SR661 – Utilising discards not destined for human consumption in bulk uses

Funded by Defra (contract MF1227)

Authors; SC Mangi and TL Catchpole
Centre for Environment, Fisheries and Aquaculture Science

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Authors: S.C. Mangi and T.L. Catchpole

Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, UK

Head office
Centre for Environment, Fisheries & Aquaculture Science
Pakefield Road, Lowestoft, Suffolk NR33 0HT, UK
Tel +44 (0) 1502 56 2244 Fax +44 (0) 1502 51 3865
www.cefas.defra.gov.uk

Executive summary

The EU is currently proposing changes to the common fisheries policy that include provisions for a ban on discarding of small and large pelagic species (from 2014), and species under quota (from 2015). Such a ban would mean that fishermen would be required to land all fish they catch. The main objective of the ban will be to avoid the capture of any unwanted catch. However, there is always likely to be some fish caught that cannot be sold on the human consumption market due to a weak or absent demand for these species, or catches of fish under the minimum landing size that cannot legally be sold. We explore whether the discards not destined for human consumption could be utilised. This information is needed in order to be better prepared to deal with the discards ban when implemented.

Fish and shellfish automatically become an animal by-product when the decision is made that they are not intended for human consumption. Fish discards that do not enter the human food chain will be classified as Category 3 animal by-products provided they do not show signs of disease communicable to humans or animals in which case they would be category 2 animal by -products. As such, the main regulatory framework for utilising discards is the EC Regulation 1069/2009 (EU control Regulation) and its corresponding implementing EU Regulation 142/2011 (EU Implementing Regulation). The key Articles related to this legislation are reviewed.

The views of the main commercial outlets towards their suitability and interest in utilising unwanted catch that would not be destined for human consumption were sought through interviews with company managers. Results indicate that the opportunities for utilising discards not fit for human consumption include reduction to fishmeal and fish oil, ensiling, composting, anaerobic digestion with energy recovery, and freezing (prior to use as bait). Nine main outlets in UK expressed interest in utilising discards as raw materials to process into animal, pet and aqua feed; compost and organic fertilizer; frozen bait; and other products such as renewable energy generation. Most outlets stated that they accept raw material in all formats including as whole fish, trimmings, ensiled or fresh.

Estimates of discard quantities from English fleets, based on data from scientific observers, showed that most of the commercial outlets are not located close to the main landing ports where the discards would likely come ashore. Most outlets however, have extensive transport links that they would use which would enable them to cover even the remote ports. Others would consider setting up processing facilities at the major ports where most material would be landed.

Preliminary analysis on cost of discarding shows that a discard ban on all species will lead to

increases in annual operating costs for fishermen ranging from £4,708 to £90,959. If the ban is imposed on quota species alone, as has been suggested by the Commission, then the annual increase in operating costs for each vessel will range from £1,709 to £33,005. Given that the discards may end up for fishmeal processing where the fishermen will fetch around £125 per tonne, then majority of the fishermen will make losses in their fishing operations.

Although the commercial outlets interviewed could not provide estimates for the revenue they would generate by processing discards, managers insisted that they would be able to make profit by utilising unwanted catches that were not destined for human consumption. With the exception of two outlets who would consider building new infrastructure to accommodate fish discards, all other outlets indicated that they already have sufficient processing capacity.

Two outlets expressed some concerns regarding the quantities that will be available to them whereas the majority did not see any issues towards utilising bulk discards. When asked whether utilising fish discards makes commercial sense, the respondents stated that utilising as many of the discards as possible to help feed humans was key. Most felt that directing the remaining discards to usable products such as fishmeal, fish oil, animal feed, pet feed and organic fertiliser, would be a disincentive for fishermen to catch discards. This is due to the low prices paid by the fish by-product processing companies in comparison to the potential revenue from supplying for human consumption. All commercial outlets stated that dealing with by-products was their main business and the utilisation of discards is a real opportunity to expand their business. They were keen to develop business models and pilot schemes to accommodate fish discards.

This feasibility study reveals that there is enough interest in UK registered commercial bulk outlets dealing with Category 3 animal by-products to utilise fish discards not destined for human consumption. Most see this as an opportunity to expand their current business while others see it as an opportunity to develop further solutions. As a result, commercial outlets could utilise all of the non-human consumption discards that would be landed with the implementation of a discard ban. However, the financial returns to the catching sector would be low (less than £150 per tonne) compared to the human food chain.

This work has shown that any discards that are landed should ideally be utilised in human consumption. Where this is not practicable then utilisation of discards in bulk uses such as fishmeal or animal feed is the next preferred option. Bulk outlets that may be considered ‘waste’ operations such as composting and anaerobic digestion are least desirable.

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1. Introduction

1.1 Background to the study

Discarding is one of the most significant issues currently affecting many fisheries. The practice of returning part of the catch to the sea during fishing operations has generated substantial public attention recently and high profile media campaigns have been conducted to end the practice. The failure to make use of fish that are already caught is viewed by many as highly undesirable. Strong views have therefore been expressed by politicians, fishing industry, environmental groups, scientists and the public on the fact that discarding is threatening endangered species, wasting resources, increasing fishery costs and impacting on food webs (Catchpole *et al.* 2005, Hall and Mainprize 2005). Most commentators agree that discarding is a major problem especially in mixed fisheries and has serious social, economic and environmental consequences.

In the EU, discarding has taken place partly because of quota allocations awarded for each species through the common fisheries policy (CFP). Current CFP regulations require fishing fleets to throw back any excess fish or shellfish when they catch more than their allocated quota, or species for which they do not have quota. This is exacerbated in fisheries that target many species when the proportion of quota for each species does not reflect the composition of the catch. It has recently been estimated that these 'over-quota' discards (quota species discarded above the legal minimum landing size) account for up to 27% of English discards (data from Cefas Observer Programme). Legal minimum landing sizes are in place for important commercial species to protect small or juvenile fish from being targeted and sold. However, the mix of species found in most UK fisheries means that one size of net mesh is rarely suitable for all species. Poor gear selectivity therefore results in many fish being caught below the required minimum landing size which are then discarded. Around 19% of discards from the English fleets are of fish under the minimum landing size.

Market conditions also influence discarding. Some species are discarded because they are not popular to eat and have no market, these make up 30% of English discards. Others have a weak or inconsistent demand on the market or there is inconsistency in landing these fish by fishermen. Around 24% of English discards are attributed to inconsistencies in sorting and markets (data from Cefas Observer Programme).

Discarding is therefore a highly complex problem influenced by environmental (mixed fisheries) and social (regulations and fishermen's behaviour) factors. It is a consequence of the composition

of catches that are controlled by fishermen, who are affected by landing constraints and economic forces. Further, the CFP regulations such as quota restrictions have been developed in order to protect fish stocks from overfishing which makes stopping discarding a complicated issue.

The EU is currently proposing changes to the CFP that include provisions for a ban on discarding of small and large pelagic fisheries (such as mackerel, herring and bluefin tuna), and demersal species that are under quota (such as cod, haddock, whiting and saithe). This proposal has received a mixed response by stakeholders. Some think that such a ban will be very difficult to implement (e.g. UK House of Commons' Environment, Food and Rural Affairs Committee report) while others insist that the ban is being rushed through when regulations on seasonal closures and selective gear have not been strictly enforced (e.g. Marine Conservation Society). There is strong public support for the idea of a ban on discarding.

The ban would mean that fishermen targeting pelagic species and demersal species under quota would be forced to land all fish they catch. However, simply bringing the currently caught and unwanted catches ashore would not reduce the environmental impact of discarding or aid the building of commercial fish stocks. It is recognised that the objective of a discard ban should be to avoid catching unwanted fish in the first instance. However, there is likely to be a proportion of the catch that cannot be sold for human consumption. The question then becomes what will happen to the residual unavoidable catch? One option could be turning discards into useful commodities, but this needs to avoid creating any unwanted incentives. As species become serially depleted, what was once a discard could soon become a targeted resource (Hall and Mainprize 2005).

1.2 Objectives

This study explores whether discards not destined for human consumption can be utilised by commercial outlets in the UK. The availability of commercial outlets for discards not used in the human food chain is a key factor in the development and success of a potential utilisation programme in the event of a total discard ban. Therefore, the views of existing commercial outlets towards the potential use of discards were sought because without the support of commercial outlets, there would not be a foundation on which to develop a successful utilisation programme. The findings of this study will help decision making for dealing with discards brought on land, in the event of a total discard ban.

This report identifies existing outlets and utilisation opportunities for discards in the UK and explores each commercial outlet's suitability in terms of:

- locality to the catching sector;
- capacity to receive discards;
- limitations and uncertainties;
- associated revenues and costs for the catching sector; and
- requirements for additional investment such as storage facilities, sorting and grading, traceability and processing.

The legal framework related to use of discards in bulk such as the animal by-product regulations is reviewed. Data on quantities discarded gathered through the Cefas Discard Observer Programme are analysed and correlated to landing ports and used to explore whether there are variations in local, regional or national opportunities.

2. Legal framework associated with use of discards

The main regulatory framework associated with the use of discards not intended for human consumption in bulk outlets is the EU regulations that control the use, sale and disposal of high and low risk animal by-products. Fish and shellfish automatically become an animal by-product when the decision is made that they are not intended for human consumption. This is an irreversible decision. EC Regulation 1069/2009 (EU control Regulation) and its corresponding implementing EU Regulation 142/2011 (EU Implementing Regulation) therefore form the key European regulations related to fish discards. Wild caught fish landed but not intended for human consumption typically fall into Category 3 animal by-products provided they do not show signs of disease communicable to humans or animals in which case they would be category 2 animal by - products. Category 3 is the lowest risk category and therefore has the greatest number of potential uses.

The EU regulations also stipulate that with certain exceptions any persons wishing to handle animal by-products must be registered or in some cases approved to do so. This includes transporting, storing, processing and end use (if it has not been transformed to a final product which is out of scope of the Regulation). It is the legal person who has the animal by-products under their actual control that has a duty to ensure it is handled in compliance with these regulations and ensure that any contractors are approved or registered to handle animal by-products.

2.1 Legislation

There are five key Articles related to the use of discards that are not destined for human consumption, details of which are provided in Annex 1. In brief, Article 14 of EC Regulation 1069/2009 sets out the use and disposal routes for Category 3 materials such as fish discards. Article 31 controls feeding to farmed animals (non- ruminants and farmed fish), Article 32 placing on the market as fertilisers and Article 35 sets out controls for placing on the market of pet food, while Article 36 presents conditions related to the placing on the market of other derived products outside the feed chain or for application to land.

2.2 Pet food

The EU Control Regulation and EU Implementing Regulation control the manufacture of raw pet food, processed pet food, including dried pet food and canned pet food. A comprehensive guidance on the regulation of animal by-products for use in pet food is provided on the Animal Health Veterinary Laboratory Agency website at http://animalhealth.defra.gov.uk/managing-disease/animalbyproducts/food-and-feed-businesses/pet-food-manufacture.htm. In summary, only

certain Category 3 animal by-products (ABP) and products derived from Category 3 material including processed animal protein (PAP) and certain imported Category 1 materials can be used in pet food. The EU Control Regulation requires operators of pet food plants to carry out safe sourcing or failing that, safe treatment where safe sourcing alone does not ensure sufficient control. The material must be sourced to minimise risk and where the risks cannot be kept at a suitable level then treatment must be adequate to reduce the risk to an acceptable level. It is likely that any fish discards used in pet foods would be processed regardless of risk and not be used in raw pet foods. [NB Article 35 does not permit use of raw fish in raw petfood but this remains under discussion with the European Commission].

Material deemed suitable for processing into pet food would be animals that were passed fit for human consumption before slaughter and the animal of origin was not showing signs of a communicable disease. Wild caught fish should meet these criteria if they are stored and handled correctly, as an excessive deterioration in quality could limit their uses as category 3 material under Article 14(d) and would not be permitted in pet food. Collection and transport of raw materials for inclusion in pet food must be done under general conditions described in the EU Implementing Regulation. In accordance with the principles of safe sourcing material, pet food must be transported in a way that excludes risks to human and animal health, i.e. at appropriate temperature and in appropriate conditions. Unprocessed material going to pet food plants does not have to be temperature controlled if it is processed within 24 hours of collection or has already been chilled or frozen and the storage temperatures are maintained during transport.

2.3 Fishmeal

Fishmeal is the most commonly used restricted protein in non-ruminant feed. It is more commonly used in a dry form, but 'wet' products are also produced. Fishmeal is a processed animal protein, and the guidance on the use of processed animal protein or fishmeal can be found on the animal health website at http://animalhealth.defra.gov.uk/managing-disease/animalbyproducts/food-and-feed-businesses/derived-products-animal-origin-in-farm.htm. Fishmeal can only be used in feed for non ruminants. It is also prohibited to feed farmed fish with processed animal proteins, such as fishmeal, derived from the bodies of farmed fish of the same species. However, wild species (fish discards) of the same species can be fed to farmed fish. Raw or insufficiently processed fish cannot be used in pet food without processing. The process required to ensure fish is sufficiently processed is laid down in the Implementing Regulations. After this process it can be used in feed material or for any other use in feeding stuffs, including pet food, or for use in organic fertilisers or soil improvers.

2.4 Animal by-product approvals and responsibilities

There are a number of requirements relating to the production, transport and treatment of ABP's. This section contains only a summary of the main requirements. Further information is available from Animal Health http://animalhealth.defra.gov.uk/managing-disease/index.htm

A product of animal origin becomes an animal by product when the operator decides the material is no longer intended for human consumption, this is the start point where the Regulation takes effect. From this point, the operator is responsible for ensuring compliance with the requirements of the Regulation. An operator is defined as 'Natural or legal persons having an animal by-product or derived product under their actual control, including carriers, traders and users'. In respect of vessels landing discards not intended for human consumption this is the person who has physical possession of the material, which may be the Skipper.

Any operator that generates, transports, handles, processes, stores, places on the market, distributes, uses or disposes of ABP's or derived products must be either approved or registered under animal by-products or food safety legislation. It is the responsibility of the operator to ensure compliance. Each operator in the chain must ensure that these products are only supplied to an approved or registered transporter or treatment facility.

To ensure full traceability, it is required that documents accompany the consignment and that these records are kept by each operator that has a responsibility for the material. One step traceability is required, this means an operator must keep records of who supplied the material, and the operators to which material is supplied. When ABPs are collected, commercial documentation should be exchanged. This documentation requires the name of the business where the ABP's originated, a description of the ABPs, quantity, date of collection, who collected by, and details of the destination (including approval number where applicable). It should also be signed by the responsible person i.e. if the document is produced by the consignor, it should be signed by the consignor. If the document is produced by the transporter, it should be signed by the transporter.

When the ABPs are consigned to another operator, the responsibility for the ABPs is transferred to that operator. The commercial documentation provides a record of the transfer of ABPs and all parties (producers, transporters, treatment companies) are required to maintain records for at least two years and make available to competent authorities on request.

If the discards not intended for human consumption are to be temporarily held in a facility awaiting

collection e.g. a stand alone chill store, this should be approved as an ABP handling and storage plant. There are specific hygiene requirements for the design and operation of handling and storage plants.

If ABP and food material are transported in the same vehicle, they must be kept separate and identifiable during transport. During storage and transport, the vehicle, container or packaging must have a label attached stating the ABP category and the appropriate wording, in this case 'Category 3 material not for human consumption'. Animal by-products must be transported in vehicles or containers which are covered, leak proof and maintained in a clean condition. These should be cleaned, washed and/or disinfected after each use to the extent required to prevent cross contamination, and cleaned and dried before re-use.

2.5 Licensing waste facilities

Certain outlets for the utilisation or disposal of discards will be classed as waste operations. This includes composting and anaerobic digestion facilities. Such facilities would need an Environmental Permit to operate. Further information is available from Defra at http://www.defra.gov.uk/environment/quality/permitting/ If these facilities accept animal by-products they would require specific approval for that purpose.

3. Approach used in the study

3.1 Questionnaire and interviews

A list containing all possible utilisation routes for discards was collated from previous projects and through official list of premises approved to treat animal by-products held by Defra (Table 1). The list also included details of two associations that represent the rendering industry: UKRA (UK Renderer's Association) and FABRA (Foodchain and Biomass Renewables Association).

Each commercial outlet was contacted by telephone and or email to establish their interest in utilising discards. A questionnaire that included both open and closed ended questions was used to gather detailed information on the suitability of each outlet (Annex 2). The questionnaire included general questions to establish the respondent's background in utilising fish and shellfish as raw material in their business. The remainder of the questions gathered information on: i) location of the company including the location of other processing plants it owns; ii) the potential capacity of discards that they are able to process; iii) raw material requirements including the quality of fish and shellfish, format required and any preference for certain species; iv) the cost of processing discards, including transport, price for the discards, and labour costs; v) income including the product they would develop, where they would sell their processed material, and the revenue it would generate; vi) infrastructure including facilities for storage, sorting, grading and processing. Respondents were also asked to state whether there was a requirement for them to know the source of the raw material they process; and vii) whether there were limitations and uncertainties to utilising fish discards that the respondent could think of.

In order to explore perceptions of respondents towards discarding, an open-ended question was used with each respondent asked to give their opinions on whether utilising discards in their business makes commercial sense. In total 24 commercial outlets were contacted. Seven of them could not be reached due to incorrect contact details or lack of availability. One outlet had gone into administration, and three stated that they did not deal with fish. Three outlets initially expressed interest in taking part in the study however, they did not complete the questionnaire in time. Detailed interviews were therefore conducted with nine commercial outlets (Table 1).

Table 1: All outlets contacted in the study

	Company / Association	Location	Response
1	Holsworthy	Devon	Interviewed
2	Bio-Waste Solutions Ltd	North Lincolnshire	Non contactable
3	Flintshire Fish	Flintshire	Non contactable
4	M Gaze & Co. Ltd	Norwich, Norfolk	No response
5	Neal Environmental Ltd.	Cardiff	Study not for us
6	New Earth Solutions Ltd.	Wimborne, Dorset	Non contactable
7	Sustainable Biowaste Solutions Ltd	Oundle	Interviewed
8	Scanbio Scotland Ltd	Fort William	Interviewed
9	Bioganix Ltd	Herefordshire	Gone into administration
10	EcoSci	Exeter	Interviewed
11	Fats & Proteins (UK) Ltd.	Lancaster	Non contactable
12	Gray Composting Service	Aberdeenshire	Study not for us
13	Peake GB Ltd	Liskeard, Cornwall	Deal with medical waste
14	The Firm of AH Tucker	West Lothian	No response
15	Western Waste Ltd.	Penzance, Cornwall	No response
16	Wyvern Waste Services Ltd.	Somerset	Non contactable
17	TEG Environmental	Perth	Non contactable
18	United Fish Industries	Grimsby	Interviewed
19	BHJ UK Seafood	Hull	No response
20	Waddington Waste ltd	Bradford	Interviewed
21	Rossyew	Greenock	Interviewed
22	Interfish Ltd	Plymouth	Interviewed
23	FABRA		Interviewed
24	UKRA		No response

3.2 Data on discards

Using data collected as part of on-going monitoring of discard patterns in English fisheries, an estimate was made of the quantities of discards by species and by corresponding region and English port where those catches would be landed. Cefas observers accompany fishing vessels to measure samples of the different components of the catch that is discarded (Enever *et al* 2007; 2009). The discards data from the English fleet includes species, quantities and types of discards and has been consistently collected since 2002.

A total estimated weight of all fish discarded by English vessels in 2010 was calculated (Catchpole 2011). An observed regional discard rate (average 2008-2010), was applied to recorded landed weights derived from official logbooks from English registered vessels to generate estimated annual weights of discards by species and by English port. Data are therefore given only for those species which were recorded as landed in each port and recorded during a sampled trip in that region.

The data provide the best available estimates but must be considered only as indicative of the locations and relative proportion of species that could be available. The estimates therefore may not represent the catches that would ultimately become available to bulk outlets following a change in EU policy, the details of which have not yet been agreed.

The current CFP proposal indicates that the ban on discards will start with small pelagic fisheries (i.e. fisheries for mackerel, herring, horse mackerel, blue whiting, boarfish, anchovy, sardine and sprat) and large pelagic fisheries (including fisheries for bluefin tuna, swordfish, albacore tuna, and bigeye tuna) from January 2014. A ban on species under quota such as cod, haddock, whiting, saithe, sole and plaice should follow from January 2015. Analyses were therefore completed with the data on discards pooled into two scenarios. The first scenario considered changes in discard quantities following a ban applied to small and large pelagic species and quota species only while the second scenario considered a ban that applied to all species.

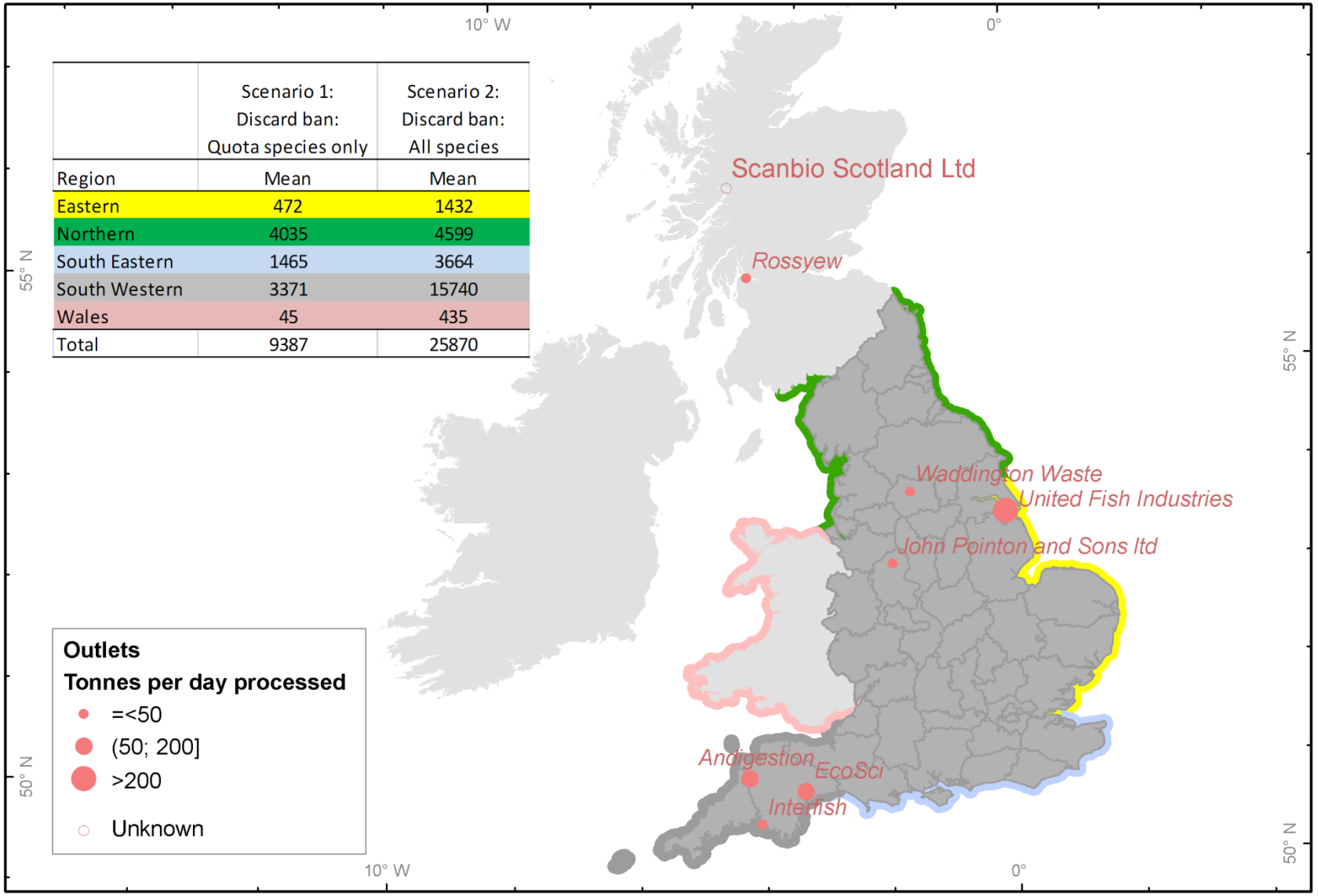
In order to explore changes in quantities discarded by region, discard data from each landing port were grouped into the corresponding region using the Marine Management Organisation (MMO) regions. The regions include:

- Northern (from Berwick to Skipsea on the east coast, and Connah's Quay to the Scottish border on the west coast);
- Eastern (from Skipsea to Gravesend);
- South Eastern (from Gravesend to Lyme Regis);
- South Western (from Lyme Regis to Chepstow, including the Isles of Scilly); and
- Wales

4. Results

4.1 Quantities discarded

Data collected on board the English fishing vessels during the Cefas observer programme shows that on average, 9,387 tonnes of species under quota and 25,870 tonnes of all fish and shellfish caught by fishermen are discarded each year. Between 2008 and 2010, the majority of discarding took place in the South West of England where there is the highest level of fishing activity (Fig. 1). Discard data shows that around 49% of discards were related to the three main landing ports in the South West (Fig. 2). Brixham showed the highest volume of discards at an estimated 5,988 tonnes per year followed by Newlyn with 5,018 tonnes per year discarded, while Plymouth had 1,790 tonnes per year of fish and shellfish discarded annually between 2008 and 2010 (Table 2). Other major landing ports where a considerable amount of discards could be available include North Shields (1,291 tonnes per year), Whitby (1,086 tonnes per year) both in the North East, and Shoreham (920 tonnes per year) in the South East of UK. The landing ports that showed the highest volumes of discards of all species also showed the highest quantities of discards for species under quota.



Region	Scenario 1: Discard ban: Quota species only Mean	Scenario 2: Discard ban: All species Mean
Eastern	472	1432
Northern	4035	4599
South Eastern	1465	3664
South Western	3371	15740
Wales	45	435
Total	9387	25870

Figure 1: Map of UK showing location of commercial outlets and estimated quantities discarded in each region

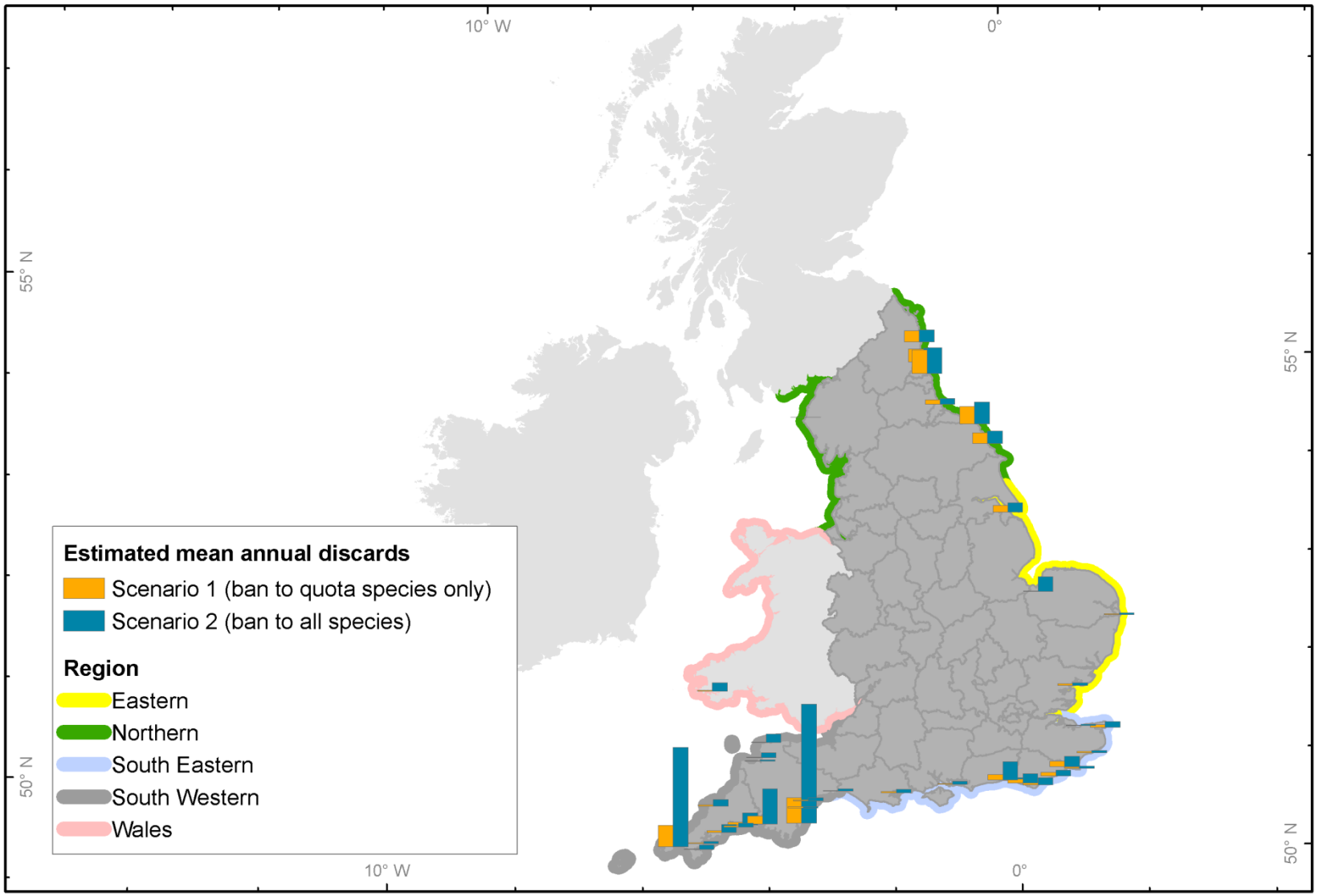


Figure 2: Map of UK showing estimated annual discard quantities of commercial species by landing port. The quantities discarded at each port are presented in Table 2.

Table 2: Estimated annual discard quantities of commercial species by landing port (2008-2010)

Landing port	Region	Discard ban: Quota species only Mean	Standard Deviation	Discard ban: All fish species Mean	Standard deviation
Brixham	South Western	1274	162	5988	540
Newlyn	South Western	1076	52	5018	237
Plymouth	South Western	426	135	1790	539
North Shields	Northern	1191	125	1291	112
Whitby	Northern	874	287	1086	285
Shoreham	South Eastern	265	10	920	240
Kings Lynn	Eastern	2	1	738	117
Blyth	Northern	646	70	687	70
Scarborough	Northern	534	39	622	38
Amble	Northern	553	99	615	95
Looe	South Western	143	34	605	54
Rye	South Eastern	275	25	506	26
Newhaven	South Eastern	202	36	486	17
Grimsby	Eastern	329	38	472	15
Ilfracombe	South Western	21	4	439	29
Milford Haven	Wales	45	18	435	245
Mevagissey	South Western	100	42	418	55
Eastbourne	South Eastern	92	23	355	145
Padstow	South Western	66	15	330	36
Hartlepool	Northern	235	68	297	87
Ramsgate	South Eastern	125	24	278	21
Hastings	South Eastern	164	40	277	54
Appledore	South Western	13	5	235	33
Helford River	South Western	16	4	208	37
Polperro	South Western	65	6	198	19
Poole	South Eastern	63	14	183	19
Exmouth	South Western	50	8	167	12
Portsmouth	South Eastern	47	28	154	65
West Mersea	Eastern	89	18	135	32
Brighton	South Eastern	63	6	115	20
River Falmouth	South Western	34	4	111	18
Dungeness	South Eastern	69	19	109	30
Folkestone	South Eastern	60	5	109	6
Lyme Regis	South Western	22	14	98	43
Whitstable	South Eastern	38	10	87	12
Lowestoft	Eastern	53	26	87	42
Granville	South Eastern	2	0	84	28
Bideford	South Western	6	9	69	94
Teignmouth	South Western	59	86	67	87
Whitehaven	Northern	2	2	3	2
	Total	9387	1611	25870	3656

The top ten species discarded between 2008 and 2010 include cuttlefish, monkfish, whiting, plaice, sole, haddock, rays, cod, nephrops and lemon sole (Table 3). These species are usually discarded for a variety of reasons including that they were below the minimum legal landing size, some have no minimum landing size but were discarded because they were non-commercial species or too small to sell. Some of them were discarded because of inconsistencies in the markets for these fish while others were discarded as a result of a response to quota restrictions, catch composition regulations or because they were damaged. Clearly some of these species could be sold at the market if fishermen were allowed to land them.

Table 3: Estimated annual discard quantities by species (top 18 species out of 152 species landed/caught by English vessels)

	Species	Discard ban: Quota species only Mean	Standard deviation	Discard ban: All fish species Mean	Standard deviation
1	Cuttlefish			2705	699
2	Monks			2546	374
3	Whiting	1804	225	1804	225
4	Plaice	1613	156	1613	156
5	Sole	1472	134	1472	134
6	Haddock	1469	200	1469	200
7	Cod	1286	97	1286	97
8	Nephrops	1186	229	1186	229
9	Lemon sole			1126	317
10	Pollack			974	119
11	Gurnard			843	55
12	Brown shrimps			800	120
13	Megrim			703	180
14	Pout whiting			690	45
15	Whelks			459	309
16	Skates and rays			433	466
17	Squid			373	25
18	Bass			346	34

4.2 Cost of landing discards not destined for human consumption

It is difficult to quantify the overall costs that fishing vessels will incur by bringing ashore discards that are not destined for human consumption since the discard ban is not yet in place. Further, fishermen's decisions on whether to adopt more selective fishing gear or where they fish may change once a ban is imposed making it difficult to provide accurate estimates of the volume of discards, and therefore the associated cost of landing discards.

Fishing vessels incur a range of operating costs such as fuel and oil, boxes, ice, food and stores, sales commission, landing fees, subscriptions and levies, shore labour, travel costs, quota leasing, purchase of days at sea and crew wages. Fishing costs vary depending on the amount of vessel activity. It is most likely that some of these costs will increase if fishermen are required to land everything they catch. For instance, the number of boxes landed will be much higher than it is at the moment since more boxes will be required to accommodate what is currently discarded. This will add an extra cost towards landing fees and purchase or rental of more boxes. The amount of ice taken aboard when fishing will also most likely increase for vessels that use ice or that fish offshore. Most day boats may see a reduction in fishing duration as the fishermen will be able to fill their hold more quickly than at present and will therefore see a reduction in associated costs such as fuel and oil. For vessels fishing offshore, however, such a reduction in fishing duration might mean that they take more fishing trips so as to meet targets for allocated quota which would lead to increased fuel consumption.

If fishermen are required to land everything they catch, then crew in most vessels will have to spend more time sorting the catch to separate what will be landed for the human food chain from the discards that will be sent to other outlets. An increase in sorting time will most likely affect the fishing operation thereby inconveniencing the crew and potentially reducing overall productivity. Discussions with fish auctioneers show that most crew members are paid a share based on the gross sales of the retained catch and therefore it is difficult to estimate the increased costs due to crew sorting discards. For vessels that have conveyer belts, vessel owners may need to re-engineer such that the catch goes to a collection area in the deck. In fact, the increase in time required to sort the catch may be the single largest increase in fishing costs associated with landing discards not destined for human consumption as it may necessitate employing more crew.

In order to illustrate the cost of bringing ashore discards not destined for human consumption, costs and earnings for specific vessel segments were taken from the 2009 Economic Survey of the UK Fishing Fleet (Curtis and Brodie 2011). Data for similar vessel segments as the metiers usually boarded by Cefas Observers were used. However, it is acknowledged that the segmentation used by Curtis and Brodie (2011) differs from that used by the Cefas Observer Programme (COP). To calculate the cost of landing one tonne of fish, the annual operating costs were divided by the total landings (Table 4).

Table 4: Vessel segment data obtained from Curtis and Brodie (2011) that were used to illustrate changes in costs of landing discards.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Vessel segment	Average vessel length[a] m	Operating costs per vessel[b] £	Landings per day[c] Tonnes	Average days at sea[d] Number	Annual landings[e] Tonnes	Cost to land one tonne of fish[f] £
<10m drift / fixed nets	8	28179	0.23	94	21.62	1303
<10m demersal trawl/seine	9.7	40806	0.27	100	27.00	1511
Area VIIb-k trawlers 10-24m	13	127210	0.43	174	74.82	1700
N.Sea beam trawl <300kW	14	60229	0.72	104	74.88	804
N.Sea nephrops <300kW	14	171142	0.61	149	90.89	1883
Area VIIa demersal trawl	15	53571	1.31	78	102.18	524
Area VIIa nephrops <250kW	15	74200	0.46	131	60.26	1231
Gill netters	18	269616	0.98	149	146.02	1846
Area VIIa nephrops >250kW	20	151906	0.71	173	122.83	1237
S.West beam trawl <250kW	20	301979	0.59	219	129.21	2337
N.Sea nephrops >300kW	21	403543	1.2	195	234.00	1725
S.West beam trawl >250kW	27	532114	1.12	225	252.00	2112

[a-d] = data obtained directly from Curtis and Brodie (2011)

[e] = Landings per day (Column 4) multiplied by Average days at sea (Column 5)

[f] = Operating costs per vessel (Column 3) divide by Annual landings (Column6)

Estimates of average discard rates (% of total catch weight discarded) for each metier calculated from data collected through the COP (Table 5) were used together with the total

landings to estimate the tonnes of discards per vessel segment. From this quantity, the proportion of discards that are not destined for human consumption was estimated by adding together the proportion of discards that are of fish under the minimum landing size (19%) and the fish that are discarded because they are not popular to eat and have no market (30%) (see Introduction section). Therefore, 49% of the total discards for each vessel segment was used as the proportion of discards that would not enter the human food chain if landed. Given that the ban on discarding will be in phases starting with small and large pelagic in 2014 and quota species in 2015, the analysis was completed with the discards data pooled into two scenarios of a discard ban: a ban applied to quota species only and a ban applied to all species.

Results show that a discard ban on all species will lead to increases in annual operating costs for fishermen ranging from £4,708 in Under 10m netters to £90,959 for vessels over 300kW targeting nephrops in the North Sea per vessel (Table 5). If the ban is imposed on quota species alone, as has been suggested by the Commission, then the annual increase in operating costs for each vessel will range from £1,709 in the Under 10m netters to £33,005 in vessels over 300kW that target nephrops in the North Sea. Assuming that all of the discards not destined for human consumption end up for fishmeal processing where the fishermen will fetch around £125 per tonne, then majority of the fishermen will make losses in their fishing operations. This may act as an incentive to adopt more selective fishing techniques to reduce discards.

The highest costs in landing discards not destined for human consumption will be in the development of onshore handling, storage and refrigeration facilities before the discards are collected to the commercial outlets. For instance, Brixham Trawler Agents estimate that between 1 and 2 million pounds are required to build a proper purpose built facility to deal with discards not destined for human consumption at Brixham (Rick Smith, personal communication).

Table 5: Estimates of discard rates for each vessel segment that were used to calculate the proportion of discards not destined for human consumption and the cost of discarding for each of the two scenarios: a ban applied to quota species only and a ban on all species.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Vessel segment	Discard rate[a] %	Discarded quantity[b] Tonnes	Proportion not destined for human consumption: all species[c] Tonnes	Proportion not destined for human consumption: quota species only[d] Tonnes	Cost to land discards not destined for human consumption: all species[e] £	Cost to land discards not destined for human consumption: quota species only[f] £
<10m drift / fixed nets	34.1	7.37	3.61	1.31	4705	1707
<10m demersal trawl/seine	34.1	9.21	4.51	1.64	6818	2479
Area VIIb-k trawlers 10-24m	34.0	25.44	12.47	4.52	21202	7685
N.Sea beam trawl <300kW	32.0	23.96	11.74	4.26	9443	3426
N.Sea nephrops <300kW	46.0	41.81	20.49	7.43	38582	13990
Area VIIa demersal trawl	43.0	43.94	21.53	7.81	11288	4095
Area VIIa nephrops <250kW	46.0	27.72	13.58	4.93	16721	6070
Gill netters	14.0	20.44	10.02	3.63	18501	6703
Area VIIa nephrops >250kW	46.0	56.50	27.69	10.05	34245	12429
S.West beam trawl <250kW	34.0	43.93	21.53	7.81	50318	18253
N.Sea nephrops >300kW	46.0	107.64	52.74	19.14	909524	33008
S.West beam trawl >250kW	34.0	85.68	41.98	15.23	88643	32159

[a] = % of total catch weight discarded for each metier calculated from data collected through Cefas observer programme

[b] = Discard rate (Column 2) multiplied by Annual landings (Column 6 in Table 4)

[c] = 49% of discards (Column 3). 49% is the sum of proportion below minimum landing size (19) and proportion discarded due to weak or absent demand (30) (see Introduction section)

[d] = 36% of discards not destined for human consumption (Column 4). From the table inserted on Figure 1, 9387 out of 25870 tonnes discarded represent discards of species under quota which equates to 36%.

[e] = Proportion not destined for human consumption (Column 4) multiplied by cost to land one tonne (from Column 7 in Table 4)

[f] = Proportion of species under quota not destined for human consumption quota (Column 5) multiplied by cost to land one tonne (from Column 7 in Table 4)

Condie et al (2012) assessed the cost of landing discards in the English North Sea otter trawlers by examining changes in the hold capacity, landing costs and additional sorting time. Their results indicate that in 2010 a discard ban for all fish species would have resulted in a 45% increase in the mean weight of landings per trip, and a 21% increase in the value of landings based on vessel segment. Despite the increase in landings, the hold capacity of North Sea otter trawlers would not have been exhausted. The study could not quantify the extent to which landing discards would increase sorting times as crew efficiency and sorting processes vary between vessels. However, Condie et al (2012) conclude that landing costs associated with discards would be minimal under a discard ban. In terms of profit generated from the sale of the total catch, the study indicated that trip profits would have increased by more than 1% due to the low value of discards as a raw material for fishmeal.

In summary, the study by Condie et al (2012) shows that a requirement for North Sea otter trawlers to land all catches of fish species will not result in curtailed fishing trips, due to the capacity of fish holds. Retaining catch that would otherwise have been discarded therefore will not displace marketable landings and additional trips will not be required. An increase in landings will result in longer sorting times, and assuming 10% of the catch is comprised of discards not destined for human consumption, then fishermen may have to adopt selective fishing in order to utilise their time more effectively. The degree to which sorting times are increased by landing discards will vary between vessels, depending upon the nature of the catch, the efficiency of the crew and the sorting procedure.

4.3 Utilisation opportunities for discards

Opportunities for utilising discards not fit for human consumption fall into 6 main categories: i) reduction to fishmeal and fish oil; ii) ensiling (liquefied fish); iii) composting; iv) rendering; v) anaerobic digestion with energy recovery; and vi) freezing prior to use as bait. Nine main outlets expressed interest in utilising fish discards as raw materials to process into animal, pet and aqua feed; compost and organic fertilizer; frozen bait; and other products such as renewable energy generation (Table 6).

Table 6: Utilisation opportunities for discards showing the products that the discards not destined for human consumption would be processed into.

	Utilisation opportunity	Outputs	Commercial outlet contacted during survey
1	Reduction to fishmeal and fish oil	For sale in animal, aqua and pet food industries	United Fish Industries
			Interfish Ltd
2	Ensiling	Animal, pet and aqua feed	Scanbio Scotland Ltd
			Rossyew
3	Composting	Compost production for land restoration, horticulture and agriculture	EcoSci
		Organic fertiliser	Biotel Organic Solutions Ltd
4	Rendering	Ingredients (hydrolysed protein and oil products) for animal and aqua feed; Energy sold to power station	John Pointon & Sons Ltd
			Waddington waste
5	Anaerobic digestion with energy recovery	Renewable energy and bio-fertiliser	Holsworthy
6	Freezing	Frozen bait	Interfish Ltd

4.3.1 Potential capacity

A total of 730 tonnes of fish by-product is processed daily by the nine commercial outlets identified in this study (Table 7). The largest processor is the United Fish Industries that process 48% of all fish by-product.

United Fish Industries (UFI) is the largest fishmeal producer in the UK,, processing 350 tonnes per day of fish trimmings and whole fish in its three plants in Grimsby, Aberdeen and Killybegs (Table 7). All of UFI's processing plants are EU approved rendering factories dedicated to fishmeal production. Managers informed us that they have capacity to process substantially more raw materials in their current plants. A lot of fishmeal used in the UK is imported and hence UFI thinks there is a chance to boost local production to meet the domestic demand.

Interfish Ltd is the other commercial outlet producing fishmeal and fish oil in their plant based in Plymouth. Interfish currently process around 50 tonnes of fish trimmings per day mainly coming from their own boats. Given that they are only licensed to treat their own raw materials, Interfish is currently of limited scope when it comes to utilising discards from vessels they do not own.

Scanbio Scotland has two processing plants, one in Fort William, Scotland and the other in Norway. They ensile fish locally and store it in bulk tanks at ambient temperature. Ensiling is the process of liquefying fish through enzymic or microbial action, usually by the addition of acid or through fermentation. The fish breaks down to a liquid which can be stored for a long period of time. The ensiled fish can be used in animal feed or further treated for other purposes. The ensiling plants use fish by-products of all format including whole fish and trimmings but would not take any shellfish or crustaceans. Based on the current estimates of fish discarded, managers of Scanbio stated that they would need to build new infrastructure such as storage facilities to accommodate the increased volume of available fish discards. Scanbio managers however, wanted to reassure us that they are well established to process fish discards.

Rossyew is based in Greenock Scotland and has capacity to process 15,000 tonnes of fish by-products per year to sell as animal feeds, pet feeds and aqua feeds. They are approved to process Category 3 material. Rossyew would like to receive their raw materials as ensiled, however, it is possible to receive it as fresh then ensile it themselves. Salmon is the only raw material they use at the moment but they could use other species as well. To do this, they will need to make a separate line for the plant as they would like to keep the processing of salmon separate from that of other species.

John Pointon and Sons Ltd is a commercial bulk outlet based in England that provides disposal, recycling and environmental solutions for animal by-products and food waste. Pointon process waste material including fish by-product into high quality products destined for major pet food manufacturers, oleochemical industries and cement producers. Managers stated that they process around 20 tonnes of fish by-products per day.

EcoSci is involved in composting, processing and recycling a wide range of organic wastes. EcoSci opened an In-Vessel Composting (IVC) site at Exeter in 2008 where food waste is processed to produce West Country compost enhanced which is a nutrient rich compost for bulk use. In terms of processing fish by-products, EcoSci's In-Vessel vertical Composting (IVC) system currently processes shellfish by-products between 8 and 10 tonnes per week and another 10 tonnes per week of fish trimmings. The IVC has full Category 3 by-product accreditation and is therefore suitable to process fish discards not destined for human consumption.

Biotel Organic Solutions Ltd (BOS) is owned by Philip Moore & associates. They are the owners of the Biotel technology and all related intellectual property rights and work with Les Edge / Eko-edge group of companies in a global joint venture partnership. BOS is keen to develop options for the recycling of landed fish discards including a pilot scheme based on the experience and business model they developed when the BIOTEL process was used in a pilot project to manufacture fish by-products from Northern Ireland seafood. All the by-products were manufactured into a validated organic fertiliser product.

The product manufactured fully complied with UK / EC animal by-products legislation therefore allowing it to be applied to land as a fertiliser. Since then they have developed a Biotel demountable process system that can be deployed where animal by-products classified organic wastes are generated enabling its manufacture into a validated organic fertiliser. The system is totally demountable and BOS believe that it could be located close or on the dock where fish is landed. The system is also sealed and environmentally benign in operation and has a very low carbon footprint. As well as fish by-products, it could also process waste streams such as food wastes totally eliminating the need to resort to landfill disposal.

When asked to provide an initial overview based on the quantities discarded at each port, BOS estimated that processing the fish discards would require to employ between 3 and 4 people (preferably fishermen) in each location. The fertiliser product would be collected from each operation and marketed by the joint venture partner Les Edge / Eko-edge group of companies. For the ports with low quantities of discards, BOS's plan is to arrange to supply suitable sealed containers and collect them for processing at ports where large quantities are discarded. For example, in the South West the main treatment would take place at either Brixham or Newlyn and collections made from all the smaller ports.

Waddington Waste Co. Ltd is based in Bradford, and processes food waste and animal by-products. Managers informed us that they have the technology, expertise and management in the handling, processing and disposal of animal by-products including fish, shellfish and from seafood processing. Waddington Waste process between 25 to 50 tonnes of fish by-products per day and would require the fish to be fresh when delivered to the plant.

Table 7: Summary of location and potential capacity for each of the nine commercial outlets

Commercial outlet	Location of processing plants	Current volumes processed (tonnes per day)	Remarks on potential capacity
United Fish Industries	Grimsby (England), Aberdeen (Scotland), and Killybegs (Ireland)	350	Have capacity to process substantially more raw materials in their current plants
Interfish	Plymouth (England)	50	Only licensed to treat their own raw materials
Scanbio Scotland Ltd	Fort William (Scotland); Norway		Would need to build new infrastructure e.g. storage facilities to accommodate fish discards
Rossyew	Greenock (Scotland)	40	Keen to work on a business model to accommodate fish discards
John Pointon & Sons Ltd	Leek (England)	20	Keen to take more fish
EcoSci	Exeter (England)	140	Volumes processed will be limited due to amount of grit and odour
Biotel Organic Solutions Ltd	None in operation	0	Keen to utilise all available volumes of discards at major ports in England
Waddington Waste	Bradford (England)	50	Volume processed will depend on smell, yield of oil and fishmeal
Holsworthy	Devon (England)	80	Will only consider large volumes of discards landed in South West
Total		730	

Holsworthy biogas plant is a centralised anaerobic digestion facility that process around 80,000m^3 per year of organic material. After pasteurisation and digestion the waste is returned to local farms as a bio-fertiliser for use on both arable and grasslands. The plant has 3.9MWof installed generating capacity. The amount of electricity being generated at any one time depends on the quantity and nature of the feed stocks being supplied to the plant. Typically, the plant produces 1,600 to 1,800 MWhs per month. Around 90% of this electricity is exported to the national grid, with the other 10% powering the plant itself. The feed stocks for the plant come from various sources, including industrial bakeries and food processors, abattoirs, fish processors, cheese producers, biodiesel manufacturers and councils. Holsworthy accepts any volume supplied by customers including waste from large producers typically between 50 and 100 tonnes per week, to waste from small businesses typically around one tonne per week.

Holsworthy say they will only consider fish discards when in large volumes. They would charge a fee to accept any fish discards at competitive prices but are keen to utilise discards that are not destined for human consumption.

The commercial outlets that took part in this study are located in the North, Eastern and South West regions of England and Scotland (Table 8) implying that discards landed at ports in the South East of England and Wales will need transport to reach the outlets. Correlation of the potential capacity of commercial outlets and estimates of quantities discarded by English fleets shows that all of the current discards could be utilised by the available outlets (Table 8).

Table 8: Regions where commercial outlets contacted during the survey are located showing the total potential capacity processed and estimated discards per year

Region	Location of commercial outlets contacted	Total capacity processed per year
Eastern	UFI	127,750
Northern	Waddington Waste, John Pointon & Sons Ltd	25,550
South Western	Interfish, Holsworthy, EcoSci	95,550
Scotland	Scanbio Ltd, Rossyew	14,600

4.3.2 Raw material requirements

All of the nine commercial outlets identified in this study are EU approved facilities dedicated to processing animal by-products including fish and would be suitable to utilise discards not destined for human consumption. Most of them will accept the raw material in all formats including either as whole fish, trimmings, ensiled or fresh. Some commercial outlets such as Scanbio will only process fish by-products while others such as Pointon will process both fish and shellfish by-products (Table 9). Most of them informed us that they require their raw material to be of good quality either chilled but they can also handle frozen fish. Most prefer their raw material in bulk loads but would be happy to take any volume that can be supplied. While the majority of commercial outlets can utilise any species that is available to them, some commercial outlets have preference for certain species. For instance, Interfish prefer to process small pelagic only. Rossyew currently process salmon by-products only but managers stated they could use other species as well. To do this, they will need to make a separate line for the plant as they would like to keep the processing of salmon separate from that of other species.

4.3.3 Cost

The majority of commercial outlets either operate their own transport or have partners / contractors who provide transport for them (Table 9). Some outlets such as UFI will buy the discards from the fishing industry while others especially those involved in composting and digestion will require the fishing industry to pay a gate fee to take the discards. The outlets that are prepared to pay for the discards stated that the price will depend on the achievable yield of fishmeal and fish oil, the location of the raw material and costs for other logistics. Based on current information, Rossyew indicated that they would pay £50 per tonne for fish discards, while UFI indicated that they currently pay between £120 and £130 per tonne for whole fish delivered into the Grimsby site. Those who would require the producer of the discards to pay them to take the material, e.g. Pointon, stated that they will charge £50 per tonne to process the discards plus an extra £2 per mile for transport. Scanbio indicated that cost of processing raw material is around £80 per tonne including ensiling, storage, transport and processing.

Table 9: Types of discards utilised and the transport arrangements for each outlet

Commercial outlet	Type of discards utilised	Transport arrangement
United Fish Industries	Finfish	Operate own transport in Humber area; Have transport partners across England and south of Scotland
Interfish	Small pelagic	Operate own transport
Scanbio Scotland Ltd	Finfish	Have own transport
Rossyew	Only Salmon processed so far; Could use other species	Employ a contractor
John Pointon & Sons Ltd	Finfish, Shellfish	Operate own transport; Are happy for discards to be delivered to their plant
EcoSci	Finfish, Shellfish	Operate own transport; Are happy for discards to be delivered to their plant
Biotel Organic Solutions Ltd	Finfish, Shellfish	Transport is not needed as discards will be treated at landing ports
Waddington Waste	Finfish, Shellfish	Operate own transport; Are happy for discards to be delivered to their plant
Holsworthy	Finfish, Shellfish	Cover transport for bulk discards in the South West only

4.3.4 Income

None of the commercial outlets was interested in providing a figure for the revenue they would generate by processing discards stating that this was commercial sensitive information. It is therefore difficult to derive a value added figure for processing fish discards, however respondents stated that they will sell their processed products from discards at the highest prices to enable them generate as much revenue as is possible. Managers therefore stated confidently that they will be able to make a profit by utilising discards not destined for human consumption.

4.3.5 Infrastructure

It is likely that storage and transport facilities for discards not intended for human consumption will be required in the different ports where they are landed. Storage facilities are likely to be required to enable the aggregation of sufficient quantities of material which will make subsequent transport or treatment cost-effective. For certain uses, such as fishmeal, it will be advisable to chill the discards during storage. In some ports this will require investment in onshore storage and possibly refrigeration facilities, which will need to be approved (see section 2.4).

During this study it was not possible to identify the extent of existing storage infrastructure for the animal by-product discards in the different ports. It is assumed to be limited because there are currently no facilities in place to handle ABPs produced by the catching sector. In larger ports there are existing arrangements for the onshore processing sector (predominantly the collection of fish by-products for fishmeal production) but in smaller ports or for the collection of shellfish by-products, these facilities are currently much more limited.

In terms of the processing capacity, apart from Scanbio and Rossyew who stated that they would need to build new infrastructure such as storage facilities to accommodate fish discards, all other commercial outlets indicated that they have sufficient processing capacity already (Table 10). One outlet (Interfish) stated that they would sort and grade the discards while the remaining eight stated that they would not need to grade or sort the raw material. Rossyew however, indicated that while they will not need to sort and grade the discards, they will examine the oil and fat content of the species first before processing it. In terms of traceability, four outlets (UFI, Interfish, Rossyew, Ecosci) would be keen to know the source of the discards since they do not accept illegal, unreported and unregulated fish, while five

outlets (Scanbio, Holsworthy, Waddington Waste, Pointon, Biotel Organic Solutions) indicated that they do not need to know the source of the discards. Majority of those who indicated that they would need to know the source of the discards elaborated that they did not require the information at fishing vessel level. For instance, if ten boats discharge discards into one tank in one week then all they need to know is that the material in the tank is from those ten boats.

4.3.6 Limitations and uncertainties

Two outlets (Scanbio and Rossyew) expressed some limitations towards utilising discards mainly to do with the quantities that will be available to them as raw material. If the volumes are too small then it would not be economically viable. Rossyew also stated that the quality of the discards will be a limiting factor as they need the discards before they are decomposed and free from anything that will affect the quality of the final product. Rossyew will therefore need to control the quality of raw material so that they do not end up with low quality processed products. However, the other commercial outlets did not see any limitations towards utilising bulk discards not destined for human consumption.

Table 10: Summary for each utilisation option

Utilisation route	Commercial outlets	Costs / revenues to fishermen	Discard material received	Remarks
Reduction to fishmeal and fish oil	UFI	Income of £120 to £130 per tonne	Finfish	Processing plant in Grimsby. Established transport links to UFI in North East, North West, East and South West with the onshore processing sector. Fishermen are likely to need to invest in onshore refrigeration to retain quality of discards prior to despatch.
	Interfish		Small pelagic	Can only treat their own material
Ensiling	Scanbio Scotland Ltd; Rossyew	Processing cost is £80 per tonne Could generate income for discards sold at £50 per tonne	Finfish	Investment required in ensiling plants in England; or transport to Scotland Scanbio and Rossyew are happy to develop business models and transport solutions for ensiling in England.

		Cost to fishermen ~£30 per tonne		
Composting	EcoSci; Biotel Organic Solutions Ltd	UK ranges £29 to £82 per tonne (median of £43/t)	Finfish Shellfish	Biotel Organic Solutions Ltd keen to establish composting facilities at major ports Regular collection is available from landing ports No need for refrigeration but need for bulk storage to maximize opportunities for savings on transport There are a number of licensed composting facilities in the UK which could be utilised for the utilisation of discards
Anaerobic digestion with energy recovery	Holsworthy	UK ranges are £26 to £64 per tonne (median of £43/t)	Finfish Shellfish	There are 31 anaerobic digestion sites currently listed to take waste materials for processing and licensed for animal by-products
Rendering	Waddington Waste; John Pointon & Sons	Cost would be > £50 per tonne	Finfish Shellfish	They will charge the catching sector to transport the discards
Freezing prior to use as bait	Interfish		Finfish	Available only to Interfish vessels

4.3.7 Perceptions towards utilising discards

When asked whether utilising fish discards makes commercial sense, respondents stated that utilising as many of the discards for human consumption was critical.

Most feel that directing the remaining discards to outlets such as fishmeal, fish oil, animal feed, pet feed and organic fertiliser, would act as a disincentive to catch discards. This is because fish by-product processing companies are unable to compete on the price paid for the fish to enter the human food chain. The respondents see the utilisation of fish discards not destined for human consumption as making absolute sense. The entire business of some of the commercial outlets interviewed (UFI, Scanbio, Rossyew) is built on fish by-products and the companies will need to prepare for receiving discards if there is sufficient volume of the right species of fish.

5. Discussion

The purpose of this feasibility study was to assess opportunities that are available for utilising discards not destined for human consumption in commercial bulk outlets and collect views from existing outlets on their suitability to utilising discards. The results show that nine major commercial outlets are interested in processing bulk fish discards into fishmeal and fish oil, animal, aqua and pet feeds, compost and fertilizers and energy generation, although other facilities for options such as composting and anaerobic digestion are widely available across the UK. All of the respondents stated that dealing with by-products is their core business and therefore utilising fish and shellfish discards not destined for human consumption would complement their existing operations. The commercial outlets see this as a real opportunity to expand their business and were keen to develop business models and pilot schemes to accommodate fish discards.

The lack of monetised revenue and costs figures involved in the processing of fish discards into the various products (fishmeal, fish oil, animal feeds and fertilizers) makes it difficult to assess the gross value added of utilising discards not destined for human consumption. In part, this is due to many factors that are still unknown including whether the volumes currently discarded would all be available to the commercial outlets. A total ban is likely to result in many fishermen adopting selective gear to maximise their revenue thereby catching less discards, and the fish that would otherwise be discarded may be utilised in the human food chain. The commercial outlets interviewed found it difficult to give a definitive indication of actual costs and revenue that they would generate from utilising discards. Although some commercial outlets are keen to develop business models to utilise discards not destined for human consumption, it is likely that they will not be able to put any investment in place in the short term. The catching sector therefore will need to be prepared to handle any discards that will be landed in the short term as commercial outlets make business decisions on the required investments.

The conversion of fish by-products into fishmeal and oil is the most popular utilisation route currently utilising around 85% of fish processing by-products in the UK, and from a fishing industry point of view, it is the most promising utilisation route for discards not destined for human consumption. This is because, the commercial outlets engaged such as UFI would buy the discards from the fishermen. This not only brings income to the fishermen but it takes

away the need for the fishing industry to find ways to dispose of the landed discards. The outlets keen to convert fish discards to fishmeal and fish oil also accept all species of finfish and have existing transport and processing infrastructure. Further, the discards sent for fishmeal would, in turn, be used to feed poultry and pigs thereby generating food for humans and reducing the need to import fishmeal. The need to increase domestic and global demand for fishmeal and fish oil means that commercial outlets would accept more volumes of raw materials and they therefore see the utilisation of discards as a win-win situation.

Ensiling the fish discards not destined for human consumption is another utilisation route that appears favourable to the fishing industry. There may be a requirement to invest in ensiling plant in different regions, which would be a cost to the catching sector. However, the companies involved in taking or processing ensiled material would purchase the ensiled discards from the industry. The outlets involved in ensiling have their own transport links and can reach remote areas hence reducing the burden of fishermen finding ways to utilise the discards. Ensiling is also suitable for most types of finfish material and given that it is a simple and low technology process, it can be operated at a wide number of scales. The ensiling companies have an end product that they can sell hence are motivated to utilise discards.

A number of commercial outlets have developed technologies that involve composting as a way of dealing with fish by-products. Composting of fish and shellfish is carried out at various sites around the UK. Although the fishing industry will need to pay the composting companies to take the discards, gate fees for composting are typically the cheapest for the options that would be a cost to the catching sector. Gate fees vary across the country from £29 to £82 per tonne (ref Wrap) with a median of £43/t. Some will make additional charges for transport to their site but others provide free transport. One company, Biotel Solutions Ltd, is keen to set up mobile facilities at the major ports hence eliminating the need for transport. By employing some of the fishermen to operate the plant and incorporating the fishing industry in joint venture business, the proposal has a social value as well.

A number of outlets collect organic commercial and municipal wastes and process them to produce renewable energy and other products such as organic fertiliser. Utilising the discards and recovering renewable energy in the process is one of the routes that could be used by the fishing industry to dispose of discards not intended for human consumption. There are

currently 31 sites around the UK that take waste derived material for anaerobic digestion and are licensed to take animal by-products (http://biogas-info.co.uk/maps/index2.htm#). These will charge a gate fee to receive the discards hence adding a cost to the fishing industry. The gate fees will be similar to those charged by composting outlets ranging from £36 to £64 per tonne. However, the commercial outlets keen to utilise fish discards through this route offer a renewable and environmentally sustainable source of energy which contributes towards a reduction in green-house gas emissions. The commercial outlets involved in this utilisation route provide clean and efficient process for handling animal by-products and returning valuable nutrients to farmland, without incurring the huge energy costs required in mineral fertiliser production.

The results of the discard estimates by English fleets from on-board observers showed that most of the commercial outlets contacted are not located close to the main landing ports where a high percentage of discarding takes place. This prompted some commercial outlets to consider plans to locate processing plants as close to the source of major discarding as is possible. For example, Biotel Solutions Ltd is keen to set up mobile facilities at Brixham and Newlyn to reduce transport as these two ports were associated with the highest quantities of discards. Most commercial outlets however, have extensive transport links that they provide for bulk discards covering remote ports e.g. UFI, Scanbio and Rossyew and therefore they should be able to collect and process discards from all ports.

The commercial outlets interviewed all agreed in their perceptions that utilising discards makes commercial sense. Most were keen to suggest that discarding should be stopped in the first instance and some of them e.g. those involved in compost and energy recovery thought that the gate fee they would charge could act as an incentive to the fishing industry to adopt more selective fishing gear. Most commercial outlets stated that in case any discards are landed then they would make full use of them hence avoiding a situation where the unwanted fish in the sea has been shifted to unwanted fish on land.

The findings show that each of the utilisation routes has its own merits and should be considered in terms of existing infrastructure and its availability to the catching sector. On this basis, each utilisation option has been assigned a score between 1 to 3, where 1 represents the easiness and cost-effectiveness of taking forward that utilisation route by the fishing industry while a score 3 indicates that the utilisation route requires further assessment in terms

of feasibility in different regions (Table 11).

Table 11: Ranking for each utilisation route and recommendations to take forward each route.

Utilisation route	What's required to take this forward	Ranking
Fishmeal and fish oil	Appears most promising for utilisation of fish discards not destined for human consumption, although not suitable for shellfish. Logistics are already well established in the East, North East, West and South West of England but additional coverage is required for the South and South East. The catching sector may have to invest in onshore storage and refrigeration facilities to ensure the quality of the discards does not deteriorate	1
Ensiling	The major ensiling plants are based in Scotland and therefore local investment in ensiling plants would be required to cover the different regions in England and Wales where the discards would be landed. There are companies who will purchase the ensiled material and the cost/benefits of this option require further investigation. This option is only available for finfish discards.	2
Composting	Facilities for composting are available in most regions across the UK. However, these will cost the catching sector approximately £43 per tonne plus transport based on average gate fees. Some of the composting facilities also have issue with grit and odour from discards and therefore this utilisation route has limitations. However, it is one of the few options that is available for shellfish discards.	3
Rendering (other than fishmeal)	Rendering facilities in the UK are not located near to the areas where the discards would be landed. Therefore, the catching sector will need to pay for treatment and transport costs. Rendering is also an option that is available for shellfish discards.	3
Anaerobic digestion with energy recovery	This utilisation route is available in 31 sites across the UK . This route would also cost the catching sector approximately £43/t plus transport based on average gate fees. However, it is yet to be clarified to what extent it would be available for shell from shellfish discards.	3

The options for finfish discards are greater than those for shellfish discards. Finfish discards could potentially generate an income if supplied for fishmeal production. However, the options identified for supplying shellfish discards in bulk uses are more limited and would be at a cost to the fishermen.

Regional variations in discards will also affect the options. In regions already covered by United Fish Industries (N, E, and SW) then it is recommended to link in with the existing logistics wherever possible. Storage and refrigeration facilities for temporarily holding the discards until collection would be required and this investment would need to be covered by the catching sector. In other regions, notably Wales and South East, there is currently no established supply route to the fishmeal plant. In these regions new supply links would need

to be established, in addition to the need for local storage of discards until they are collected.

There will be economies of scale with any option available, particularly in relation to the potential quantities of discards available. In order to reduce transport costs, some of the regions where small quantities of discards are landed will need to develop more local solutions. This could include freezing the discards until there is a sufficient quantity available to justify transport. The uncertainties over the quantities of discards available make it difficult to provide a definitive solution at this stage.

Each region should consider the options available to them and further investigate the cost and benefits of each utilisation route. This should include consideration of any investments in storage, refrigeration, transport links to the commercial outlet, registration / licensing requirements for local / regional holding facilities, management / operation of a regional holding facility and the cost / revenue implications for the catching sector. A co-operative approach where the catching sector in each region works in conjunction with the commercial outlet they are supplying, should improve the cost-effectiveness of the bulk utilisation options.

6. Conclusion

There is sufficient interest from commercial bulk outlets in the UK to utilise fish discards not destined for human consumption. Most see this as an opportunity to expand their current business while others see it as an opportunity to develop further solutions to dealing with by-products. As a result, commercial outlets could utilise all of the discards that will be landed. Most commercial outlets agree that incentives are needed to enhance the efforts to reduce unwanted catches and think that by either paying a very low price for discards or charging to receive discards then they are contributing towards an incentive to fish more selectively. It can be concluded that the relatively low value of bulk discards is unlikely to create an incentive for fishermen to target more of the fish currently discarded.

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Annex 1: Legislation related to the key articles on the use of discards that are not fit for human consumption

Article 14

Article 14 of EC Regulation 1069/2009 sets out the use and disposal routes for category 3 materials (fish discards). According to this Article, Category 3 materials shall be:

- disposed of as waste by incineration, with or without prior processing;
- recovered or disposed of by co-incineration, with or without prior processing, if the Category 3 material is waste;
- disposed of in an authorised landfill, following processing;
- processed (except in the case of Category 3 material which has changed through decomposition or spoilage) so as to present an unacceptable risk to public or animal health, through that product, and used for the:
    i. manufacture of feed for farmed animals other than fur animals, to be placed on the market in accordance with Article 31, except in the case of material referred to in Article 10(n), (o) and (p);
    ii. manufacture of feed for fur animals, to be placed on the market in accordance with Article 36;
    iii. manufacture of pet food, to be placed on the market in accordance with Article 35; or
    iv. manufacture of organic fertilisers or soil improvers, to be placed on the market in accordance with Article 32;
- used for the production of raw pet food, to be placed on the market in accordance with Article 35;
- composted or transformed into biogas;
- in the case of material originating from aquatic animals, ensiled, composted or transformed into biogas;
- in the case of shells from shellfish, other than those referred to in Article 2(2)(f), and egg shells, used under conditions determined by the competent authority which prevent risks arising to public and animal health;
- used as a fuel for combustion with or without prior processing;

- used for the manufacture of derived products referred to in Articles 33, 34 and 36 and placed on the market in accordance with those Articles;
- in the case of catering waste referred to in Article 10(p) processed by pressure sterilisation or by processing methods referred to in point (b) of the first subparagraph of Article 15(1) or composted or transformed into biogas; or
- applied to land without processing, in the case of raw milk, colostrum and products derived there from, which the competent authority does not consider to present a risk of any disease communicable through those products to humans or animals.

The highest value would be obtained from use in feeding farmed animals (non-ruminants and farmed fish), organic fertilisers, pet foods, or other derived products. These are controlled via Articles 31, 32 35, and 36 respectively.

Article 31 Placing on the market

1. Animal by-products and derived products destined for feeding to farmed animals, excluding fur animals, may only be placed on the market provided:

(a) they are or they are derived from Category 3 material other than material referred to in Article 10(n), (o) and (p);
(b) they have been collected or processed, as applicable, in accordance with the conditions for pressure sterilisation or other conditions to prevent risks arising to public and animal health in accordance with measures adopted pursuant to Article 15 and any measures which have been laid down in accordance with paragraph 2 of this Article; and
(c) they come from approved or registered establishments or plants, as applicable for the animal by-product or derived product concerned.
2.
Measures for the implementation of this Article may be laid down relating to the public and animal health conditions for the collection, processing and treatment of animal by-products and derived products referred to in paragraph 1.
Those measures, designed to amend non-essential elements of this Regulation by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 52(4).

Article 32 Placing on the market and use

1. Organic fertilisers and soil improvers may be placed on the market and used provided:
(a) they are derived from Category 2 or Category 3 material;
(b) they have been produced in accordance with the conditions for pressure sterilisation or with other conditions to prevent risks arising to public and animal health, in accordance with the requirements laid down pursuant to Article 15 and any measures which have been laid down in accordance with paragraph 3 of this Article;
(c) they come from approved or registered establishments or plants, as applicable; and
(d) in the case of meat-and-bone meal derived from Category 2 material and processed animal proteins intended to be used as or in organic fertilisers and soil improvers, they have been mixed with a component to exclude the subsequent use of the mixture for feeding purposes and marked when required by measures adopted under paragraph 3.

In addition, digestion residues from transformation into biogas or compost may be placed on the market and used as organic fertilisers or soil improvers.

Member States may adopt or maintain national rules imposing additional conditions for or restricting the use of organic fertilisers
and soil improvers, provided that such rules are justified on grounds of the protection of public and animal health.

2. By way of derogation from point (d) of paragraph 1, mixing
shall not be required for materials whose use for feeding purposes
is excluded due to their composition or packaging.

3. Measures for the implementation of this Article may be laid down relating to the following:
(a) public and animal health conditions for the production and use of organic fertilisers and soil improvers;
(b) components or substances for the marking of organic fertilisers
or soil improvers;
(c) components to be mixed with organic fertilisers or soil improvers;
(d) supplementary conditions, such as the methods to be used for marking and the minimum proportions to be observed when preparing the mixture, in order to exclude the use of such fertilisers or soil improvers for feeding purposes; and
(e) cases where the composition or packaging allows the materials to be exempted from the

mixing requirement.

Those measures, designed to amend non-essential elements of this Regulation by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 52(4).

Article 35: Placing on the market of pet food

Operators may place pet food on the market provided:

- the products are derived:
    i. from Category 3 material, other than material referred to in Article 10(n), (o) and (p);
    ii. in the case of imported pet food or of pet food produced from imported materials, from Category 1 material referred to in Article 8(c), subject to conditions laid down pursuant to point (a) of the first paragraph of Article 40; or
    iii. in the case of raw pet food, from material referred to in Article 10(a) and (b)(i) and (ii); and
- they ensure the control of risks to public and animal health by safe treatment in accordance with Article 38, where safe sourcing in accordance with Article 37 does not ensure sufficient control.

Article 36: Placing on the market other derived products

Operators may place on the market derived products, other than the products referred to in Articles 31, 32, 33 and 35, provided:

- those products are:
    i. not intended for use for the feeding to farmed animals or for application to land from which such animals are to be fed; or
    ii. intended for feeding to fur animals; and
- they ensure the control of risks to public and animal health by:
    i. safe sourcing in accordance with Article 37;
    ii. safe treatment in accordance with Article 38, where safe sourcing does not ensure sufficient control; or
    iii. verifying that the products are only used for safe end uses in accordance with Article 39 where safe treatment does not ensure sufficient control.

Annex 2: Questionnaire used to gather views from commercial bulk outlets on their suitability to utilise fish not destined for human consumption

Question

1. Are you aware of fish that is not destined for human consumption as a raw material?

2. Is this fish material relevant to your business?

3. Does your business utilise fish raw material?

4. Is there potential in your business to utilise fish material?

5. What would you utilise it for?

6. Please provide answers to the following questions.

Issue	Question	Answer
Location	Where is your main plant located? (please include your address and postcode)	
	Are there other plants that you own?	
	Where are these located? (please include addresses and postcodes)	
Capacity of discards	What volume of raw fish material could you process (e.g. tonnes per day)?	
Raw material requirements	What quality of raw fish material are you happy to use? (e.g. fresh, frozen)	
	Any preference for certain species? If yes, which species?	
	In what format do you require the raw material?	
Cost	Do you have transport or would you require the fish raw material to be delivered to you?	
	Roughly, how much would you pay for the raw material? (£/tonne)	
	What is the cost of processing the fish raw	

	material (£/tonne)	
	What does this figure include? (e.g. transport, staff wages etc)	
Income	Where would you sell your final processed material?	
	What revenue would you make? (£/tonne)	
	Based on your current business, around how much gross value added do you think utilising fish raw material would make? (profit plus wages)	
Infrastructure	Do you have storage facilities currently to receive and store raw material? (e.g. freezers)	
	Would you require additional storage in order to receive fish raw material?	
	Would you require to sort and grade the fish raw material? If yes, do you have the infrastructure for this?	
	Infrastructure for processing – how are you set up for processing fish raw material?	
	Traceability: is there a requirement to know the source of your raw material – which fishing boat, where fish were caught etc?	
Limitations and uncertainties	What do you consider would limit your business in utilising fish raw material?	
	What would you need to overcome these limitations?	
	In your view, would utilising discards make commercial sense?	
	Is there any other information that could help us assess how fish raw material could be utilised?	

7. a) Are there other businesses that you know of who deal with or would be able to utilise fish raw material in bulk?

b) Please provide details of a contact person

Thank you for your cooperation

Sea Fish Industry Authority

e: seafish@seafish.co.uk w: www.seafish.org

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