Discarding in the North Sea and on the historical efficacy of gear-based technical measures in reducing discards

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ABSTRACT

We describe and analyse newly available catch and discard data from the English and Welsh fishing fleet operating in the North Sea. In this fleet we estimate that between 2003 and 2006 discard rates averaged 36% by number and 25% by weight. Additionally, we analyse historical discard data from the fleet to evaluate the efficacy of square-mesh panels and increases in codend mesh size. These various gear-based technical measures have been introduced into the fisheries for the purpose of reducing discarding; we demonstrate that these technical measures have been effective in this respect.

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1. Introduction

In commercial fisheries, discards (or discarded catch) is defined as the portion of the total organic material of animal origin in the catch, that is thrown away or dumped at sea for whatever reason (Kelleher, 2005). Discarding is widely regarded as running counter to fisheries and marine conservation objectives worldwide, and global discards are estimated to be around seven million tonnes per year (Kelleher, 2005).

Kelleher (2005) reported that the North Sea (ICES subarea IV, 600,000 km^2 in area) accounts for the highest level of discarding in the world, some 13% (909,109 t) of global discards. We examined the source data used in Kelleher's North Sea estimate and find that of this North Sea quantum, 84% (759,409 t) were fish, cephalopods and *Nephrops norvegicus*, and the remaining 16% were miscellaneous benthic invertebrates. Seven countries border the North Sea (UK, France, Belgium, The Netherlands, Germany, Denmark and Norway). Fish caught in the North Sea accounts for >50% of the European Union (EU) combined total allowable catches (TAC) (Koundouri et al., 2004). Kelleher's estimates are based largely on data that are over a decade old and here we present new catch and discard data from the English and Welsh fishing fleet operating in the North Sea. Such data have not been previously available and is

obtained from the English and Welsh national sea-going observer programme.

Since the 1990s fisheries managers have introduced a number of gear-based technical measures in the North Sea that are intended to improve fishing gear selectivity and reduce discarding. In the towed gear fisheries, many of the technical measures have stipulated changes to codend mesh size or the inclusion of square-mesh escape panels (SQMPs). However, little evidence has subsequently emerged in the scientific literature to quantify how effective these measures have been since their introduction. Here we use historical catch data from the study fleet to investigate the efficacy of such technical measures post-introduction.

2. Materials and methods

2.1. New catch and discard information from the North Sea (English and Welsh registered fishing vessels)

We collected catch data (fish, cephalopods and *Nephrops norvegicus*) onboard English and Welsh registered otter trawlers, demersal fish beam trawlers, *Nephrops* trawlers and netters. All of these vessels were greater than 10 m in length overall and were active in the North Sea (ICES subarea IV) between 2003 and 2006. We refer to them as the study fleet. We do not present data from beam trawlers targeting brown shrimp (*Crangon crangon*) as these were recently described by Catchpole et al. (2008).

We estimated the total numbers and weights of fish, cephalopods and *Nephrops norvegicus* discarded and retained by

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Table 1
Sampling effort on board the fishing fleet of England and Wales in the North Sea (>10 m) 2003–2006, with mean raising factors per sample, trip and fleet by gear group

Gear group	Number of sampled trips	Number of sampled hauls	Sample to haul raising factors		Fleet raising factors
			Discarded	Retained	
Beam trawling	11	237	15.4 (0.84)	5.9 (0.22)	378 (192.8)
Otter trawling	65	434	5.2 (0.49)	3.64 (0.13)	169 (43.2)
Nephrops trawling	101	268	13.6 (0.83)	25.3 (2.24)	104 (8.4)
Netting	14	41	2.7 (1.08)	1.1 (0.07)	201 (103.12)

Figure in parentheses refer to one standard error of annual estimate.

the study fleet following the approach of Enever et al. (2007). This approach uses fishing effort as the basis for raising (hours fished for static gears and number of trips for towed gear groups). All fish were measured to the nearest centimetre below (total length) except *Nephrops norvegicus* that was measured to the nearest millimetre (carapace length). Our estimates are derived from an analysis of catch and discard data from 191 fishing trips (980 hauls) recorded by observers accompanying the study fleet between 2003 and 2006 (Table 1 and Fig. 1).

2.2. Analyses of the efficacy of various gear-based technical measures at reducing discard levels after their introduction

2.2.1. The effect of codend mesh sizes and SQMPs on discards

Here we examine the associated catches and discards of the study fleet over a longer time period (1999–2006) and excluded *Nephrops norvegicus* from the analyses, because earlier data were not available.

We evaluated whether technical gear measures led to significant changes in discard patterns in the catches by *Nephrops*, otter and beam trawlers. We compared discard rates (numbers) before and after the introduction of certain technical measures, between different mesh sizes of net and also between nets with and without SQMPs. An analysis of covariance was carried out on the total numbers of fish discarded (all fish species combined) at a haul level, using the total catch (at a haul level) as a covariate. Initially, vessel lengths, vessel tonnage, engine power, haul duration, haul depth and trip duration were also entered as covariates. Covariates that were initially not significant were removed from the model, and the analysis was then repeated. Rates of discarding (and their standard errors) were calculated from the marginal mean number discarded for each category. The time of year (quarter) was included as a fac-
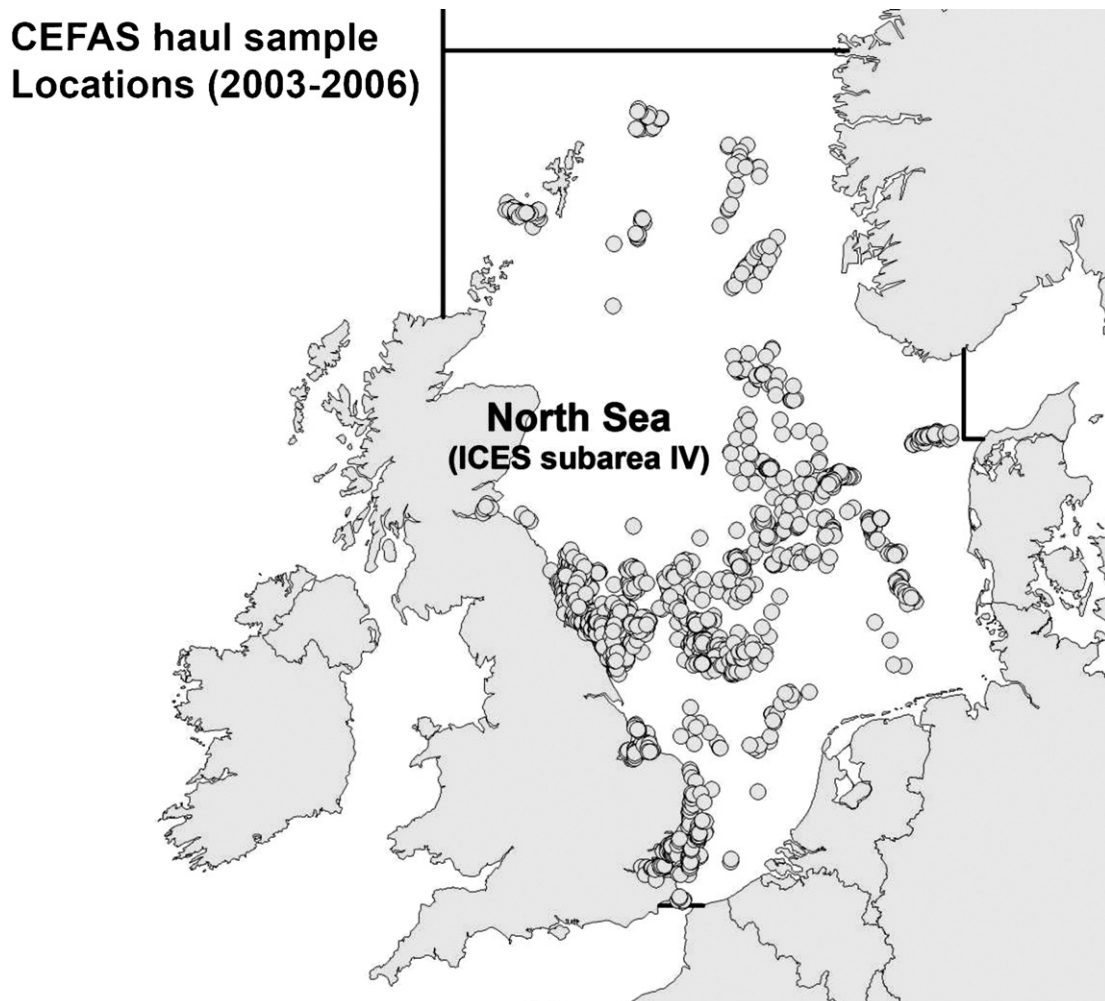

Fig. 1. Map of the North Sea showing the Cefas catch and discard sample locations on vessels registered in England and Wales between 2003 and 2006.