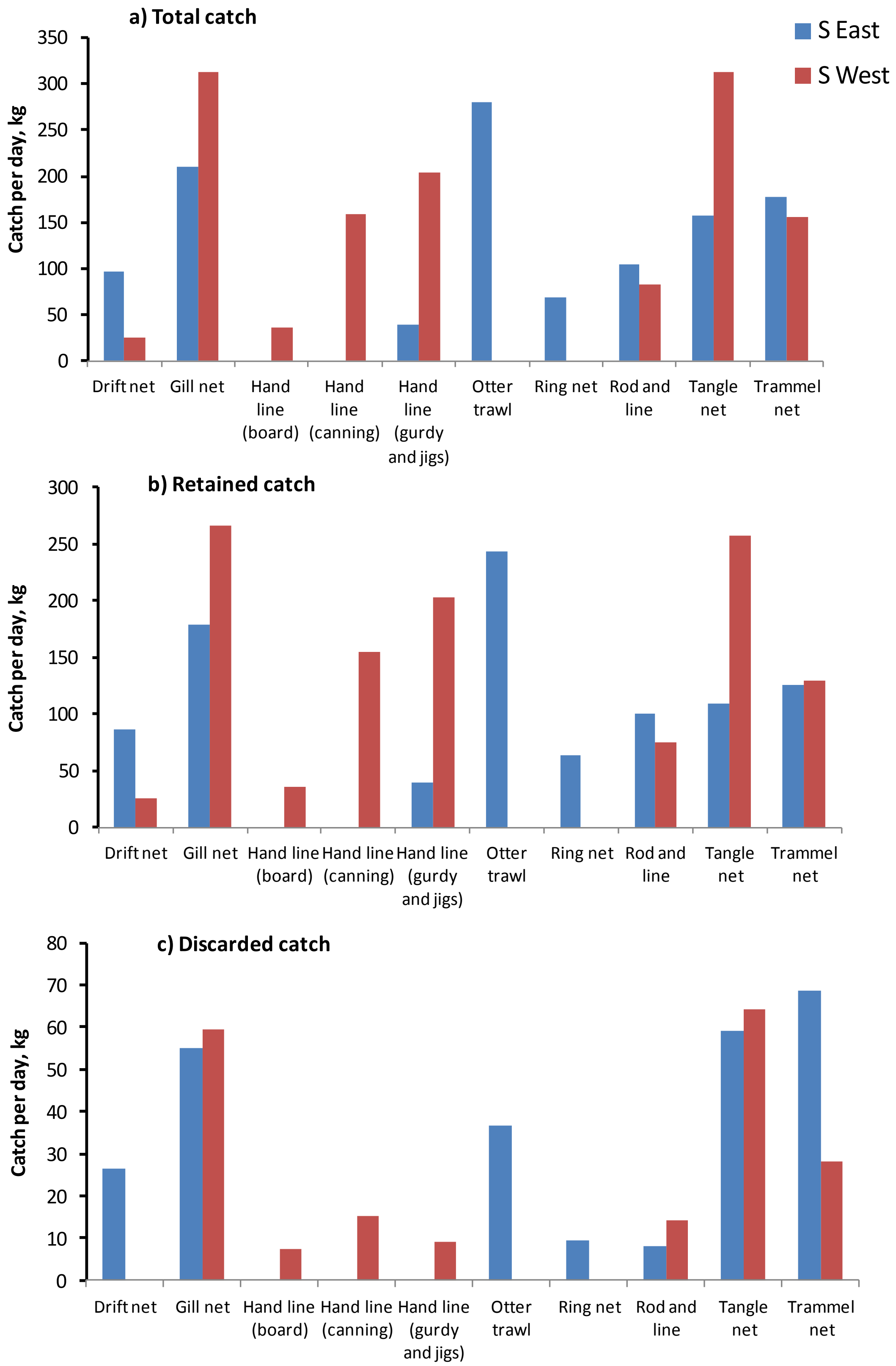


Figure 5: Comparison of gears and sites (south east versus south west) on a) total daily catch, b) proportion of catch retained, c) proportion of catch discarded, d) species richness and e) species diversity. Table 5 presents the statistical analyses for the gear comparisons.

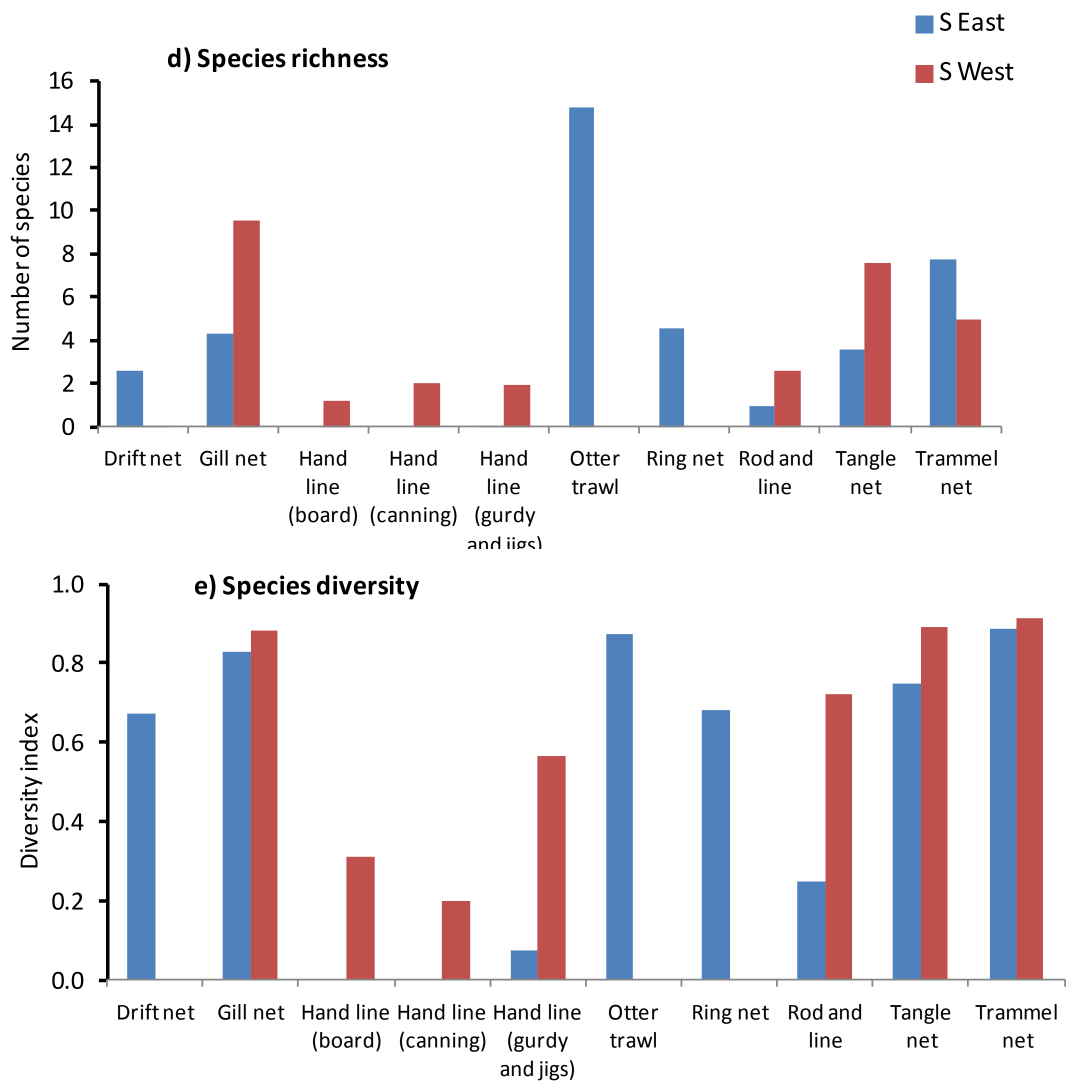


Figure 5 continued

Table 9: Pair-wise comparisons using Tukey's HSD on each of the gear types for the differences in (a) total daily catch, (b) proportion of catch retained, (c) proportion of catch discarded, and d) number of species caught per day as presented in Figure 5. + = significant; NS = not significant.

	Drift net	Gill net	Hand line (board)	Hand line (canning)	Hand line (gurdy and jigs)	Otter trawl	Ring net	Rod and line	Tangle net
a) Total catch F = 5.3; p < 0.01									
Gill net	+								
Hand line (board)	NS	+							
Hand line (canning)	NS	NS	NS						
Hand line (gurdy and jigs)	NS	NS	NS	NS					
Otter trawl	NS	NS	NS	NS	NS				
Ring net	NS	+	NS	NS	NS	NS			
Rod and line	NS	+	NS	NS	NS	NS	NS		
Tangle net	+	NS	+	NS	NS	NS	+	+	
Trammel net	NS	NS	NS	NS	NS	NS	NS	NS	NS
b) Retained catch F = 5.0; p < 0.01									
Gill net	+								
Hand line (board)	NS	+							
Hand line (canning)	NS	NS	NS						
Hand line (gurdy and jigs)	NS	NS	NS	NS					
Otter trawl	NS	NS	NS	NS	NS				
Ring net	NS	+	NS	NS	NS	NS			
Rod and line	NS	+	NS	NS	NS	NS	NS		
Tangle net	+	NS	+	NS	NS	NS	+	+	
Trammel net	NS	NS	NS	NS	NS	NS	NS	NS	NS
c) Discarded catch F = 3.9; p < 0.02									
Gill net	NS								
Hand line (board)	NS	NS							
Hand line (canning)	NS	NS	NS						
Hand line (gurdy and jigs)	NS	NS	NS	NS					
Otter trawl	NS	NS	NS	NS	NS				
Ring net	NS	NS	NS	NS	NS	NS			
Rod and line	NS	NS	NS	NS	NS	NS	NS		
Tangle net	NS	NS	NS	NS	NS	NS	NS	+	
Trammel net	NS	NS	NS	NS	NS	NS	NS	+	NS
d) Species richness F = 42.6; p < 0.001									
Gill net	NS								
Hand line (board)	NS	NS							
Hand line (canning)	NS	NS	NS						
Hand line (gurdy and jigs)	NS	NS	NS	NS					
Otter trawl	+	+	+	+	+				
Ring net	NS	NS	NS	NS	NS	+			
Rod and line	NS	NS	NS	NS	NS	+	NS		
Tangle net	+	NS	+	+	+	+	+	+	
Trammel net	+	NS	+	+	+	+	+	+	NS

5.2.3 Discard rates

Discard rates varied between the different gear types with tangle net (24 ± 9%) and trammel net (23 ± 9%) showing the highest discards ratios, while hand lines (board = 3%, canning = 3%, and gurdy and jigs = 1 ± 1%) had the lowest (Table 10). Overall, data collected by skippers showed that on average 16 ± 5% of the catch from the vessels from the inshore fleet participating in this trial was usually discarded while the remaining 84 ± 5% was retained.

Table 10: Retention and discard rates by gear type for the south east and south west vessels and for all vessels combined.

					All vessels			
	Retained rate,%		Discarded rate, %		Retained %		Discarded %	
Gear	S East	S West	S East	S West	Mean	SD	Mean	SD
Drift net	89	100	11		94	8	11	
Gill net	85	85	15	15	85	0	15	0
Hand line (board)		97		3	97		3	
Hand line (canning)		97		3	97		3	
Hand line (gurdy and jigs)	100	99	0	1	99	1	1	1
Otter trawl	87		13		87		13	
Ring net	90		10		90		10	
Rod and line	96	89	4	11	93	5	7	5
Tangle net	69	82	31	18	76	9	24	9
Trammel net	70	83	30	17	77	9	23	9
All gears	80	88	20	12	84	5	16	5

The most common species discarded differed between the south east and the south west (Figure 6). The top five species commonly discarded in this trial by the south east vessels included lesser spotted dogfish, spiny spider crab, Dover sole, cod and smooth hound, while in the south west the top five species discarded included stone crab, porbeagle shark, spiny spider crab, red mullet and spurdog. Overall, the highest discarded species by weight was lesser spotted dogfish (731 kg/vessel/month), stone crab (532 kg/vessel/month), spiny spider crab (210 kg/vessel/month), porbeagle shark (136 kg/vessel/month) and red mullet (114 kg/vessel/month). It is worth noting that stone crab, spiny spider crab, and lesser spotted dog fish are not quota species, and are therefore not subject to the landing obligation. For species under quota, the highest discards were monkfish, haddock and mackerel mainly by south west vessels, and for cod, whiting and plaice mainly by vessels in the south east (Figure 7).

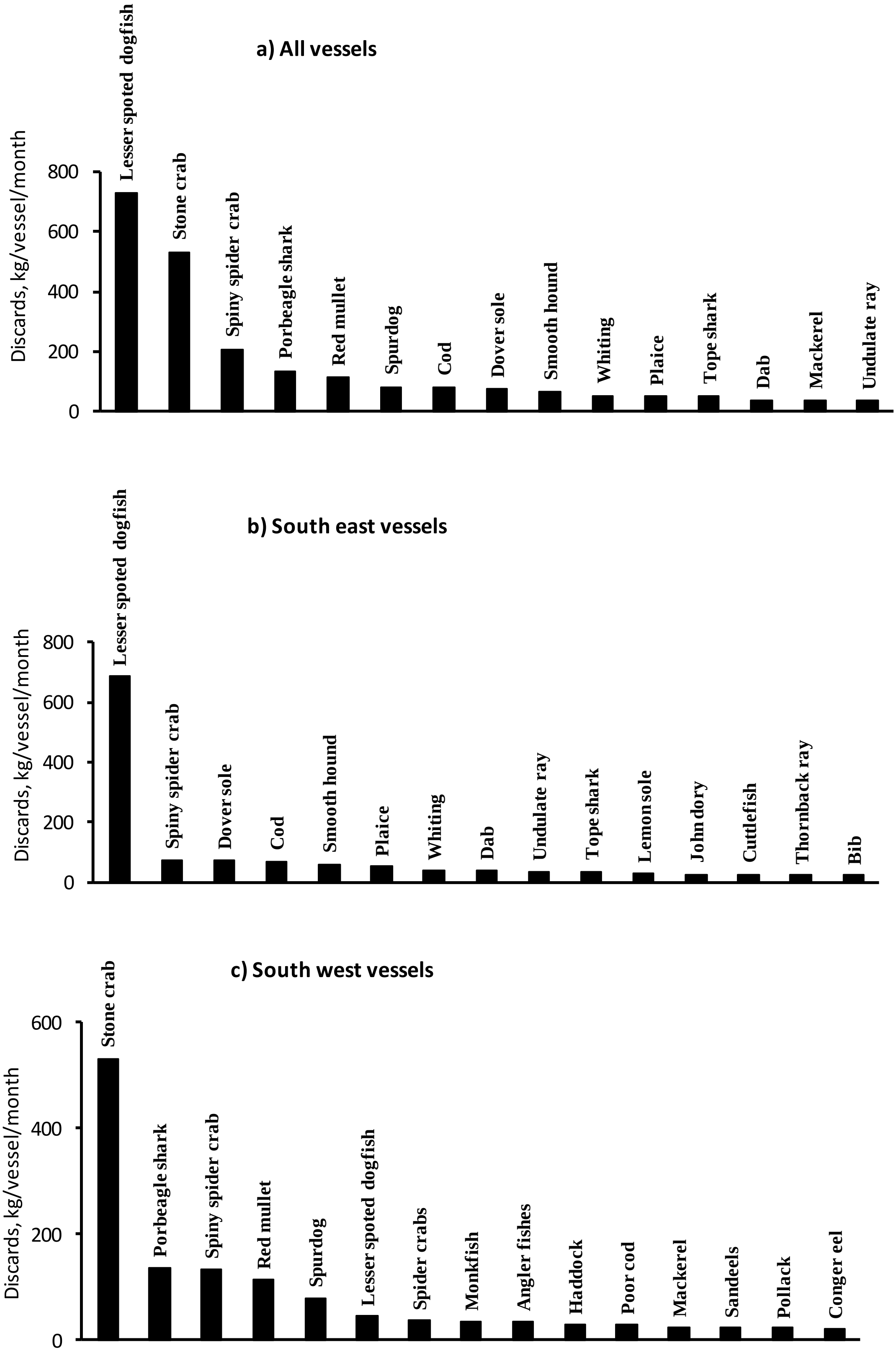


Figure 6: Proportion of each species discarded (kg) by each vessel per month based on data pooled for all gear types showing the 15 commonest species discarded by all vessels and for vessels in south east and south west separately.

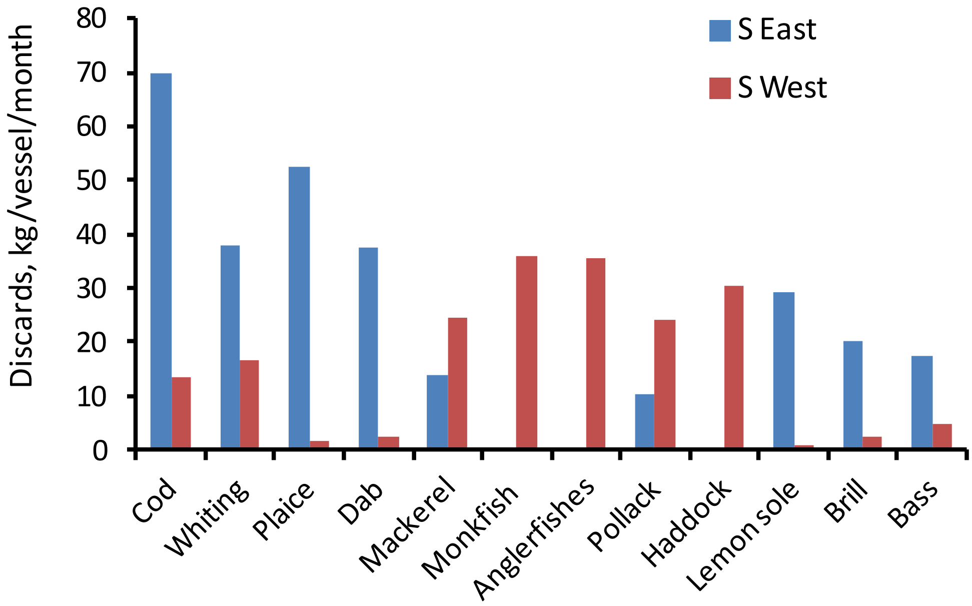


Figure 7: Proportion of quota species (kg) discarded each month per vessel showing the 12 commonest species as recorded by skippers.

5.2.4 Reasons for discarding

Table 11 presents the main species and proportion of each species discarded by south east and south west vessels under each of the drivers of discarding. The main reasons for discarding by vessels in the south east were lack of market (40%), catch was under the minimum landing size (now MCRS) (32%), lack of quota (16%) and species with zero TAC (3%) (Figure 8). In the south west however, a large proportion of the catch was discarded because it was damaged mainly by seals and lice (43%), the species had no market (17%), skipper lacked quota (15%) and species with zero TAC (7%). Overall, the main reasons for discarding in the inshore fleet are the lack of market (31%), catch was comprised of species under the minimum landing sizes (now MCRS) (24%), damaged by seal and lice (21%), lack of quota (15%) and species with zero TAC (5%). A large proportion of the catch that was discarded as damaged comprised of crabs. It is worth noting that many skippers were breaking the claws off edible crabs and retaining them while the body is discarded. These discarded crab bodies were entered by skippers as discards when in effect they are not, since the marketable part of the crab (the claws) were retained. In some cases the whole crab would be discarded due to damage. Where the skippers had indicated that the discards related to crab bodies only then these were not used to calculate the discard rates, but when the whole crab was discarded they were.

Table 11: Species that are commonly discarded due to a) lack of market, b) damaged, c) under MLS, d) no quota, e) under marketable size, and f) berried showing the top 5 species under each category and the proportion (kg/vessel/month) discarded by south east and south west vessels.

	S East	S West		S East	S West
a) No market			b) Damaged		
Lesser spotted dogfish	760	64	Edible crab	45	65
Stone crab		135	Whiting	35	13
Smooth hound	83	7	Mackerel	24	23
Tope shark	40	25	Angler fishes		38
Spiny spider crab	1	44.5	Haddock		37
c) Under MLS			d) No quota		
Plaice	57	1	Cod	160	182
Whiting	40	16	Plaice	143	
Dover sole	49	1	Whiting	93	
Saithe		50	Ling		47
Dabs	39	1	Skates and rays	9	15
e) Under marketable size			f) Berried		
Pollack	12	32	Lobsters	3	9
Mackerel	3	31	Monkfish		5
Whiting	17	4	Spider crabs		3
Bib	19	1	Crawfish		3
Plaice	12	2	Female crab		3
g) Zero TAC					
Porbeagle shark		137			
Spurdog	4	120			
Undulate ray	34	1			
Blond ray	16	17			
Thornback ray	25	2			

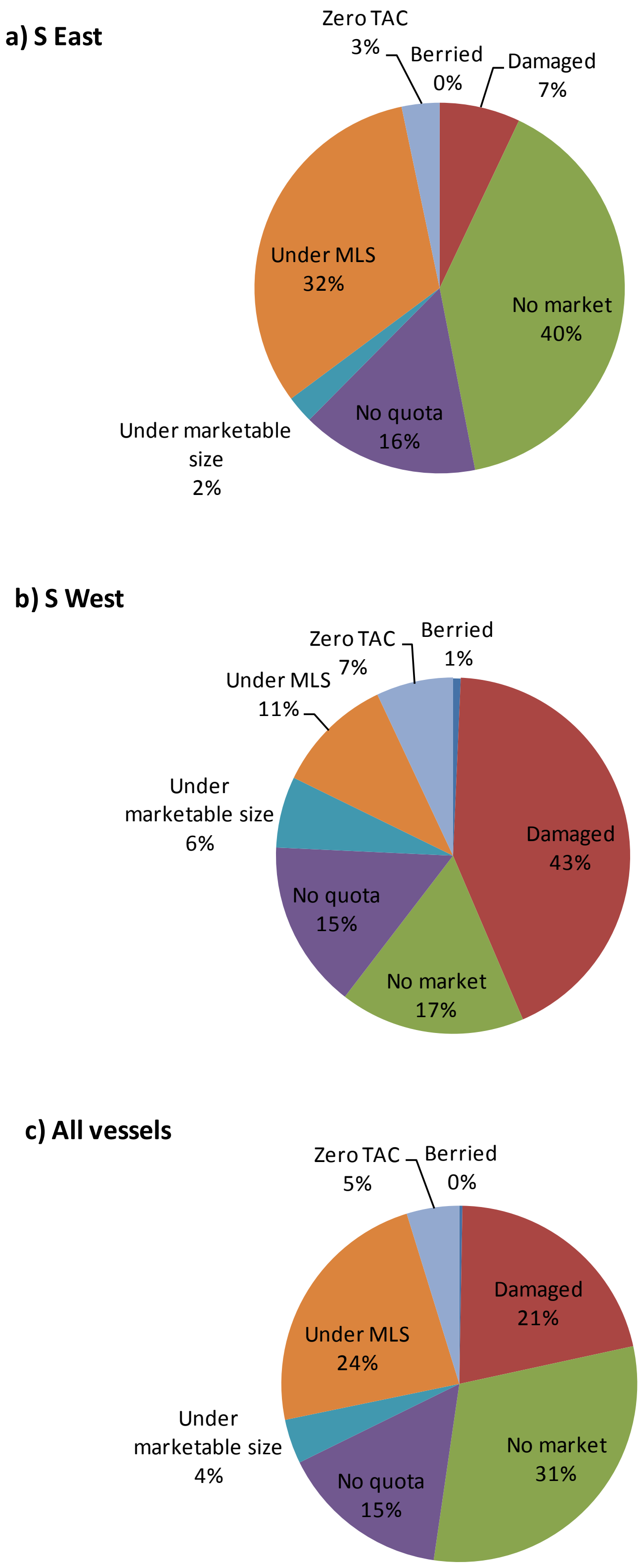


Figure 8: The main reasons provided by skippers in the trial for discarding showing the relative frequency based on data pooled for all gear types. Berried refers to fish that were seen carrying fertilised eggs hence discarded.

5.3 Perceptions of skippers towards the trial

All responses provided by participating skippers during the feedback questionnaire are summarised under each key question. The number in parenthesis indicates the number of times the same statement was made.

5.3.1 Response to the question 'Why did you decide to join the project?'

- To provide important data that could be used to set more realistic quota and by-catch regulations for the under ten metre fleet (3).
- To show some form of track record as to where we fish, what we catch and how little discards we have (9).
- It was an interesting project (1).
- Inshore sector is not recorded in a satisfactory way. More details required on fishing methods/gear types and need for small vessels to be very adaptable and change methods quickly to suit catches/conditions (1).
- I was keen to get the truth told about the fish I catch (1).
- I was asked by Cefas member (1).
- To help research with fishing methods and stocks - to be able to fish in the future (2).
- To get money (3).
- I was sick of certain TV chefs telling us we were raping the sea (1).

5.3.2 Response to the question 'Do you think that the project collected the right data?'

76% of skippers indicated that the project collected the right data while 24% thought it did not. The following statements were provided to clarify the responses to this question.

- With regards to discards, would it have been useful to monitor if fish were returned dead or alive? All of mine were returned alive and unharmed (2).
- The right data but weather, temperature and foreign activity i.e. Belgian beamers and French trawlers should be taken into account (2).
- At the time we started the project the season for cod was nearly over, therefore we missed an opportunity to record the high discard through lack of quota (2).
- Yes, but the data sheets should have had somewhere to record the amounts of discards that were returned alive and those that were dead (1).

5.3.3. Responses to the question 'What parts of the project worked well?'

- It all worked well with us: administration was clear and well communicated, the log book, species codes, gear codes, the mentoring, easy forms to fill out, communication between team members, good partnership all worked well (16).
- All worked well apart from the camera, as being single handed unable to film actually catching the fish, only before and after shots (2).
- The fact that we demonstrated that by selective gear, short soak times and good marketing we had no discards apart from banned species (1).
- Because it was a hundred day survey it shows the diverse methods of fishing in Cornwall: from gill nets to monk nets and hand lining (1).
- It highlighted how my brief yearly use of small mesh nets for species such as winter mackerel has a shocking level of discards, although all in my case are later used as pot bait (1).
- All except timing of data collection (1).
- Time spent on start-up delayed the project (1).
- It started okay for me but I had to take a lot of time off as I was not well (1).
- The type of gear used was only a small sample of my fishery and with poor weather in that year not more netting took place so I had to stop data collection (1).

5.3.4 Responses to the question 'What could have been done better in relation to the running of the project?'

- Only two days achieved by an observer on my vessel. Observers need to go out more times (1).
- Not sure about the camera aspect i.e. taking photos of the catch as a way of independently verifying my recording (1).
- The payments could have been faster, more frequent and more flexible (1).
- The correspondence with observer was first class e.g. I had a species of fish not on the list and after a phone call within minutes I was given the code (1).
- Nothing (9).
- Would have preferred a project team member coming out for the day just to see how we fish and to witness 99% of discards returned to sea alive (1).
- Right time of year would give better results (2).

5.3.5 Responses to the question 'If the daily payment for data was not there, would you still have taken part in the project?'

57% of skippers indicated they would still have participated in the project without a daily payment, 33% would not have taken part and the remaining 10% were unsure (Figure 9).

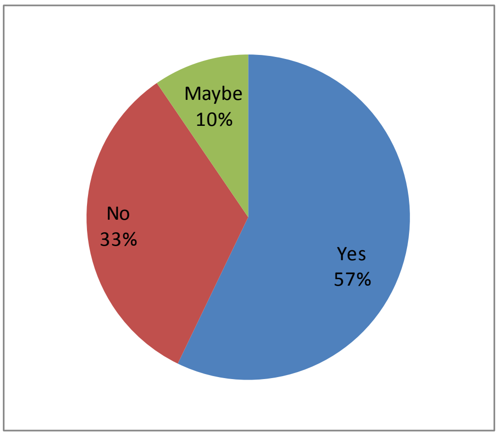


Figure 9: Proportion of skippers under each response on whether they could have participated in the project without a daily payment.

5.3.6 Responses to the question 'Did you change your behaviour or fishing pattern in any way as a consequence of being in the project?'

81% of participating skippers indicated that they did not change their fishing pattern while 19% indicated they had changed (Figure 10).

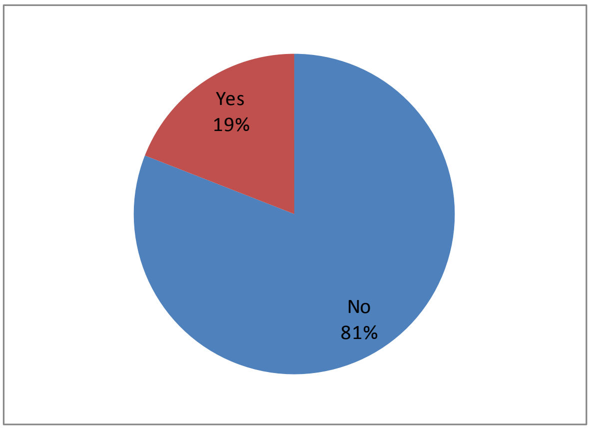


Figure 10: Proportion of skippers who indicated that they changed their fishing behaviour / pattern during the trial and those who indicated they had not.

Apart from one reason that was a consequence of the trial, three of the four reasons provided by skippers who indicated that they had changed behaviour / fishing pattern during the trial were not. These include:

- I have invested further in long line fishing and rod fishing. It is unlikely I will give up netting though (1).
- I had already decided to use larger mesh as quality is more important than quantity (1).
- I was able to target more of the fishing with trammel nets (1).
- The reason provided by the skipper who changed his fishing behaviour during the trial was that during the trial he was counting and identifying retained and discarded fish which he used not to (1).

5.3.7. Responses to the question 'In your view, can self-sampling deliver the information required to fully-document fisheries?'

90% of skippers indicated that they felt self-sampling could deliver the data needed to fully-document fisheries, 5% did not think it could, while 5% were unsure (Figure 11).

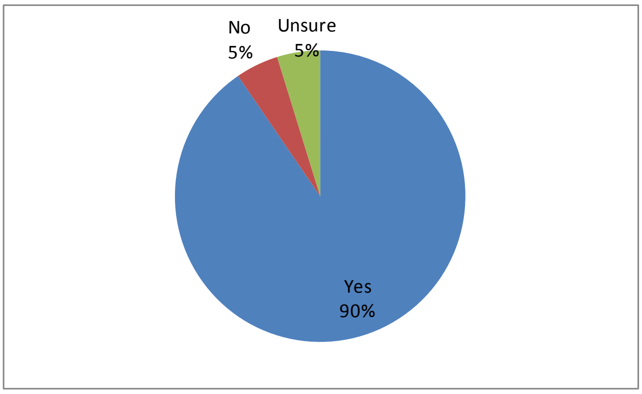


Figure 11: Proportion who agreed / disagreed on whether self-sampling can deliver the information required to fully document fisheries.

The following comments were provided by skippers in explanation of their answers:

- Yes, if everyone (all methods of fishing) did this it would better track what is actually caught and where (3).
- I would like to believe that the majority of fishermen would give a true representation of what they catch/discard when recording data. Unfortunately, there will always be exceptions to that which is why I believe the data could never be fully accurate without observers (1).

- The data collected in this way is coming straight from the vessels in all different areas and can give a good overall view of the fisheries and which healthy stocks are there at different times of the year (6).
- Yes, it gives an assessment of discards (3).
- Yes, it provides good reliable source of data collection which is easy for the fishermen to accommodate in their routine (1).
- Yes, it can if the skipper is truthful and does not have a hidden agenda i.e. reports high catch figures to fabricate track record (3).
- Self-sampling needs to go on over a long period to properly monitor fishing patterns over a few years. This is the only way of recording variables in weather patterns to obtain a true picture (2).
- Yes, as long as the skipper provides proof that he was at sea e.g. by providing a copy of a landing ticket. Otherwise, there is no proof that the data collected is true especially when there is no independent person (observer) on board.

6. CONCLUSIONS

6.1 Achievement of project objectives

The project achieved all of its specific objectives. The maximum number of vessels (30) was recruited to the trial comprised mainly of netters and hand liners. To ensure a good coverage of the under 10 metre fleet in the south coast of England, 13 of the 30 vessels fished mainly in the south east (VIId) and the remaining 17 in the south west (VIIe, f, g, h). A detailed log sheet was designed and accompanying paper work provided to each skipper to enable data collection during daily fishing operations. A database was created during the project to store the information and preliminary analyses completed. In addition to the detailed self-sampling of the catch by the skippers, Cefas observers accompanied participating vessels at pre-arranged times to independently sample the catches and validate the data recorded by skippers. Collaboration by all partners in the trial (participating skippers, NUTFA, Defra, MMO and Cefas) led to the successful achievement of all the scientific objectives of the project.

6.2 Key outputs

The key output from the trial is the gathering of data that has increased the amount of information on the fishing patterns of the inshore fleet (including what they catch and where they fish) to scientists, industry leaders and policy makers. Under ten metre skippers in this trial have demonstrated that they are capable and willing to routinely collect detailed information on their fishing practices including the range of species caught, the type of gear used, the geographical distribution of fishing effort, and the drivers of discarding.

The information on discards is particularly valuable as it gives a measure of discard rates in the inshore fleet. These discard rates are a crucial component in the assessment of the population status of stocks, and when combined with information on the biological characteristics (age and length distributions) of the targeted species, fishing effort and fleet behaviour, should improve estimates of the standing stock biomass which can help inform fishery management decisions.

The trial has demonstrated that validated self-sampling by under ten metre skippers is potentially, an efficient way of collecting commercial fishery data. The project has not only enabled skippers to work closely with scientists to generate some of the data required to improve stock assessments, but also improved contact and relations between scientists and skippers that should enable a better understanding of fishing practices in the inshore fleet.

6.3 Inferences for future management

The database created in this project provides useful information that can be used to explore how selective the different gear types used by the inshore fleet in England are, and whether these gears can be used to sustain fisheries and the marine environment. Although not an objective of this project, the data collected could provide a starting point in the discussions towards an appropriate criterion for the allocation of fishing opportunities between the inshore and offshore fleets in England.

The new CFP also requires fishermen to implement an accounting system that gives comprehensive, complete and reliable documentation of all catches including discards. There is an inherent bias with this trial in that the skippers who took part wanted to participate in the data collection exercise. They also knew that at some point their data would be validated and therefore it is likely that they were more careful in recording the data. Nevertheless, this trial has demonstrated that under ten metre skippers could use validated self-sampling as a way to document their catches during daily fishing operations. Feedback from the skippers indicate that they see self-sampling as simple to use, practical and provides data cheaply that the fishing industry can trust as they were involved in its collection. Further assessment in the confidence/accuracy in the data could be undertaken which, when applied to a risk-based approach, could be used in fully documenting catches and controlling the landing obligation.

6.4 Future use of data

A database with information on fishing effort, catches, discards and size distributions of the species targeted by netters and hand liners has been built over the course of the project. The collection of this data was essential to explore the fishing practices of the inshore fleet, but much more could still be extracted from the data from a scientific and management perspective.

6.5 Further work

Further analysis is needed to evaluate the proportion of the inshore fleet that is needed to provide a representative group that could be used as a reference fleet. The rationale for using 30 vessels in this project was mainly due to the level of funding available but statistical analyses (e.g. posterior power analyses) could be used to estimate the size of fleet appropriate for a risk-based approach in the context of the landing obligation. Further work also needs to focus on finding new markets for fish from the inshore sector and also investigate the damaged component of the catch, as these are the main reasons for discarding. For instance, a desk-based study could be undertaken to investigate the magnitude of the seal-fisheries conflict among the inshore fleet and assess the economic impact of the damage by seals to gear and catches.

7. RECOMMENDATIONS

The experience with the self-sampling trial has generated the following recommendations which can be seen as guidelines for best practice in industry-led data collection.

- **Standardisation in reporting**: There is need for compromise on how the various variables that can be measured to meet the science objectives but also in a way that is practical to the skippers. For instance, in this trial we had to compromise between single weight estimates and lengths. Since it was going to be difficult for skippers to measure the lengths for the different species in the catch, it was decided that skippers could group the weight for each species into three lengths groups (large, medium and small). Skippers were also allowed to use any measure of weight that was familiar to them to collect the catch data. While this worked smoothly during data collection, it created more work during the data analyses as the measurement methods used (counts, kilograms, stones, pounds) had to be converted to a single measure of weight.
- **Strict protocols for data collection**: These are needed to ensure the data collection has scientific rigour. In this trial, skippers were required to submit data from 100 consecutive fishing trips. This would ensure that skippers could not choose which trips to submit data for. Despite repeated reminders, some skippers did not send in their data on the trips sampled by observers as they thought that the data for that fishing trip had already been noted by the observer. This reduced the effective sample size for skipper-observer comparisons.
- **Communication**: There was good communication throughout the trial between the skippers and the project team. This was mainly facilitated by the two observers (one for the south east vessels and the other for the south west vessels). Liaison between the project team and skippers was used to manage skippers' expectations, especially with regards to data confidentiality and what can and cannot be achieved with the data.
- **Adequate financing**: Although 57% of skippers indicated that they would have participated in the trial without a daily payment, having a financial incentive at the start of the project enabled this trial to recruit a large number of vessels. Sufficient finances were also required to fund quality control methods (observers time, hand held cameras), and the scientific analyses (converting and interpreting of the data) and project management.

- **Project steering committee**: The project steering committee, comprised of key stakeholders, played an important role in agreeing the forms to be used, selection of vessels, and other practicalities related to the trial.

ACKNOWLEDGEMENTS

We would like to thank the skippers and crew for taking part in the trial and agreeing to collect and submit data from their daily fishing activities. Your enthusiasm and cooperation has led to the success of this project. We would also like to thank members of the steering group for their productive and engaging discussions on various aspects of the trial. For funding, we thank Defra and EFF.

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APPENDIX

1. Forms that were provided to skippers to collect data during fishing operations

A: Template that was used by each skipper to provide specific details of each gear type used during the trial.

				Gear List					
	Vessel:								
			Gear Specification for all Netting					Rod & Line / Handline	
Gear code	Type	Mesh Size	No. of nets in fleet	No. of meshes deep	Hanging Ratio	Twine Type	Twine Diammeter	No. of Hooks	Bait

B: Sample of the log sheet that skippers used to collect various measures of their daily fishing activity and catch. The log sheets were bound into a book with duplicate sheets where the skipper would send one copy to the project team and keep a copy for himself.

Date:	Vessel PLN:	Gear Damage/Interruption (at sea):
Gear Changes/Alterations:		

Fishing Details					RETAINED (Weight / Count)						DISCARDED (Weight / Count)			
Haul No.	Gear code	Fishing/Soak time	ICES sub-rectangle	Species	Large	Medium	Small	Units	Estimated/ Measured	Gut Y/N	Quantity	Units	Estimated/ Measured	Reason for discarding

Skipper's signature: ....

C: Three-letter codes for most of the common species in the catch that were provided to skippers to use when collecting their own data.

Commercial flatfish	
BLL	Brill
DAB	Dab
FLE	Flounder (european)
HAL	Halibut
LEM	Lemon sole
PLE	European plaice
SOL	Sole (dover sole)
SOS	Sand sole
TUR	Turbot
WIT	Witch

Commercial roundfish	
BIB	Whiting-pout (bib)
BSE	Basses
CAA	Catfish
COD	Cod
COE	Conger
EEL	Eels
HAD	Haddock
HKE	Hake
LIN	Common ling
MUL	Grey mullets
MUR	Red mullet
POK	Saithe
POL	Pollack
WHG	Whiting

Sharks, Skates and Rays	
DGH	Dogfishes
DGN	Nurse hound
DGS	Spurdog
GAG	Tope shark
LSD	Lesser spotted dogfish
SMH	Smooth hound
CUR	Cuckoo ray
SDR	Spotted ray
BLR	Blonde ray
THR	Thornback ray (roker)
SYR	Starry ray
SKT	Common skate
DIP	Unidentified skate
SKA	Unidentified rays

Other commercial finfish	
ANF	Angler fishes
JOD	John dory
GUR	Red gurnard
GUG	Grey gurnard
TUB	Tub gurnard
GUX	Gurnards
LUM	Lumpsucker
SAL	N.atlantic salmon
SBZ	Sea breams
SMT	Sand smelt
TRI	Trigger fish
TRS	Sea trout (brown trout)
WRA	Wrasses

Commercial pelagic	
GAR	Garfish
HER	Herring
HOM	Horse-mackerel (scad)
MAC	Mackerel
SHD	Shads
SPR	Sprat

Commercial shellfish	
CRE	Edible crab
CSH	Brown shrimp
CTL	Cuttle-fishes
LBE	European lobster
MLP	Velvet swimming crab
MUS	Common mussel
NEP	Norway lobster
SCE	Scallops
SQC	Common squids
WHE	Common whelk
LDM	Stone crab
OCT	Octopuses
OYF	European flat oyster
PRM	Pink shrimp
QSC	Queen scallop

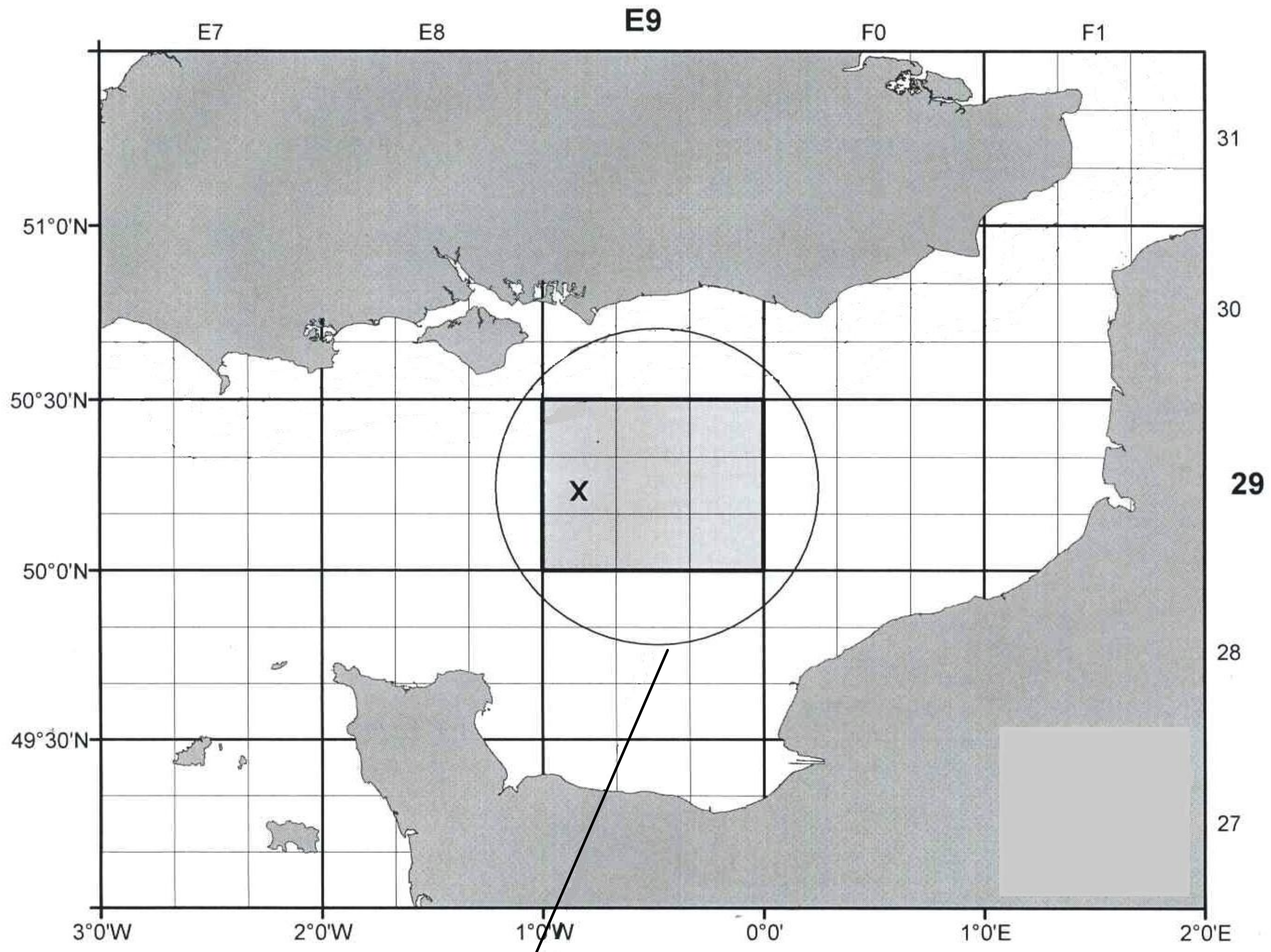
Non-commercial finfish	
MXR	Mixed roundfish
MXP	Mixed pelagics
MXF	Mixed flats
POD	Poor cod
NOP	Norway pout
SAN	Sandeels

Non-commercial shellfish	
MXC	Mixed crabs
MXH	Mixed hermits

Other biota	
STF	Starfishes
MXJ	Jellyfishes
MXU	Urchins
OHX	Brittle stars
RWK	Almond/Red whelks
AAC	Sea mouse
MXW	Sea weed
WHW	White weed

D: Maps of a) south east and b) south west of England showing the sub-rectangles that the skippers used to identify their fishing locations.

a) South east of England



Example:

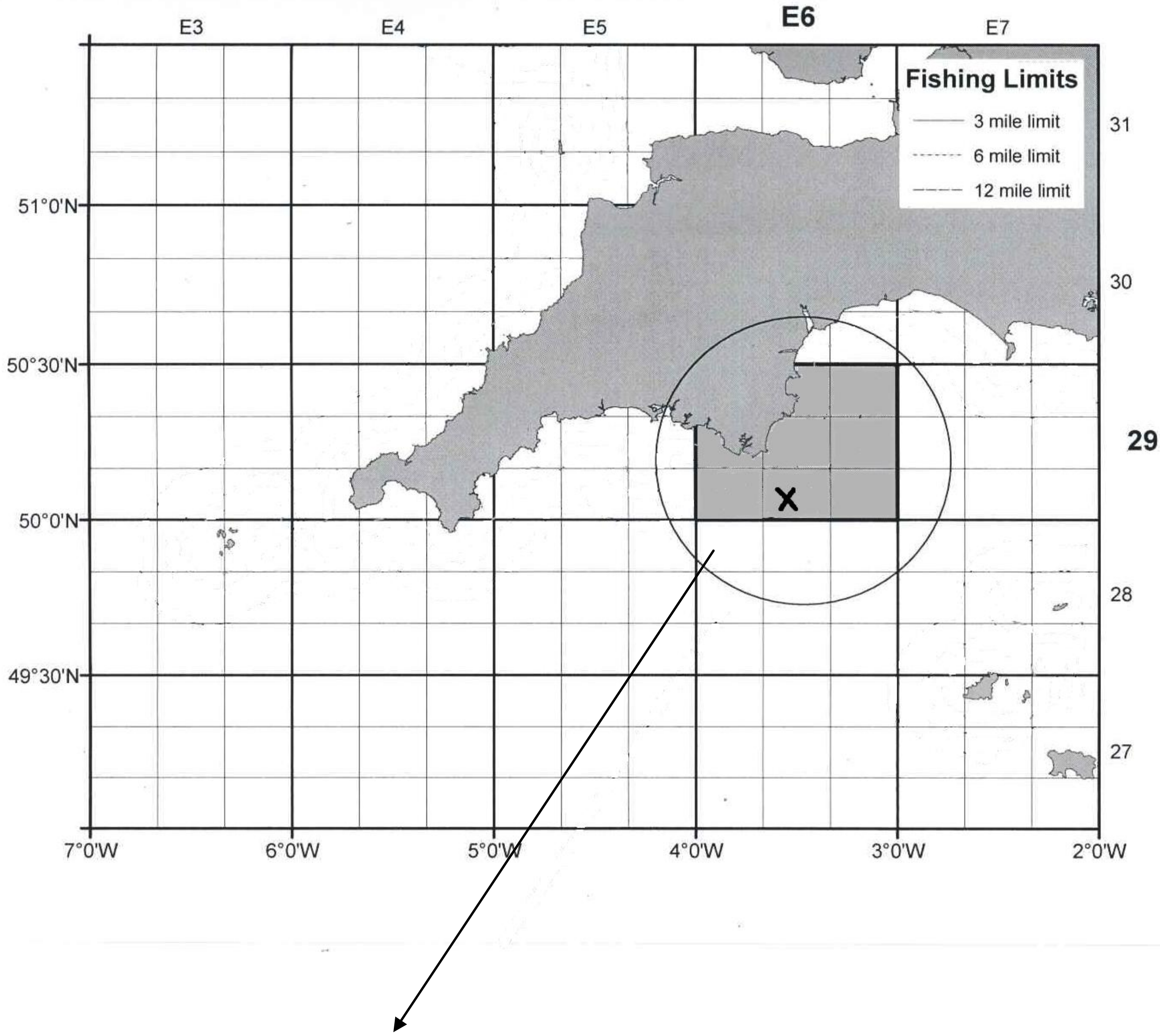
Rectangle = 29E9

Sub-rectangle = 2

1	4	7
2	5	8
3	6	9

*The cross on the chart above is an example of a fishing position. In this example, the area code is constructed from the rectangle coordinates **29E9**, the sub-rectangle **2** giving the five character reference: **29E92***

b) South west of England



1	4	7
2	5	8
3	**6**	9

Example:

Rectangle = 29E6

Sub-rectangle = 6

*The cross on the chart above is an example of a fishing position. In this example the area code is constructed from the rectangle coordinates **29E6**, the sub-rectangle **6** giving the five character reference: **29E66***

2: Skipper feedback questionnaire

Your name .... Date ....

Vessel name ....

<u>Participation in the self-sampling project</u>

1. Why did you decide to join the project? Please give your 2 or 3 top factors / reasons.

....

....

....

2. Have you taken part in any other scientific research project before? Yes / No

If **yes,** what projects and in what way?

....

....

....

....

3. Would you be willing to participate in a research project with Cefas again? *Please circle one*:

Yes / No / Under certain conditions

If **under certain conditions**, please provide these conditions ....

....

....

....

<u>Specifics of the self-sampling project</u>

4. What did you believe the purpose of the project was? ....

....

....

....

5. Did you feel that the aims of the project were clearly communicated to you? *Please circle one*:

Very well / Reasonably well / Poorly.

6. Do you think that the project collected the right data? Yes / No

If **no**, what data should have been included / excluded? ....

....

....

....

....

7. How was your relationship with the project team members (Sam Smith, Simon Armstrong, Stephen Mangi, Peter White, Mike Manser)?

Project team member .... Relationship *(choose one):* Poor / Okay / Good / Very good

8. Do you think the selection process for which gear types would participate in the project was:

(a) fair? Yes / No

(b) transparent? Yes / No

9. What parts of the project worked well? ....

....

....

....

10. What could have been done better in relation to:

a) the set up of the project? ....

....

....

b) the running of the project? ....

....

....

11. If the £25 per day payment for data was not there, would you still have taken part in the project? Yes / No

General information

12. Was the data collection period (August 2012 to August 2013) a typical year or were levels of catch particularly high / low for certain species?

	Yes	No	For which species?	Comments
Typical year				
Low catch year				
High catch year				

13. Did you change your behaviour or fishing pattern in any way as a consequence of being in the project? Yes / No

If **yes,** why (e.g. to benefit your business)? ....

....

....

Fully documenting fisheries

The self-collection of data by skippers is one of the approaches that can be used to provide fully-documented fisheries i.e. the collection of catch data needed for science and management purposes to demonstrate full documentation of fishing activity.

14. What are the advantages / benefits of collecting your own data during fishing operations?

....

....

....

....

15. What are the disadvantages of collecting your own data?..

....

....

....

....

16. In your view, can self-sampling deliver the information required to fully-document fisheries?

Yes / No

Please give reasons...

....

....

....

17. What would incentivise you to collect your own data during fishing operations? ....

....

....

....

18. Do you have any additional comments on this project? ....

....

....

....

....

Thank you for your cooperation!