8 Fact Sheets

In the DiscardLess project there are 8 case studies. The information collected by partners on their specific case studies is listed in a series of fact sheets below.

8.1 North Sea and West of Scotland case study

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8.1.1 Brief presentation of the CS and fisheries concerned

The North Sea demersal fishery is one of the most well-studied in the world. It is a typical mixed fishery, with many different species and many different gears used by a wide variety of fishing vessels. Much of the scientific development regarding the analysis and the management of mixed fisheries has been initiated here, both because the problems are particularly complex and important for the area, but also because this fishery is relatively data rich, with extensive data, knowledge and literature about the various stocks and fisheries. The West of Scotland demersal fishery is less well-known and presents some additional challenges, such as very restrictive quotas (reducing the quality of catch data) and extensive untrawlable areas (reducing the utility of research-vessel surveys). These areas support two principal demersal fisheries: the demersal whitefish fishery (mostly larger offshore larger trawlers), and the distinct Nephrops fishery (mostly smaller trawlers) in more discrete sandy or muddy grounds. The mixed whitefish fishery catches a variety of groundfish and demersal species. The Northern North Sea and West of Scotland demersal fisheries are predominantly for roundfish while those in the Southern North Sea are dominated by flatfish.

8.1.2 Causes of discarding

There a number of causes of discarding in these areas. As the majority of vessels are involved in mixed fisheries with potentially restrictive quotas, it is quite likely during the fishing year that vessels will exhaust quota for one or more species while still having quota available for other species. In this situation, vessels will continue to fish for those species for which quota remains available, and must (under current legislation) discard those for which they have no quota.

Similarly, it is difficult to design fishing gear which is appropriately selective for all the species that a vessel is likely to encounter, so catches may include fish under the minimum permitted landing size for a given species – these must also be discarded. Illegal discarding of commercial species may also occur if fish are greater than MLS but small and thus low in value (high-grading), or if the market value for a species has a whole is low. Indeed, recent studies suggest that the majority of fish discarded are the result of size selection (Heath and Cook, 2015). This arises because most fishing gears, and trawls in particular, have imperfect selection and retain fish both above and below the minimum landings size (MLS) and fish below the MLS have to be discarded by law. Furthermore, the MLS has tended to be close to the minimum marketable size so size-related discarding is closely related to economic factors.

Species for which there is no readily-available market will also be discarded: examples in the case-study area might include species such as long rough dab or grey gurnard, although which species fit into this category can change through time (monkfish were once discarded for this reason, and are now highly valued).

For many demersal fisheries the fish are landed after gutting at sea. Hence large quantities of offal are disposed of during fishing operations at sea. While parts of the offal from some species may have economic value, such as the livers or roe, many fishers discard these as the process of extracting the material is uneconomic.

8.1.3 Effects of discarding

Discarded fish of most demersal species in this area are very likely to be dead – notable exceptions include some flatfish such as plaice, and certain elasmobranchs (skates and rays) may also be resilient. In theory, discarded *Nephrops* should survive well, although the survival rate is very dependent on handling processes and the season of the year. Scottish studies have shown that older haddock escaping at depth through net mesh had good survival rates, while escaping herring experienced almost 100% mortality (see, for example, Sangster et al 1996). Discards represent live fish removed from the ecosystem, but the return of dead fish can contribute to available food for seabirds and benthic scavengers. A study by Heath *et al* (2014) suggests that discarding supresses the populations of demersal fish and some bird and marine mammal populations as a result of the high fishing mortality on smaller fish, but may be beneficial to pelagic fish populations. The study suggested that if discards were landed, there would be small negative effects on birds, mammals and scavengers. However, if the 'discards' were avoided (i.e. not caught at all) there would be significant benefits to birds, mammals and the demersal fish biomass but a negative effect on the pelagic fish biomass.

Economically, discards represent lost revenue in many cases – the fish discarded obviously cannot be sold, but there are costs associated with their capture which a vessel cannot recoup.

8.1.4 Discard Data

8.1.4.1 Discard sampling

Discards data are collected by the various member states, according to DCF protocols (and generally through the use of onboard observers). Data are submitted to both ICES and STECF according to the data calls, and information is available for most stocks and fisheries, and included in the assessment and advice.

An extensive description of data and patterns is available in the North Sea discards atlas (Quirijns and Pastoors 2014, available at http://www.nsrac.org/wp-content/uploads/2014/11/discardatlas_northsea_demersalfisheries_2014.pdf), based on data up to 2012 provided to STECF.

8.1.4.2 Measuring Discards

A comprehensive study for the North Sea (Heath and Cook, 2015) for the period 1978-2010, suggests that the proportion of all fish biomass caught that is discarded is in the region of 35% while a total weight discarded has declined from around 300 thousand tonnes to below 200 thousand tonnes (Figure 10 a and b). The decline reflects the downward trend in the total catch (Figure 10 b) but the proportion discarded has remained about the same for many years (Figure 10 a). About 90% of the discards by weight in the last decade has comprised plaice, haddock, dab, whiting, cod, saithe, gurnard, ling in that order of abundance (Figure 10d).

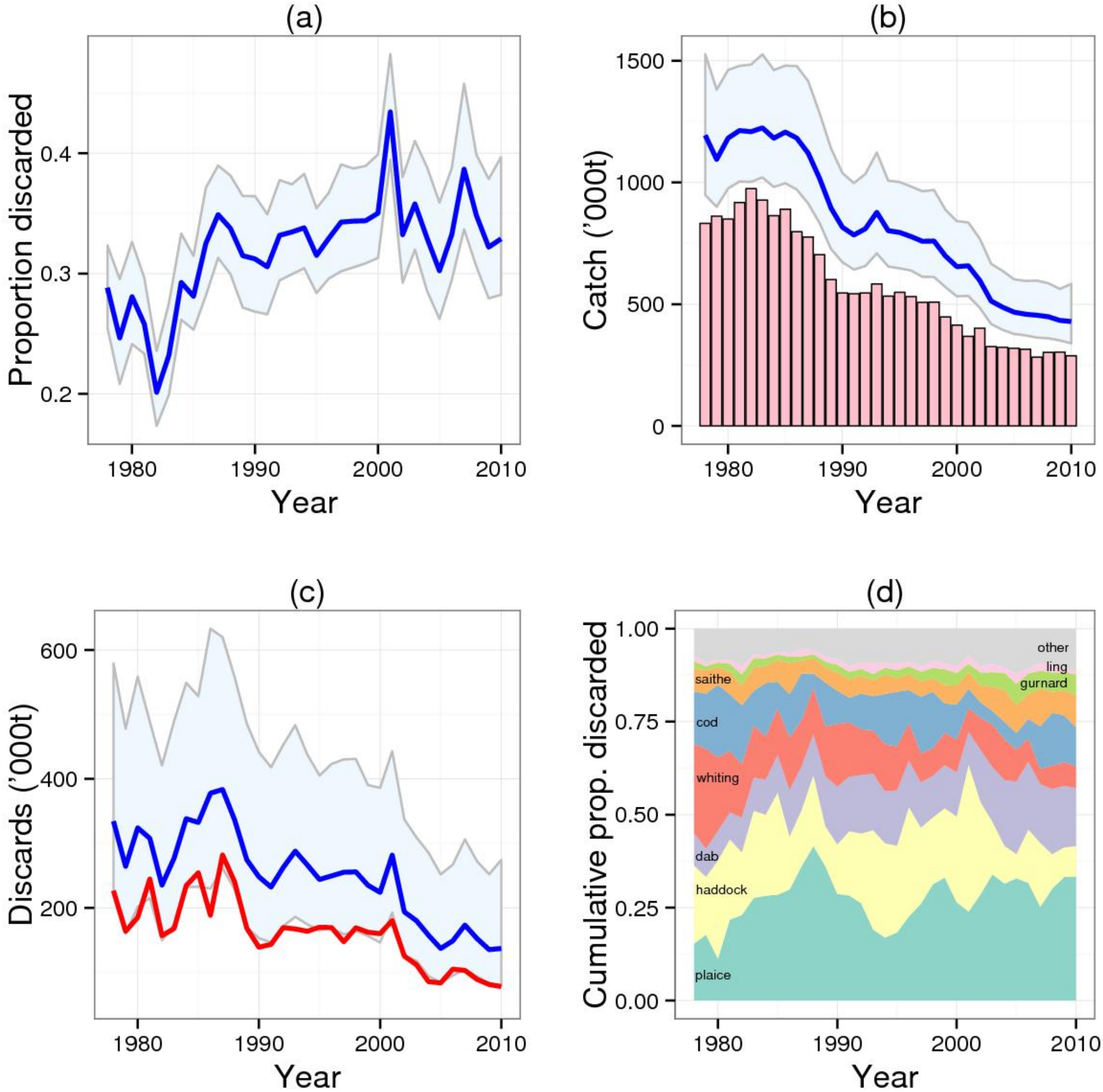

Figure 10: Summary of model results for the entire demersal fish assemblage. (a) Annual proportion of total demersal fish catch discarded (mean and 95% credible interval). (b) Total catch and landings of demersal fish. The blue line and shaded area indicates the mean and 95% credible interval of model estimated total catch, whilst the vertical bars indicate the measured landings. (c) Quantities (thousands of tonnes) of all demersal fish discarded. Blue line and shaded area indicates the mean and 95% credible interval of total discard quantity. The red line indicates the size-related weight of fish discarded, hence the area between the red and blue lines represents quantity-related discards. (d) Annual proportions of the eight most abundant species in

the discarded weight of demersal fish (in rank order of long-term average proportions: plaice, haddock, dab, whiting, cod, saithe, gurnard, ling).

Global information on the most recent year (2014) is not available in the North Sea discards atlas. Therefore, an update is provided, but using ICES information instead of STECF. As explained in the Atlas and in STECF 2013-11 report (http://stecf.jrc.ec.europa.eu/documents/43805/610582/2013-11_STECF+13-23+-+Landing+obligation+in+EU+Fisheries-part1_JRC86112.pdf), discards estimates can differ across different sources, as the same raw data from the national sampling programs can be combined and raised with different methods, and there is no single established method that is used systematically across institutions and working groups.

The Table 1 summarise the discards tonnage and the discards ratio for 29 of the North Sea demersal stocks in 2014, as used in the ICES 2015 assessment and advice. This includes both raw data as provided by Member States to ICES, and data raised by the ICES stock coordinators for missing data (no discards information provided with the landings). These data are available broken down by metier, country, quarter, area and age class in the ICES InterCatch database.

Table 1: Estimated discards and landings in 2014 for 29 North Sea demersal stocks. The values correspond to the area defined for the given stock as used for the stock assessment, and vary across stocks. Source: ICES InterCatch

Stock	**Species**	**Discards**	**Landings**	**Catch**	**Discard ratio**
bll-nsea	Brill	152.9	1671.1	1823.9	8.4%
cod-347d	Cod	10739.9	34670.1	45410.1	23.7%
dab-nsea	Dab	61806.6	4964.5	66771.1	92.6%
fle-nsea	Flounder	1407.1	1905.4	3312.4	42.5%
gug-347d	Grey gurnard	6703.9	1892.0	8595.9	78.0%
had-346a	Haddock	5057.6	40949.3	46006.9	11.0%
lem-nsea	Lemon sole	1611.6	3507.6	5119.2	31.5%
mur-347d	Red mullet	0.0	1717.6	1717.6	0.0%
nep-10	*Nephrops*	0.0	15.9	15.9	0.0%
nep-33	*Nephrops*	0.0	1146.4	1146.4	0.0%
nep-34	*Nephrops*	0.0	321.0	321.0	0.0%
nep-5	*Nephrops*	0.0	1415.0	1415.0	0.0%
nep-6	*Nephrops*	198.6	2502.6	2701.2	7.4%
nep-7	*Nephrops*	37.0	4415.3	4452.3	0.8%
nep-8	*Nephrops*	351.1	2466.2	2817.3	12.5%

nep-9	*Nephrops*	85.9	1246.8	1332.7	6.4%
nep-IVnotFU	*Nephrops*	0.5	392.5	393.0	0.1%
ple-eche	Plaice	3886.3	4319.9	8206.2	47.4%
ple-nsea	Plaice	51986.3	70846.9	122833.2	42.3%
ple-skag	Plaice	1022.7	8981.5	10004.2	10.2%
pol-nsea	Pollack	7.5	1597.6	1605.0	0.5%
sai-3a46	Saithe	6288.6	75419.0	81707.5	7.7%
sol-eche	Sole	718.2	4619.6	5337.8	13.5%
sol-nsea	Sole	1576.1	13060.4	14636.6	10.8%
tur-kask	Turbot	10.5	120.2	130.7	8.0%
tur-nsea	Turbot	158.6	2833.6	2992.2	5.3%
whg-47d	Whiting	10132.6	18658.0	28790.6	35.2%
whg-kask	Whiting	578.8	439.0	1017.9	56.9%
wit-nsea	Witch flounder	281.2	2669.1	2950.3	9.5%
Total		**164800.2**	**308764.1**	**473564.2**	**34.8%**

There are great differences across stocks. The highest discards rate are found for flatfish stocks (dab, plaice, flounder, lemon sole), and for low value roundfish (whiting, grey gurnard). High price species such as turbot, Nephrops, brill and Pollack are much less discarded.

8.1.5 Methods for reducing discards

A number of measures have been implemented in the North Sea and West of Scotland areas in order to attempt to reduce discarding. Minimum Landing Size (MLS) regulations are in place for most stocks, and at face value their effect should be to divert exploitation away from smaller, non-commercial fish to larger, profitable fish (although in practice they do not significantly alter fishing patterns, and instead induce under-size discarding). Gear measures to reduce the capture of smaller fish of many different species can also reduce discarding. Measures have included increases in the mesh size, limits on twine thickness and the use of square mesh panels. These measures are intended to allow small fish to escape by keeping meshes open. However, it is often possible to find legal ways of negating these improvements that effectively close the meshes. Area closures can protect juveniles and a system of temporary area closures has been implemented by some authorities though the benefits of the system are hard to quantify. Management loopholes are exploited by fishing fleets to avoid discarding – an example is the reporting of hake caught in the Norwegian zone of the North Sea as "Norwegian others", which avoids the discarding of hake for which the northern North Sea quota share is not representative of current stock distribution. Flexibility in quota holdings and the leasing market in quota can also help to avoid over-quota discarding. The key impact in recent years on discard rates, however, appears to be a reduction in recruitment – if there are relatively fewer young (that is, small) fish in a population, many of the reasons to discard are removed (although at the cost of a reduction in stock size following a number of years of low recruitment). Ultimately, much over-quota discarding is driven by a spatial mismatch between fishery activity, stock distribution and quota allocation. A process is also ongoing for designing a management-plan at the scale of the whole North Sea fisheries (STECF. 2015), where introducing some flexibility around the MSY target could potentially improve the balance between the fishing opportunities of the different stocks and reduce overquota discarding.

8.1.6 Ecosystem modelling of the North Sea

StrathE2E was implemented on the North Sea region (Heath, 2012, roughly corresponding to the ICES division IV, Figure 11) to explore the possible scale and mechanisms of interactions between pelagic and demersal fishing in the North Sea. The water column and living components of the model are horizontally averaged over the whole region. Vertically, the model resolves 2 water column layers, and an underlying sediment layer, because seasonal vertical layering has a defining influence on the food web fluxes of shelf seas. In addition, the sediment layer is resolved into 6 habitat types (shallow and deep, muddy, coarse and rocky sediments). Fluxes of nitrogen are simulated between detritus, inorganic nutrient and guilds of taxa spanning phytoplankton to mammals (Table 2).

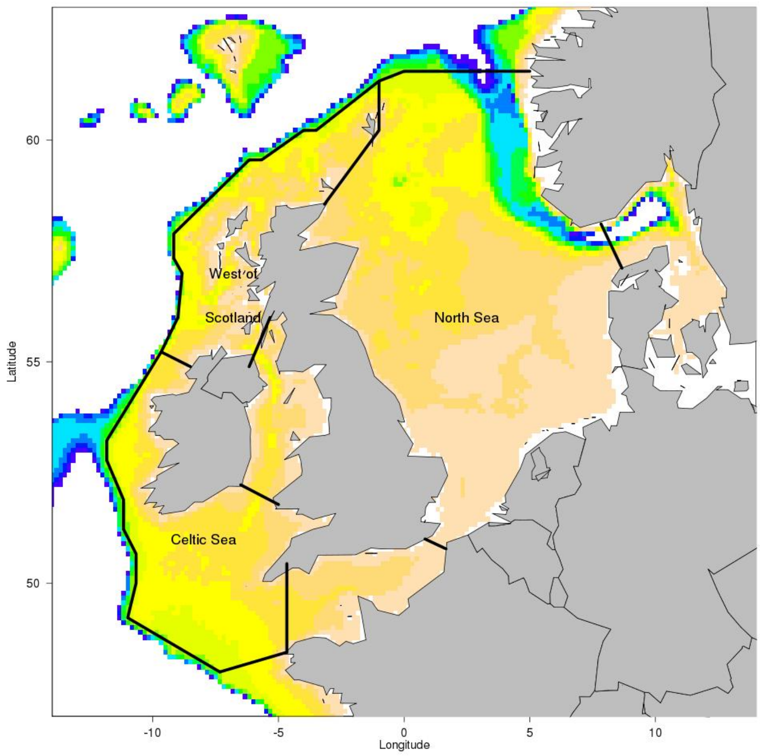

Figure 11: The strathE2E model domains, including the North Sea model used here.

12 fleets of fishing gears are explicitly represented in the model (Table 3) each with distinct activity rates, catching power with respect to pelagic and demersal fish, and each of the benthos classes, discarding rates of each of the resource classes, seabed ploughing rates, and relative spatial distributions across the model seabed habitats. The model resolves landing and discard fluxes arising

from the activity of each of these gear fleets. Data to set the rates and parameters of each fleet comes from an analysis of the STECF spatially resolved database of fishing effort, landings and discards.

Table 2: State variables of the StrathE2E North Sea model.

State variables
Surface detritus
Deep detritus
Sediment detritus in each sediment habitat
Fishery discards
Corpses in each sediment habitat
Surface ammonia
Deep ammonia
Sediment ammonia in each sediment habitat
Surface nitrate
Deep nitrate
Sediment nitrate in each sediment habitat
Surface phytoplankton
Deep phytoplankton
Mesozooplankton
Carnivorous zooplankton
Suspension/deposit feeding benthos
Carnivorous/scavenge feeding benthos
Pelagic fish larvae
Demersal fish larvae
Pelagic fish adults
Demersal fish adults
Birds/mammals

Table 3: Fishing fleets considered in the StrathE2E North Sea model.

Gear fleet	**Main target group in the model**	**Main by-catch groups in the model**
Pelagic trawl + Otter trawl 30-70mm + TR3	Pelagic fish	Demersal fish
Pelagic Seine	Pelagic fish	Demersal fish
LongLine (Mackerel)	Pelagic fish	negligible
Beam trawls BT1 + BT2	Demersal fish	Carnivorous/scavenge feeding benthos
Demersal Seine	Demersal fish	Pelagic fish
Demersal Trawl TR1	Demersal fish	Pelagic fish, Carnivorous/scavenge feeding benthos
GillNet + TrammelNet + LongLine (Demersal)	Demersal fish	Pelagic fish
Beam Trawl Shrimp	Carnivorous/scavenge feeding benthos	Demersal fish
TR2 Nephrops Trawl	Carnivorous/scavenge feeding benthos	Demersal fish
Pots	Carnivorous/scavenge feeding benthos	negligible
Dredge	Suspension/deposit feeding benthos	negligible

8.1.7 References

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