This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

DiscardLess

Strategies for the gradual elimination of discards in European fisheries

Grant agreement No: **633680**
Project co-funded by the European Commission within the Horizon 2020 Programme

Start date of project: **1st March 2015**
Duration: **48 months**

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

Deliverable 6.1

Diagnosis of the inventory of the generated unavoidable unwanted catch

(Month 8)

Due date of deliverable:	01 November 2015
Actual submission date:	19 January 2016
Dissemination Level:	Public, CC License BY 4.0

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How to cite this report: Viðarsson *et al.*, 2016. Diagnosis of the inventory of the generated unavoidable unwanted catch, DiscardLess Deliverable Report 6.1, 19 Jan 2016
http://dx.doi.org/10.5281/zenodo.215293

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

Revision Control

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 doi: 10.5281/zenodo.215293

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Executive Summary

This document is the first deliverable in work package six of the DiscardLess project, which is intended to contribute to a successful implementation of the landing obligation (LO) of the reformed Common Fisheries Policy of the EU. The work package focuses on how unavoidable, unwanted catches (UUC) can be utilised once they have been landed. The first step in that work is to provide an overview of current and expected supplies of UUC, where and when they will be landed, what are the available facilities and how the set-up is at the landing harbours to cope with changing supplies effected by the LO. This document addresses that by focusing on five selected fisheries, which will be key case studies in future work within the work package i.e. Bay of Biscay (landings in the Basque country), North Sea (Danish fleet) and Iceland. Landing and discarding statistics from the Mediterranean (bottom trawlers landing in Mallorca) and the English Channel (French fleet) are also analysed. The role of Iceland in this report is to provide an example of where a LO has been successfully in effect for decades.

Estimating future landings of what used to be discarded under a policy regime that obliged fishermen to discard UUC cannot realistically take into consideration changes in behaviour of fishermen that inevitably will occur. Once the LO is implemented the fishermen will change their practises, for example by avoiding areas with high volumes of UUC or by applying more selective fishing gear. The historic discard data can therefore only give indications on what UUC are likely to be landed in certain areas, as well as when and by which fleets.

The general results from all of the case studies is that relatively few species and fleets account for most of the discards. There are also in most fisheries very few harbours that stand out, representing vast majority of the discards. The available facilities are in most cases going to be sufficient to cope with changing supplies of catches intended for production of products for human consumption. Catches below Minimum Conservation Reference Size (MCRS) and other catches that cannot be utilised for direct human consumption will however present a challenge in many areas. Solutions for processing those materials will either have to be simple and inexpensive, or strategically located so that raw materials can easily be transported to them. The lessons learned from Iceland are that a successful implementation takes time and that economic incentives generally work best.

Safety criteria's relevant for UUC utilisation are fairly straightforward and need to apply to established rules and regulations. There is a fundamental difference in requirements for UUC intended for direct human consumption and catches that are used for other purposes, but traceability and documentation verifying that the products are safe are always required. When it comes to quality criteria's requirements can be more subjective, as long as the products are safe.

 doi: 10.5281/zenodo.215293

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Abbreviations	
CFP	Common Fishery Policy
EU	European Union
GIS	Geographic Information System
ITQ	Individual Transferable Quota
LO	Landing Obligation
MCRS	Minimum Conservation Reference Size
MLS	Minimum Landing Size
OTD	Bottom Otter Trawlers targeting Demersal species
OTM	Bottom Otter Trawlers targeting Mixed species
PTB	Pair Trawlers
UUC	Unavoidable, Unwanted Catches
WP	Work Package

 doi: 10.5281/zenodo.215293

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1 Introduction

Discards have been a part of fishing practices in most fisheries around the world since modern fisheries began. Fishermen have selected what fish to keep and what to release or throw back into the sea long before quotas and catch limits were invented. The introduction of quotas has however created new incentives for discarding, as fishermen try to maximise the value of their catches under quota regime. Unwanted catches, such as low value bycatches, catches exceeding quotas and catches of target species that are unlikely to attain highest prices are thrown back overboard due to this, and much of these catches are dead or dying. This has been the common practice in European fisheries under the Common Fisheries Policy (CFP) of the European Union (EU). European fishermen have annually discarded more than 1,5 million tonnes of perfectly good fish in order to maximise the value of their catch and to meet the requirements of the CFP (EC, 2011). This practice has though in recent years become more and more under debate, to a point where it has come to be literally unjustifiable for policy makers, fishermen and the public in general. As results the European Commission has introduced a discard ban as a part of the most recent reform of the CFP (EC, 2013). This means that in principle, all catches of species subjected to catch and/or size limits will have to be landed and will be counted against quota. But exemptions can be applied, and at the time of writing there are still ongoing discussions on the amount and time scale of these in the various EU waters. The discard ban, or Landing obligation (LO), will be gradually implemented, as the first fisheries became subjected to this landing obligation in beginning of 2015 and by 2019 all EU fisheries will be required to land all catches.

The LO presents a number of challenges for the European seafood sector. Fisheries strategies of individual fishermen will have to be enhanced, selectivity of fishing gear will need to be improved, on-board handling, sorting, storing and monitoring of compliance will need to be reconsidered, land based processing will have to adjust to different supplies and the markets will be affected. The aim of the DiscardLess project is to suggest solutions to these challenges.

While excessive economic impact of the LO should be avoided, it is clear that it will have significant effects on what is produced and how. Practical and cost effective uses of unavoidable, unwanted catches (UUC) must be developed, taking into consideration the constraints that the LO puts on potential usages of UUC. DiscardLess will produce a review of discard data and knowledge to ensure that the best possible data to identify, evaluate, select and demonstrate an integral solution to make best use of UUC without creating economic incentives and inadvertently developing markets for such products. To reach this aim, the following specific objectives will be addressed;

1) Analysing the potential availability of UUC in specific harbours;
2) Evaluating most suitable uses of UUC;
3) Constructing an initial selection of potential uses and solution approach;
4) Ensuring traceability and market acceptance of the products resulting from UUC valorisation;
5) Obtaining a clear and convincing picture of the economic profile and the feasibility of the implementation of the proposed solutions;
6) Validating the solution proposed for best use of UUC by a pilot trial;

 doi: 10.5281/zenodo.215293

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This report is the first deliverable in work package six (WP6) of the DiscardLess project, which is dedicated to the challenges that arise on land in connection with the LO, such as how to deal with different supplies of raw material. An initial step to do that is to identify and analyse current and expected supplies of UUC, where and when they will be landed, what the available facilities are and how the set-up at the landing harbours is. This document does just that, focusing on selected fisheries that will be key case studies in the work package i.e. Bay of Biscay, North Sea and Iceland. Landing and discarding statistics from the Mediterranean (Mallorca) and the English Channel (French datasets) are also analysed.

The deliverable is broken into three parts, where the first one focuses on identifying and analysing landing and discard statistics in selected fisheries, the second looks at available infrastructure in ports with respect to how to utilize and monitor UUC, and the final part looks at safety and quality criteria's for UUC.

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2 Spatial and temporal distribution of estimated UUC

The objective of this chapter is to analyse landing and discard statistics in selected fisheries and estimate potential landings of UUC of each species that will be landed under the new LO in each port. Discard ratios, species composition and size distribution, as well as gear and fleet distribution and seasonal variations are especially focused on. The selected areas are West Mediterranean (ports in Mallorca), English Channel (French part), North Sea, Kattegat and Skagerrak (Danish part), Bay of Biscay (Spanish part) and Iceland.

A general disclaimer is that in the following chapter, considerations are given on historical discards by harbour. It is obvious that by definition, these discards have not been actually landed in the harbours. But the data have been compiled as such, as discards ratios from the standard national sampling programs have been used to infer "potential" discards by trip (using the same discard ratio for all trips within a sampling stratum), and have thus been allocated to the harbour where that trip landed. The data display thus an average expectation of where discards would potentially be landed in the future.

2.1 West Mediterranean

Following is an analysis of landing and discard data from the bottom trawl fishery in the west Mediterranean that landed catches in Mallorca in the period 2004-2014.

Reported landings in Mallorca by the bottom trawl fleet 2004-2014 includes fifteen species, of which three species account for 75 - 90 % of the volume. These species are horse mackerel, European hake and striped red mullet, as can be seen in Figure 1 (STECF, 2014).

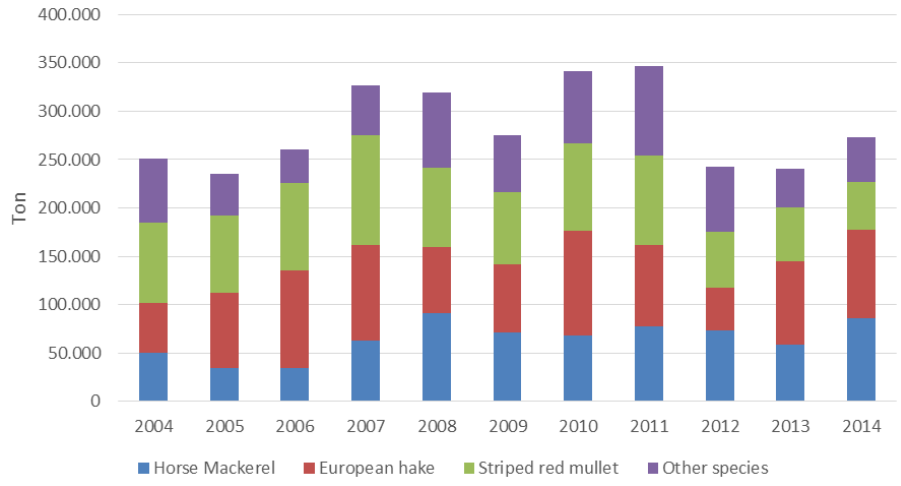

Figure 1: Volumes of landed bottom trawl catches in Mallorca 2004-2014 by key species

When looking at the reported discards for the same period it is horse mackerel that has accounted for majority of the discards, but in recent years the ratio of European hake has been increasing, as can be seen in Figure 2 (STECF, 2014). These two species alone account for over 90 % of the reported discards in the period.

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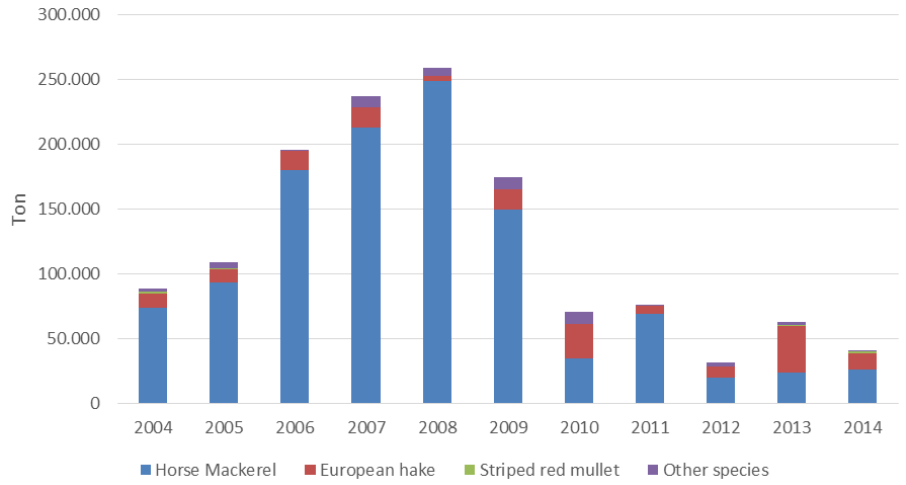

Figure 2: Volumes of discards from the bottom trawl fleet reported in Mallorca 2004-2014 by key species

There has been a significant reduction in reported discards in the period 2008-2014, which can mainly be explained by reduced discards of horse mackerel and variations in catch volumes of the three most dominating species, horse mackerel, hake and striped red mullet. It is however interesting to see how discards of hake have not decreased at the same time; and in fact they increase considerably in some years, particularly in 2013 when hake discards accounted for 58 % of the total discards, as shown in Figure 3 (STECF, 2014).

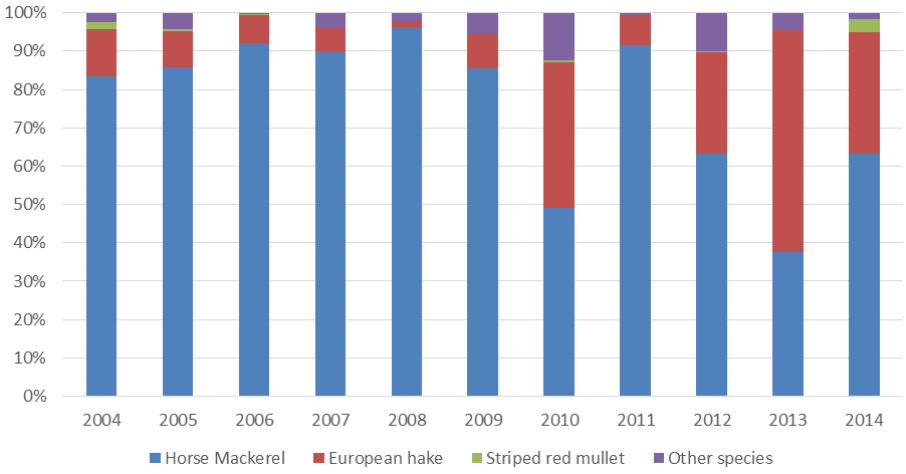

Figure 3: The share of key species in discards of the west Mediterranean bottom trawl fleet reported in Mallorca 2004-2014

The Striped red mullet has very low discard rates and discard rates in the hake fishery have also been relatively low in comparison with horse mackerel. This has though changed in recent years, as mackerel discards have decreased significantly but hake discarded have not. Figure 4 shows how discard rates have changed in the past decade and how discards of horse mackerel and hake have dominated the total discards (STECF, 2014).

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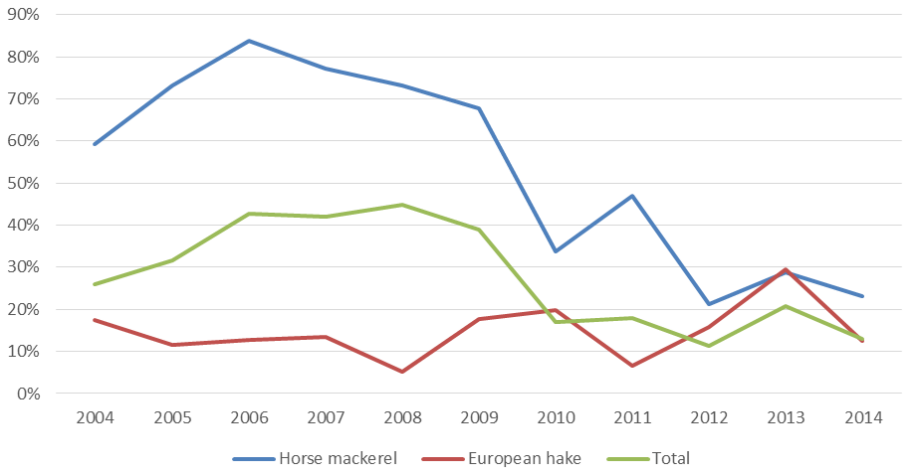

Figure 4: Discard rates of horse mackerel and European hake from bottom trawlers landing in Mallorca 2004-2014

Other species have little impact on total discard numbers. There are however species with high discard rates, but the catch volumes are relatively low and do therefore not have significant effect on the "big picture". Figure 5 shows for example that discard rates for pilchard and anchovy can vary greatly between years, but they represent only a small portion of the total annual discards (STECF, 2014).

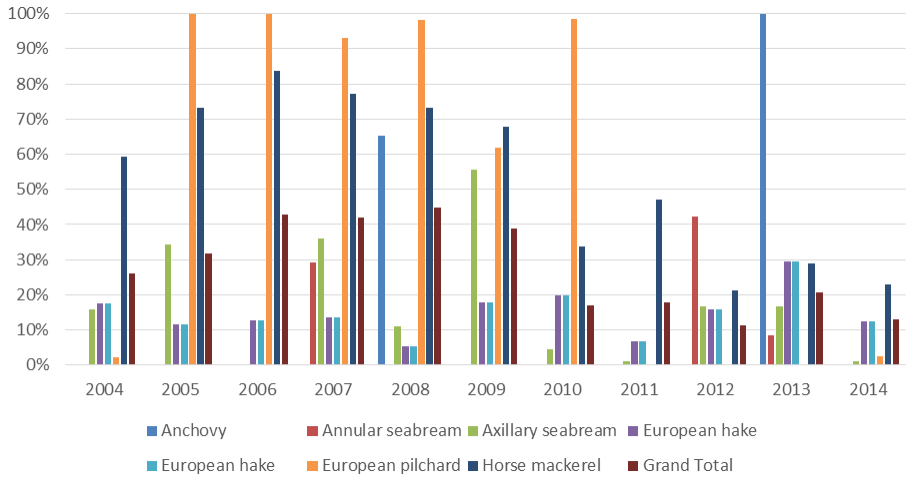

Figure 5: Discard rates of selected species

The species with significant volumes of discards and therefore most relevant in connection to expected changes in supplies because of the implementation of the LO are mackerel, European hake, axillary seabream, common pandora and European pilchard. The discard volumes of axillary seabream, common pandora and common pilchard have fluctuated between years where for example the volume of discarded axillary seabream in the past decade have varied from zero to almost 9.500 tonnes and European pilchard has not had any discards reported since 2011, but in 2010 they were over 7.600 tons (discard numbers shown in Appendix 1).

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Looking at the total volumes of discards and what affects they will have on the supply streams once subjected to the LO, it is safe to say that the effects will be greatest in the hake and horse mackerel fishery. The fluctuations in discards of other species make it difficult to predict the effects on total supply of UUC, but as with all other productions there are significant problems that arise when supply varies significantly between periods.

Seasonal variations can also be important, where it is for example expensive to have production facilities capable of receiving large volume over short time of the year and then lacking raw materials during other periods of the year. When looking at horse mackerel and hake it is apparent that there are some seasonal fluctuations in discards. Much of the discarded horse mackerel is being caught in the first quarter of the year, but the least amount of hake is discarded in that quarter, as shown in Figure 6 (STECF, 2014).

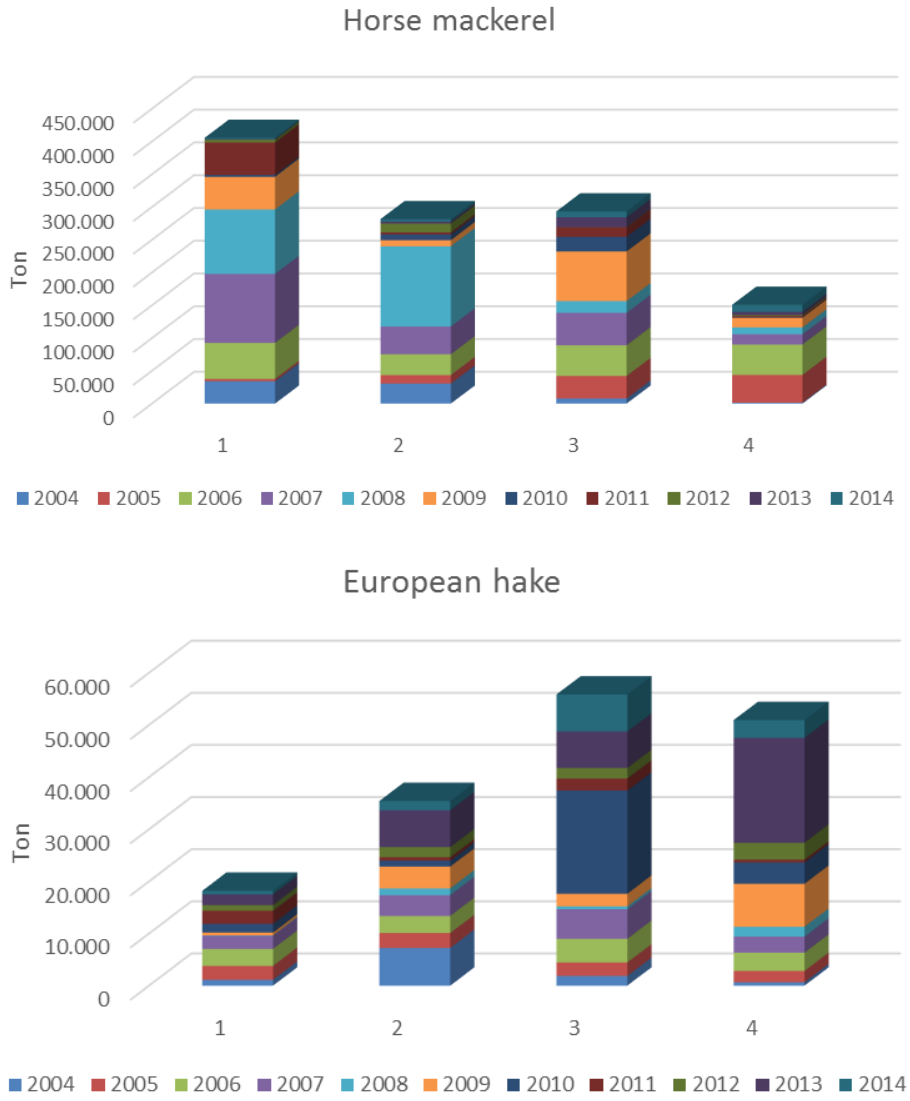

Figure 6: Seasonal fluctuations in discards of horse mackerel and European hake

 doi: 10.5281/zenodo.215293

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Fishermen have been obligated to discard catches under minimum landing size (MLS), according to the CFP. This will change now when the LO will be implemented, as catches under minimum conservation reference size (MCRS) will be landed, but it will not be allowed to use it for direct human consumption. It is therefore important to get a clear picture of what will be landed once the discard ban has been implemented, with respect to size distribution of previously discarded catches. Looking at the most relevant species it is obvious that the main issues with MCRS will be with the European hake and horse mackerel, as can be seen in Figure 7 (STECF, 2014).[1]

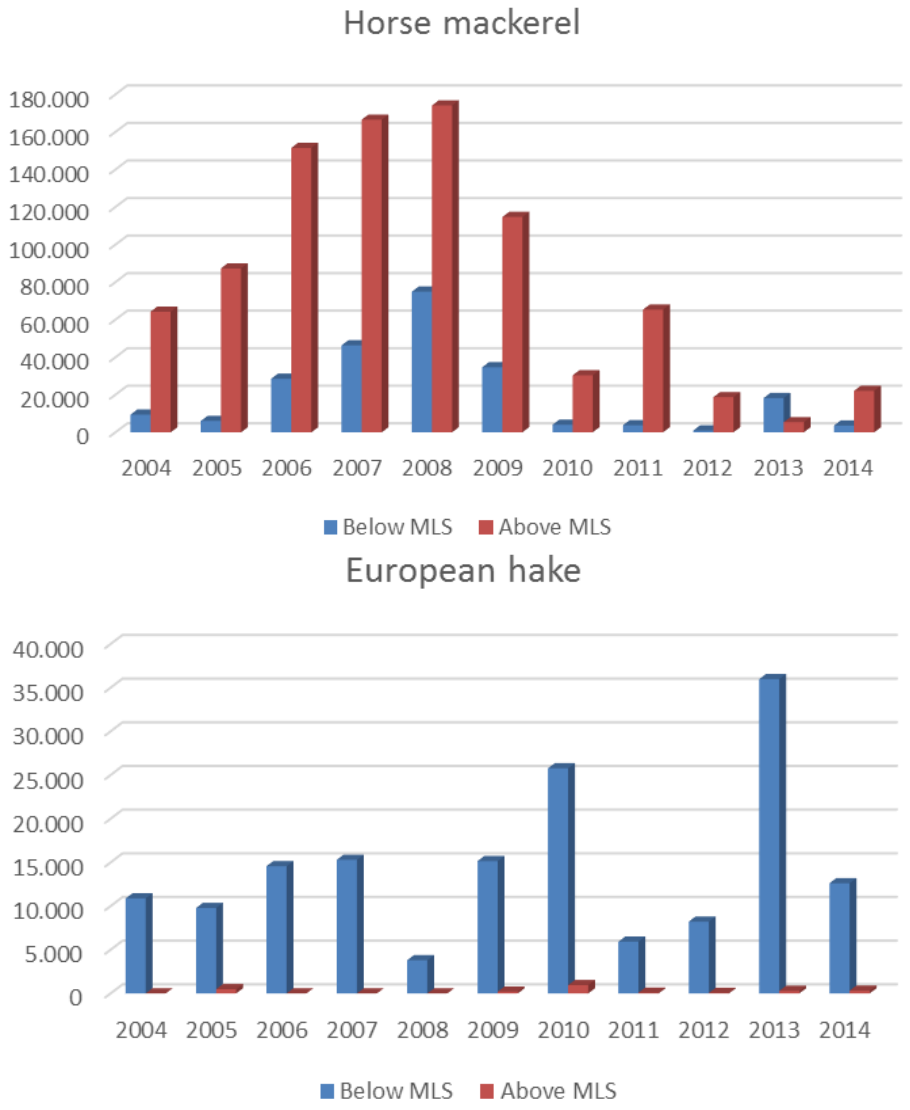

Figure 7: Discards of horse mackerel and hake with respect to MLS (ton)

The most demanding challenge for the Mallorca processing sector will therefore be to develop processes and products from juvenile European hake and horse mackerel, which cannot be used for direct human consumption. The UUC of species above MCRS will to the largest extent simply go

[1] *MLS of horse mackerel is 15 cm and hake is 27 cm* http://www.ne-ifca.gov.uk/minimum-landing-sizes/

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through the already established supply chains and be used for making conventional human consumption products.

2.2 English Channel

Following is an analysis of discards reported by France vessels in the English Channel in 2003-2013. They include all fleets and gears of French vessels fishing in the area.

Total catches reported by the fleet since 2003 have been between 40 and 80 thousand tonnes a year. The discard rates between 2003 and 2009 were very low, but after 2010 they have varied between 24 and 34 %, as can be seen in Figure 8 (STECF, 2014).

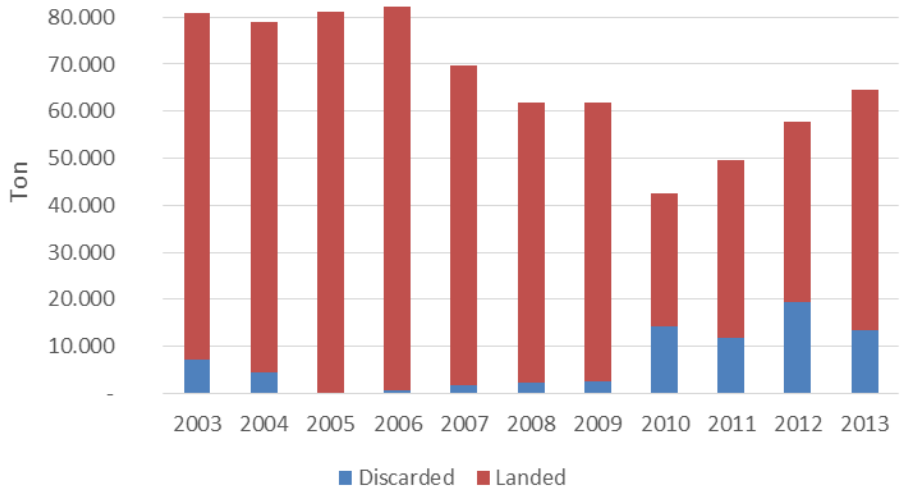

Figure 8: Reported discards of France vessels in the English Channel 2003-2013 (ton)

It seem clear that discards prior to 2010 were not documented in the same manner as they are now and the authors of this report have therefore chosen to focus on the years 2010-2013 when predicting likely landings under the LO.

The vast majority of the discards are associated with vessels landing in Boulogne-Sur-Mer, as can be seen in Figure 9 (STECF, 2014). The rest is distributed between a number of harbours, which each contribute to a relatively small portion of the total discards.*

* *Talking about discards according to landing harbour might be considered as contradiction in terms. This means that if the discards would have been land, then they would have been landed in these harbours along with the rest of the catches from that fishing trip.*

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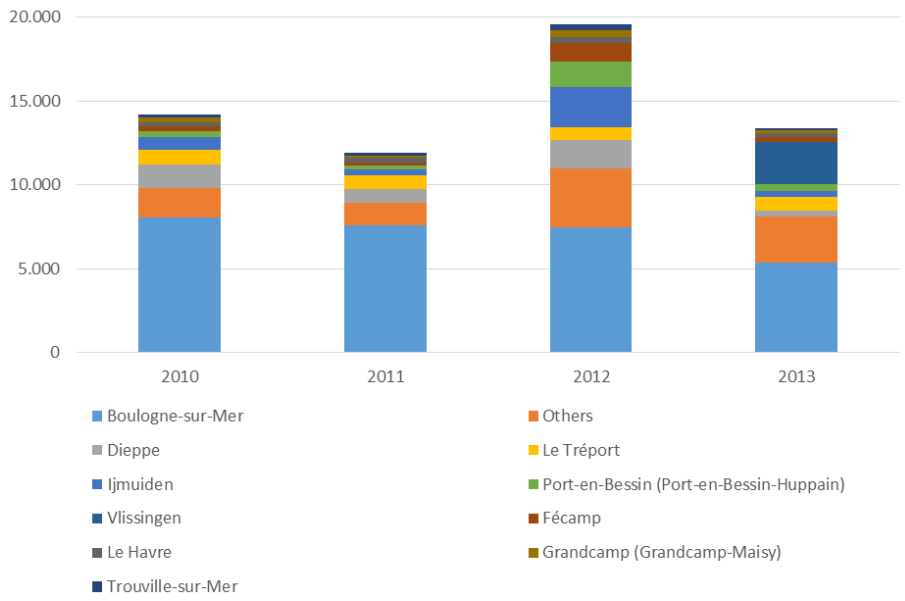

Figure 9: Discard of France vessels in the English Channel by landing harbours 2010-2013 (ton)

During the period 2010-2013 there were one to four harbours where the reported discards exceeded 1.000 tons. To complicate this even more, these were not always the same harbours, apart from Boulogne-Sur-Mer.

When the reported discards are analysed by species, it reveals that very few species account for most of the discards. These are in particular whiting, herring, common dab and plaice, as can be seen in Figure 10 (STECF, 2014).

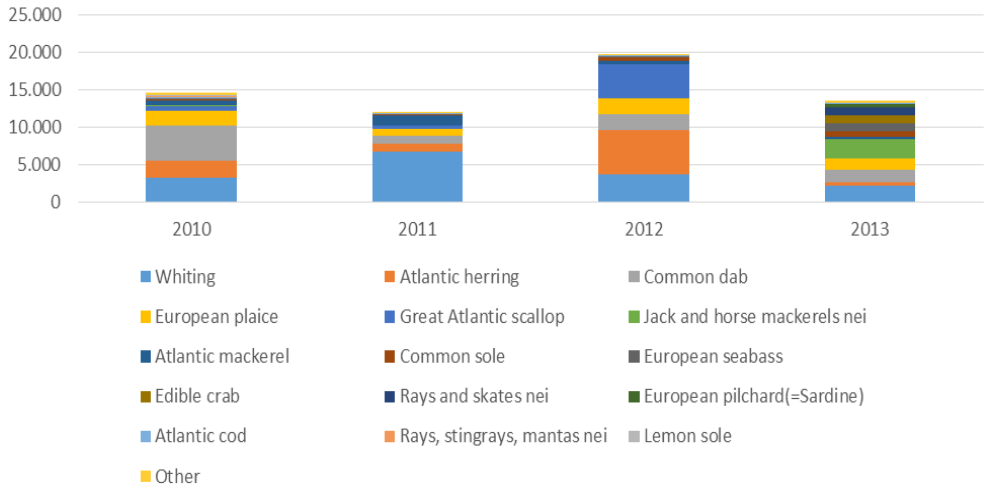

Figure 10: Discard of France vessels in the English Channel by species (ton)

In 2012 the Great Atlantic scallop is suddenly among the most discarded species, but that year stands out and based on discard estimates alone it is not possible to predict whether such large scale discards will continue under the LO. Again in 2013 a new species got close to the top of the list i.e. horse mackerel. It appears as if there has been a reduction in the discard ratios for some species throughout

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the study period. This is at least true for some species, such as herring as can be seen in Figure 11 (STECF, 2014).

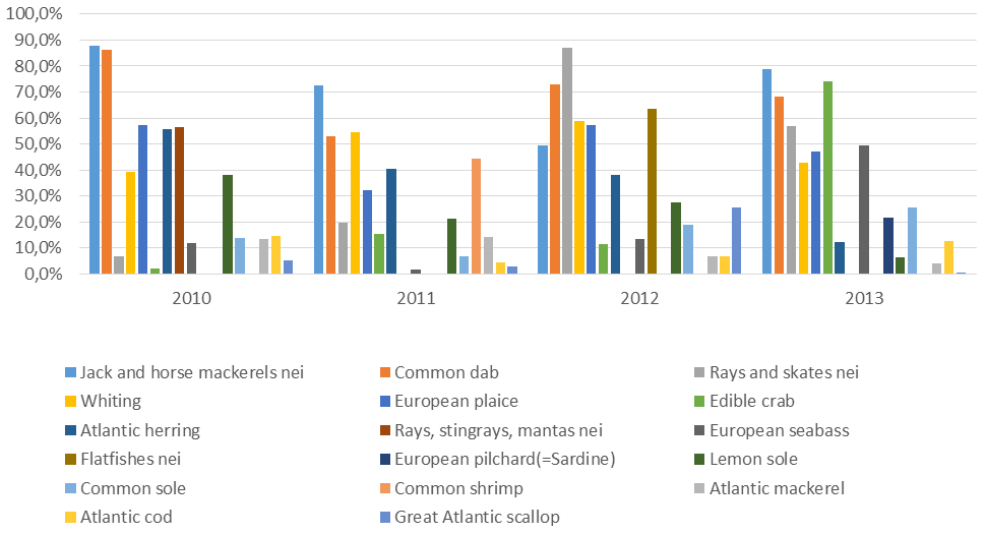

Figure 11: Discard ratio of France vessels in the English Channel by species

For other species, such as whiting, the reduction in discarded volumes are primarily the results of reduced catches, but the discard ratios remain similar between years. There are considerable differences in discard ratios from one species to another, as can be expected. Discard ratios of horse mackerel reached for example 88 % in 2010 and other species, such as common dab, European hake, whiting and Atlantic mackerel have also reached an excess of 50 % discard rate in some years of the period under study. Unfortunately the datasets do not contain information on size distribution, which makes it impossible to speculate on whether the discards were caused by MLS constrains, lack of quota or some other reason. If the main reason is MLS it is clear that considerable volumes of catches will be heading for production of products intended for non-human consumption once the LO has been implemented.

There are some seasonal variations in the total discards, but there are usually not extreme differences from one season to another, as can be seen in Figure 12 (STECF, 2014).

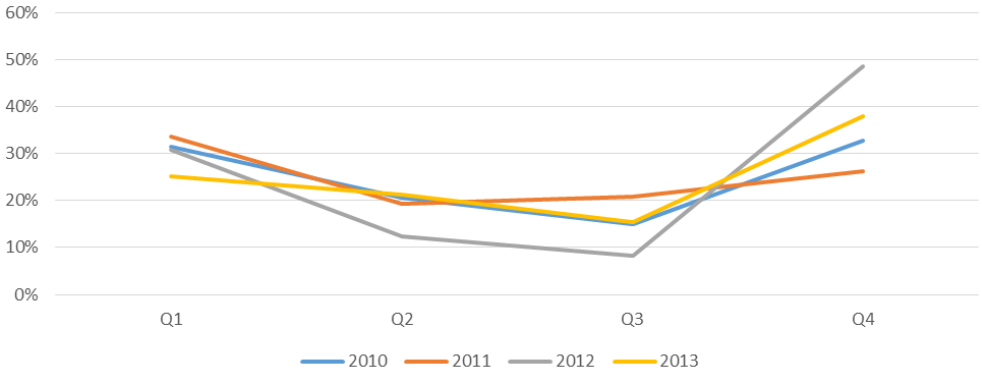

Figure 12: Seasonal changes of discard ratios of France vessels in the English Channel

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There are usually more discards in the beginning and end of year than in the middle of the year. In some years, like 2012 for example, there were considerable differences in total discards between the summer months and winter, with 50 % of the discards in the 4th quarter. When these seasonal variations in discards are explored by harbours, it can be seen that some harbours have majority of reported discards concentrated on just one quarter, as shown in Figure 13 (STECF, 2014).

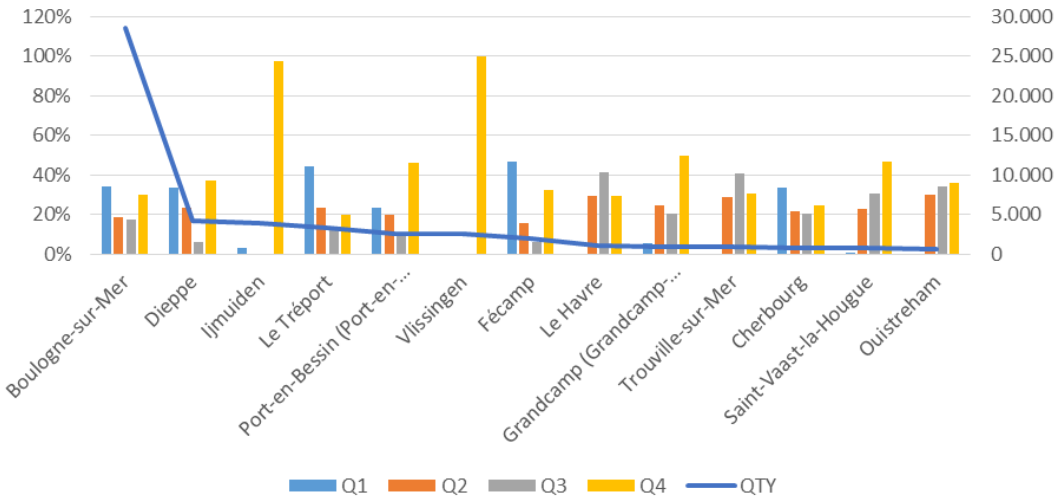

Figure 13: Seasonal variations % and total reported discards (ton) by landing harbours that have reported discards exceeding 500 tons during 2010-2013

The datasets analysed for this study covered 196 harbours in France, but reported discards in 170 of them amounted to less than 20 tons a year. Reported discards in excess of 1.000 tons a year came from eight harbours. It is therefore clear that large scale facilities for processing below MCRS catches for non-human consumption will have to be concentrated on few harbours and that catches will most likely have to be transported from other harbours to these locations. It might even be economically practical to concentrate all of the effort on that area, given that reported discard volumes in Boulogne-Sur-Mer were almost seven times higher than in the harbour with the second highest volumes (Dieppe) during the period 2010-2013.

2.3 North Sea case, Kattegat and Skagerrak – Danish fleet

This sub-chapter contains an analysis of discards reported by the Danish fleet in the North Sea, Kattegat and Skagerrak in 2014. The chapter also includes some numbers for the period 2010-2013 for confirmation that 2014 data is fairly representative for landings and discards over the past five years. The data shows that discards vary considerably between fleet types, target species, landing harbours and seasons.

Data were compiled by DTU Aqua for all trips landed by Danish vessels in any country. Discards were estimated for every trip based on the standard DCF procedures and prevalent sampling. Metier and landing harbour is known for each trip, so aggregation was made across all trips afterwards by month, area, DCF metier level 6 and harbour. It must be kept in mind in the following analysis that the spreading of discards across harbours is not based on true observations but is inferred from the spreading of landings across harbours.

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Much of the discards reported by Danish vessels are likely to be obligatory under MLS discards, which under the LO will have to be landed but not utilized for direct human consumption. This is likely to present a challenge when establishing incentives to follow the LO rules. It is clear that economic incentives are necessary in order to ensure widespread compliance amongst fishermen. It is therefore important, at this stage, to look at historic landing and discard data in order to understand which previously discarded catches are likely to be landed under the LO.

During the period 2010-2014 the total annual landings varied from little under 360 thousand tons to 640 thousand tons. At the same time the reported discards varied from 27 thousand tons to 47 thousand tons, representing 4,2-11,3 % discard rates. Nephrops (Norwegian lobster) accounted for 44-73 % of the total discards, as can be seen in Table 1.

Table 1: Total landings and discards reported by the Danish fleet in 2010-2014

Year	Total landings (ton)	Total discards (ton)	Discard rate	Landings Nephrops (ton)	Discards Nephrops (ton)	Nephrops discard rate	Nephrops % of total discards
2010	640.636	27.741	4,2 %	4.369	12.297	73,8 %	44,3 %
2011	557.347	38.478	6,5 %	3.768	18.235	82,9 %	47,4 %
2012	357.823	45.423	11,3 %	3.705	31.114	89,4 %	68,5 %
2013	519.848	47.385	8,4 %	3.032	34.340	91,9 %	72,5 %
2014	542.390	27.760	4,9 %	3.472	14.316	80,5 %	51,6 %

The high discard ratio in 2012 can partly be explained by relatively low landing volumes that year, but the figures for the other years seam rather consistent. The following analysis will therefore concentrate on 2014, under the assumption that landings and discards during that year were fairly representative for the past years and can give indications on likely future landings under LO.

In 2014, the Danish fleet landed 542.390 tonnes of catches and reported 27.760 tons of discards in total, which means that 4,9 % of total catches were discarded. The first thing one notices when looking at the discard data is that 51,6 % of the reported discards were Nephrops. Common dab was the second most discarded species, representing 12 % of total discards and European plaice came third at 7 %. There are twelve species that accounted for 95 % of the total discards of Danish vessels in 2014, as can be seen in Table 2 (STECF, Håkansson, & Ulrich, 2015).

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Table 2: Discards of Danish vessels in 2014 according to species

Species	Discarded		Landed	
	Ton	% of total discards	Ton	Species discard rate
Nephrops	14.316	51,6 %	3.472	80,5 %
Common Dab	3.395	12,2 %	976	77,7 %
European Plaice	1.870	6,7 %	19.838	8,6 %
Common Shrimp	1.578	5,7 %	3.104	33,7 %
Cod	1.428	5,1 %	9.274	13,3 %
Starry ray	1.107	4,0 %	0	100,0 %
European Flounder	631	2,3 %	2.142	22,7 %
Long-Rough Dab	472	1,7 %	256	64,9 %
Whiting	420	1,5 %	2.212	16,0 %
North Deepwater Prawn	392	1,4 %	2.474	13,7 %
Caridea shrimp	380	1,4 %	0	100,0 %
European hake	312	1,1 %	3.125	9,1 %
Other species	1.459	5,3 %	495.516	0,3 %
Total	**27.760**	**100,0 %**	**542.390**	**4,9 %**

As the Nephrops might be treated differently from the remaining UUC it will be given a special attention and not kept in the aggregated numbers in this analysis unless specifically stated.

2.3.1 Landing harbours

Danish vessels landed catches in 99 harbours in 2014, of which 72 were in Denmark and 27 in other countries. The overwhelming majority of the volume was landed in relatively few harbours, as 82 % of the total catches were landed in five harbours, as can be seen in Table 3 (STECF, Håkansson, & Ulrich, 2015).

Table 3: The main landing harbours in Denmark

Harbour	Total landings (ton)		Nephrops landings (ton)	
Thyborøn	184.218	34 %	145	4 %
Skagen	81.867	15 %	823	24 %
Hvide Sande	73.433	14 %	111	3 %
Hanstholm	66.662	12 %	375	11 %
Hirtshals	37.509	7 %	836	24 %
Other	98.702	18 %	1.181	34 %
Total	**542.390**	**100 %**	**3.472**	**100 %**

These five harbours did though only account for 35 % of the total discards, which can be partially explained by the fact that they do not include some of the main Nephrops landing harbours. When looking specifically the discards there are six harbours that stand out, accounting for 71 % of the total discards, as can be seen in Table 4 (STECF, Håkansson, & Ulrich, 2015).

 doi: 10.5281/zenodo.215293

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Table 4: Discards of Danish vessels in 2014 according to landing harbours

Harbour	Total discards (ton)		Nephrops discards (ton)	
Østerby, Læsø	3.723	13 %	2.992	21 %
Gilleleje	3.626	13 %	2.629	18 %
Grenaa	3.319	12 %	510	4 %
Hirtshals	3.297	12 %	1.840	13 %
Skagen	3.158	11 %	2.096	15 %
Strandby	2.700	10 %	1.924	13 %
Other	7.937	29 %	2.325	16 %
Total	**27.760**	**100 %**	**14.316**	**100 %**

The main landing harbours along with the harbours with the highest discard rates are shown on Figure 14.

Figure 14: Main landing harbours and harbours with highest discard rates

There are also seasonal fluctuations in discards, which are naturally highly connected to Nephrops catches, since almost 52 % of discards are Nephrops and that fishery is seasonal. This can be clearly seen in Figure 15 (STECF, Håkansson, & Ulrich, 2015).

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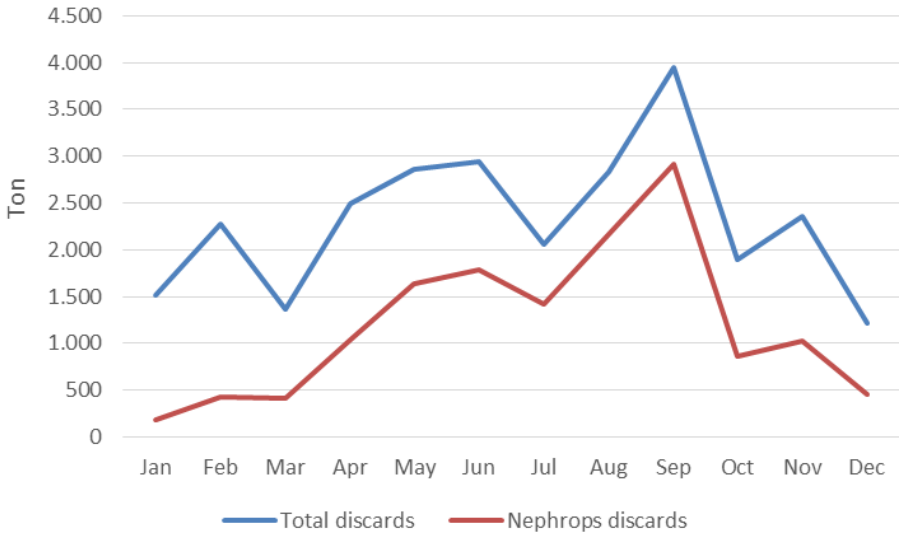

Figure 15: Discards of the Danish fleet in 2014 by month

Under the LO it is likely that utilisation of UUC of Nephrops will be different than of other species. It is therefore important to get indications of how landings of Nephrops and other species will develop under the LO. It is likely that distribution of landings of UUC of Nephrops will be concentrated on relatively few harbours and months, but that is discussed separately in chapter 2.3.2. Landings and discards of other species than Nephrops are likely to be distributed over many harbours and months, and will also include different combinations of species.

Looking at reported discards in 2014 according to individual harbours, it can be seen that discards in the most relevant harbours are dependent on seasons or months. Figure 16 shows the distribution within the year down to landing harbours, the graph shows landing sites where discards amounted to more than 100 tons in 2014, excluding Nephrops (STECF, Håkansson, & Ulrich, 2015).

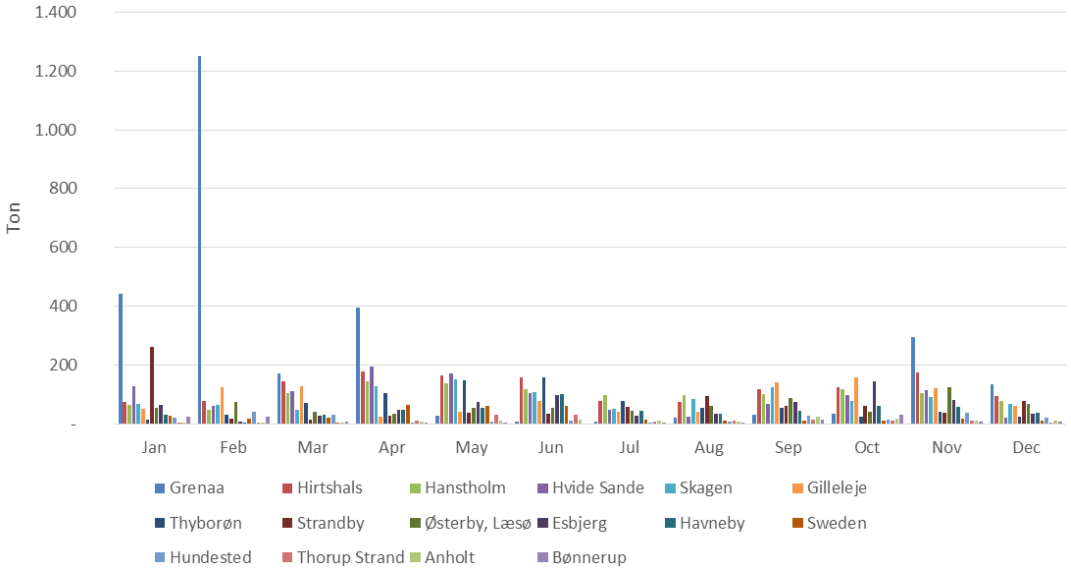

Figure 16: Harbours where Danish vessels reported discards in excess of 100 tons (excluding Nephrops) in 2014

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The discard numbers for Grenaa in February stand out, where 9,3 % of the total discards (excluding Nephrops) for the entire year, was reported in this one harbour in February alone. Explanations for this are hard to find, as the discarded volumes are comprised of common dab (37 %), Plaice (26 %) and European flounder (21 %). Grenaa did also report very high discards in January, April and November, as 85 % of the discards in Grenaa were reported in these four months. The discard figures for the other harbours are difficult to read into in Figure 16, because the discard numbers from Grenaa are so extreme in February. Figure 17 shows the same data as Figure 16, except that the Y-axis has been limited to 500 tons and harbours shown on the X-axis (STECF, Håkansson, & Ulrich, 2015).

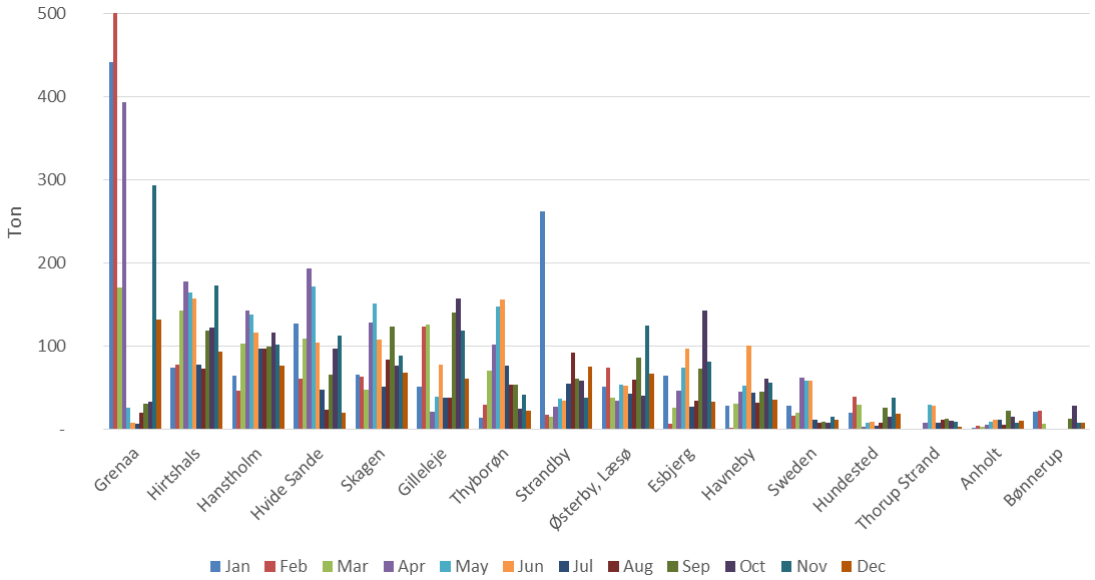

Figure 17: Harbours were Danish vessels reported discards in excess of 100 tons (excluding Nephrops) in 2014. Y-axes has been limited to 500 tons, but discards reported in Grenaa in February were 1.251 tons.

The Figure reveals that there are relatively few harbours that account for majority of discards and that discards are highly variable depending on seasons and months. This will present a challenge in developing production streams for UUC that require investments in technology and equipment. They will likely have to be strategically located in the most relevant parts of the country and will have to cope with large seasonal supplies; and then little or no supplies during other parts of the year.

Discards in the Danish fleet are generally lowest during the summer months, which is not in line with the total catch distribution. This can though be largely explained by the seasonality of pelagic fishery that counts for the vast majority of the Danish catch and has relatively low discard rates. The discard ratio of the demersal and flat fish species is also lower during the summer, further increasing this difference. This can be seen in Figure 18 (STECF, Håkansson, & Ulrich, 2015).

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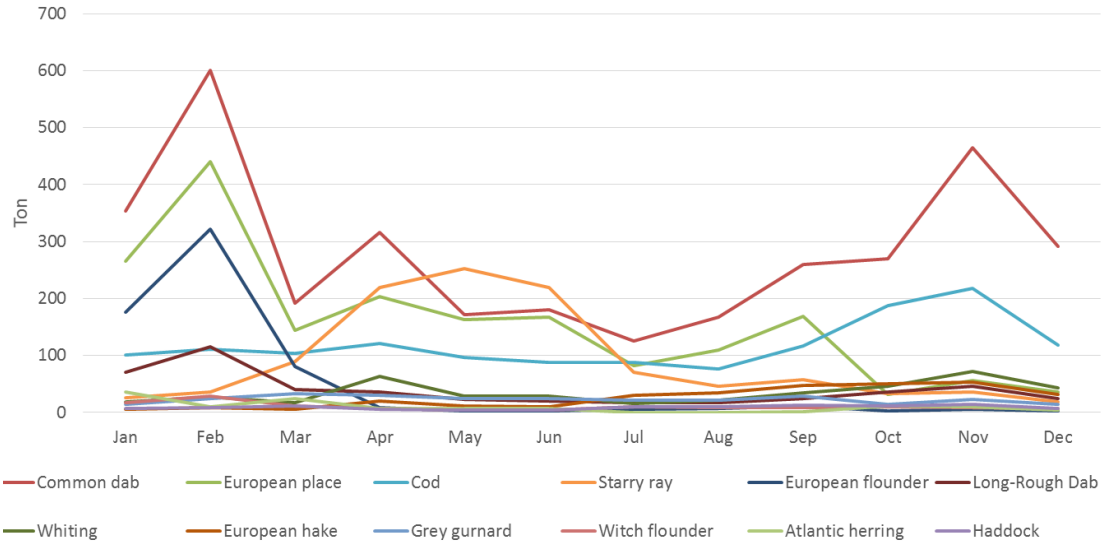

Figure 18: Monthly discards of the Danish fleet for round fish and flat fish species with more than 100 ton reported discards in 2014

It is apparent that there are very few species that will represent the vast majority of landings of UUC once the LO comes into force in Denmark. The reasons for the discards are not indicated in the available data, but the most likely explanations are catches under MLS and lack of quota. It is not going to be possible to use the catches under MLS (or more correctly MCRS) for direct human consumption, so new production streams will have to be developed for those catches.

2.3.2 Nephrops

When looking specifically at the Nephrops catches and discards it is interesting to see that discard ratios are high all year through, despite that catches (landings and discards combined) fluctuate considerably between months. Poor catches do therefore not result in significant reduction of discards, as can be seen in Figure 19 (STECF, Håkansson, & Ulrich, 2015).

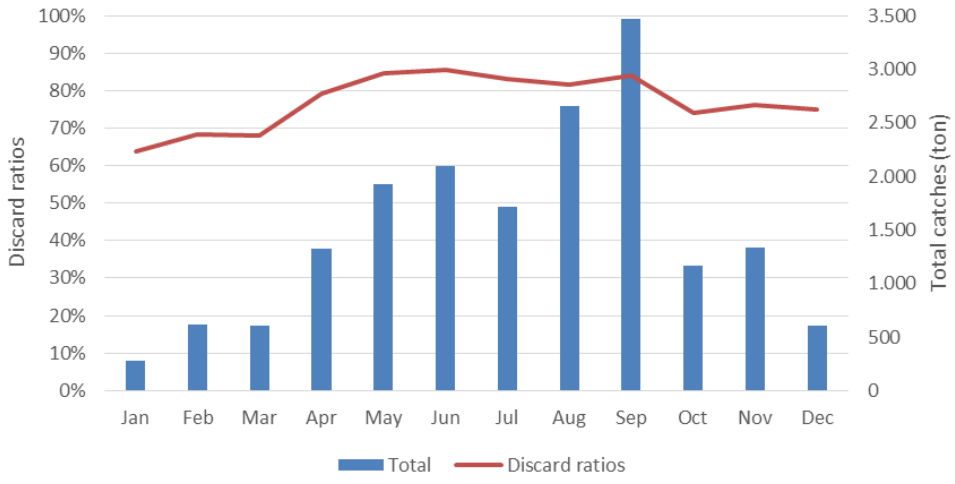

Figure 19: Catches and discard ratios of Nephrops by months in 2014

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There are however significant differences in discard rates depending on fishing grounds, where discards in the North Sea are very low, but extremely high in Kattegat and Skagerrak, as can be seen in Table 5 (STECF, Håkansson, & Ulrich, 2015).

Table 5: Discard rates be fishing grounds

Fishing grounds	Landings (t)	Discards (t)	Total catches (t)	Discard rates
Kattegat	973	10.433	11.406	91 %
North Sea	631	14	645	2 %
Skagerrak	1.868	3.869	5.737	67 %

This difference is largely explained by the difference in MLS between the two regions, which is currently 40 mm carapace length (CL) in the Skagerrak/Kattegat (Area IIIa) compared to 25 mm in the North Sea. As can be seen from Danish Sea sampling program data from 2013, most Nephrops discards in IIIa are between 25 and 40 mm, as shown in Figure 20.

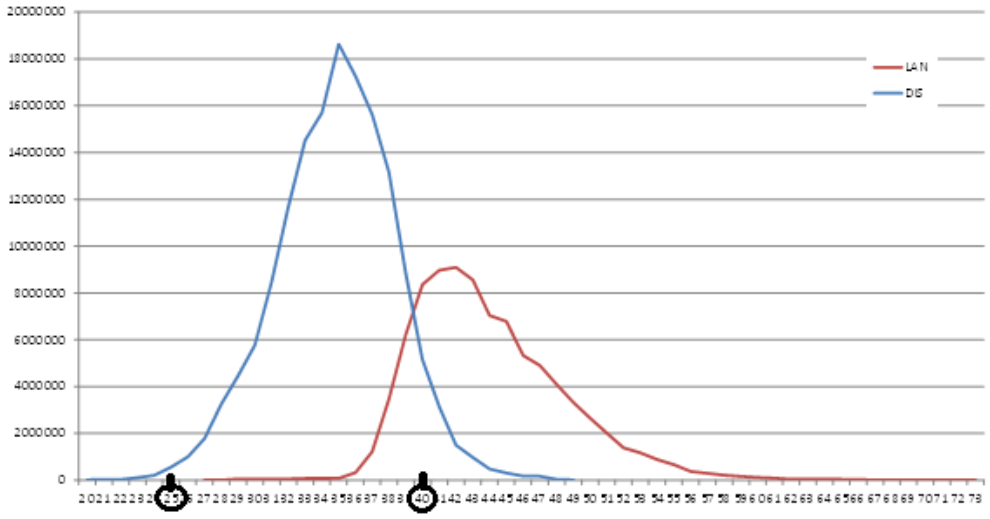

Figure 20: Nephrops carapace length distribution in Skagerrak/Kattegat (area IIIa) in the Danish sea sampling 2013. Number of samples landed and discarded

In 2016, the MLS (now called MCRS) has been reduced to 32 mm (105 mm total length), which will potentially give a major reduction in discards. Additionally, some exemptions for high survivability can be granted for this species, which will also reduce the issue of Nephrops UUC.

 doi: 10.5281/zenodo.215293

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2.4 Bay of Biscay

This sub-chapter contains an analysis of discards reported by the Spanish fleet fishing in the Bay of Biscay and landing catches in the Basque country 2005-2014.

The Bay of Biscay, together with the Iberian Atlantic coast, is a marine sub-region within the Atlantic Ocean ecoregion. It is included under the OSPAR Convention IV Region and includes several areas of the International Council for the Exploration of the Sea (ICES), such as VIIIa, b, c and d2. It is a deep sea area, reaching down to 5.000 meters, with a narrow continental shelf along the Spanish coast and a wider shelf along the French coast. It is a temperate sea, with high wave exposure, due to its long (>4.000 km) coastline. Figure 21 shows a map of the Bay of Biscay.

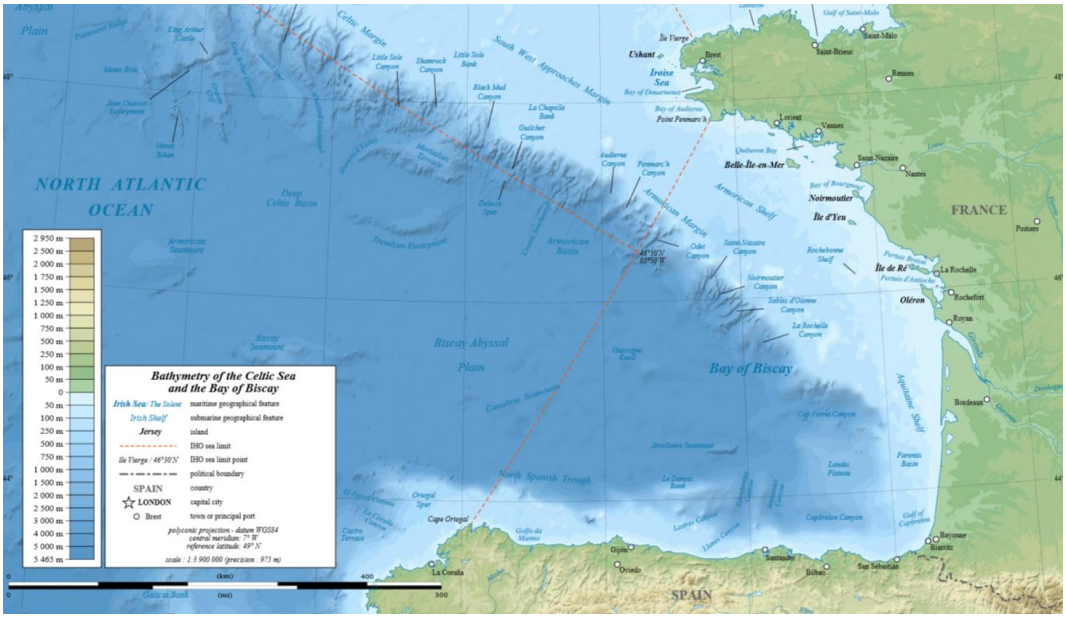

Figure 21: Bathymetric map of the Bay of Biscay and its surroundings

Following is a discussion on landings and reported discards in some of the main harbours around Bay of Biscay, which special focus on the Basque country.

2.4.1 Landing harbours

There are more than 20 fishing harbours in the Bay of Biscay area, which are distributed along the 4.000 km coastline, as shown in Figure 22.

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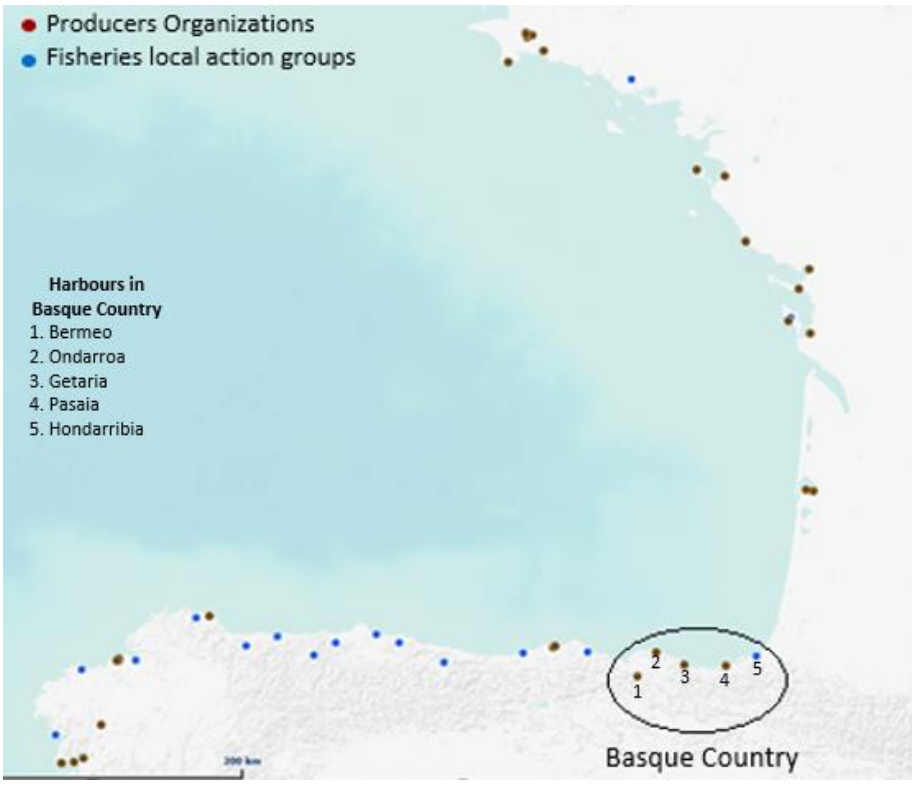

Figure 22: Fishing harbours along the Bay of Biscay

Landings in the Basque country harbours account for a significant part of the catches in the Bay of Biscay. Total landings in the eleven fishing harbours that are in the Basque country amounted to about 80 thousand tonnes in 2014, which represented 14 % of total landings in Spain that year (Eustat, 2015). Landing and discard data from the Basque country should therefore give a good representation of the likely landings of UUC in Bay of Biscay once the LO has been implemented.

There are eleven harbours in the Basque country, but more than 95 % of the total volume is landed in five harbours, as can be seen in Figure 23 (SDSP, 2015).

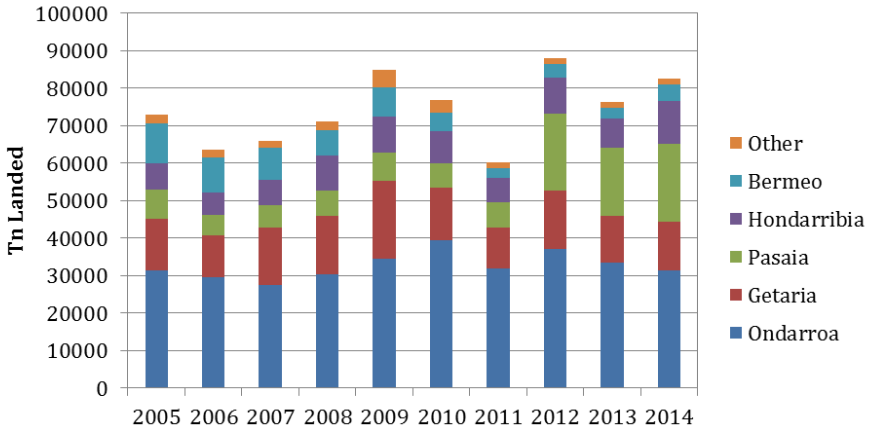

Figure 23: Distribution of yearly fish landings in the main ports of the Basque Country (ton)

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Furthermore, over 40 % of the catches and almost 100 % of the gears reporting discards land in a single port i.e. Ondarroa. Figure 24 shows species distribution in the port of Ondarroa, which shows that hake, mackerel and horse mackerel are the three main species, representing close to 50 % of landed volume (SDSP, 2015).

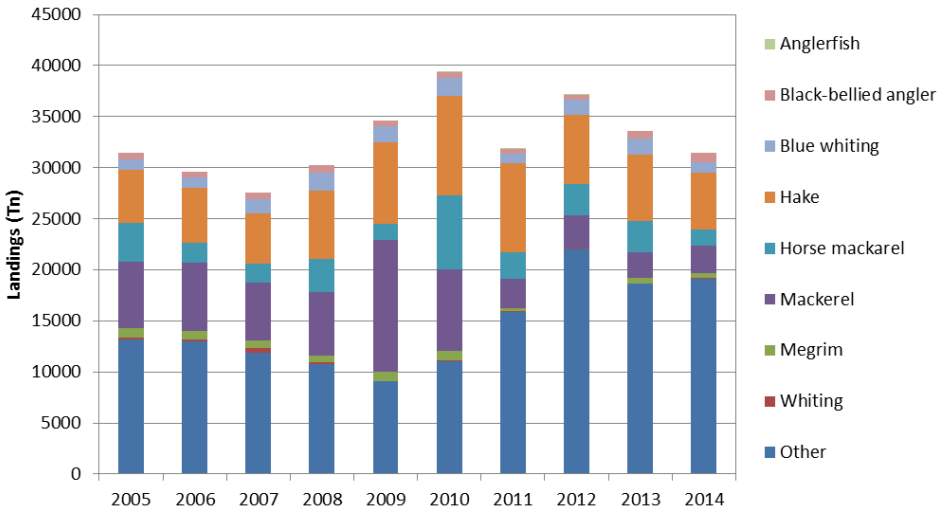

Figure 24: Species distribution of landings in the port of Ondarroa 2005-2014

The metiers that report discards in the port of Ondarroa are pair trawlers (PTB), bottom otter trawlers targeting demersal species (OTD) and bottom otter trawlers targeting mixed species (OTM). These gears represent 40-60 % of the total landings, with a decreasing trend in recent years, as shown in Figure 25 (SDSP, 2015).

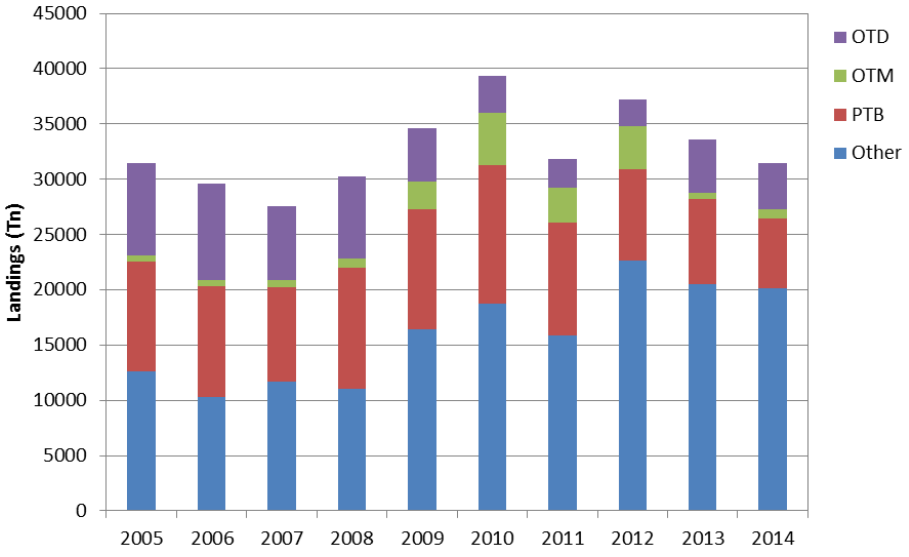

Figure 25: Distribution of gear landings in the port of Ondarroa 2005-2014

There is considerable seasonal variations in landings in the port of Ondarroa depending on fishing gear, as shown in Figure 26 (SDSP, 2015).

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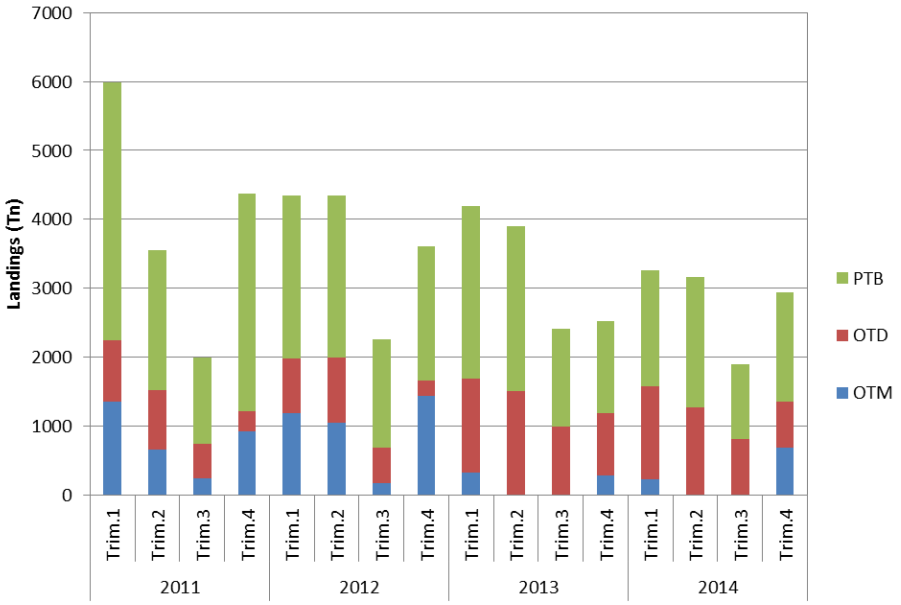

Figure 26: Distribution of fish landings in the port of Ondarroa by gear 2011-2014

It is clear that pair trawlers are the most important fleet for this particular harbour and that it is highly active during all parts of the year. The otter trawl fleets do on the other hand have months where catches are little or none at all.

Landings by the pair trawlers in the port of Ondarroa consist mainly of hake, mackerel and blue whiting. Landings are relatively evenly spread out within each year, except that catches usually decline a bit during the third quarter, as can be seen in Figure 27 (SDSP, 2015).

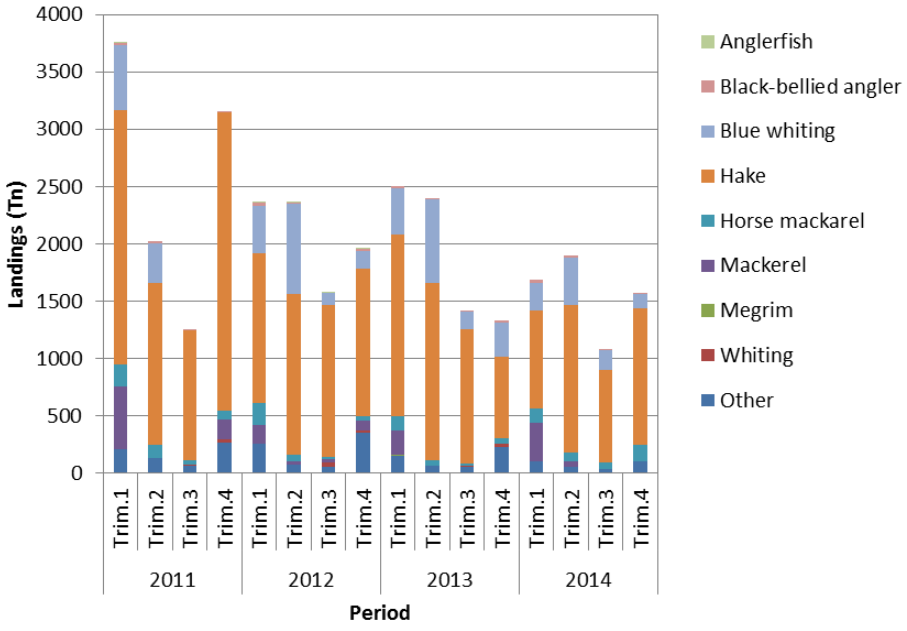

Figure 27: Landings of the PTB fleet in the port of Ondarroa in 2011-2014, distributed by species and seasons (yearly quarters)

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Landings by the bottom otter trawlers targeting demersal species in the port of Ondarroa include a large variety of species, where hake and black-bellied angler are the most important species. Landings can be highly variable between seasons (yearly quarters), as can be seen in Figure 28 (SDSP, 2015).

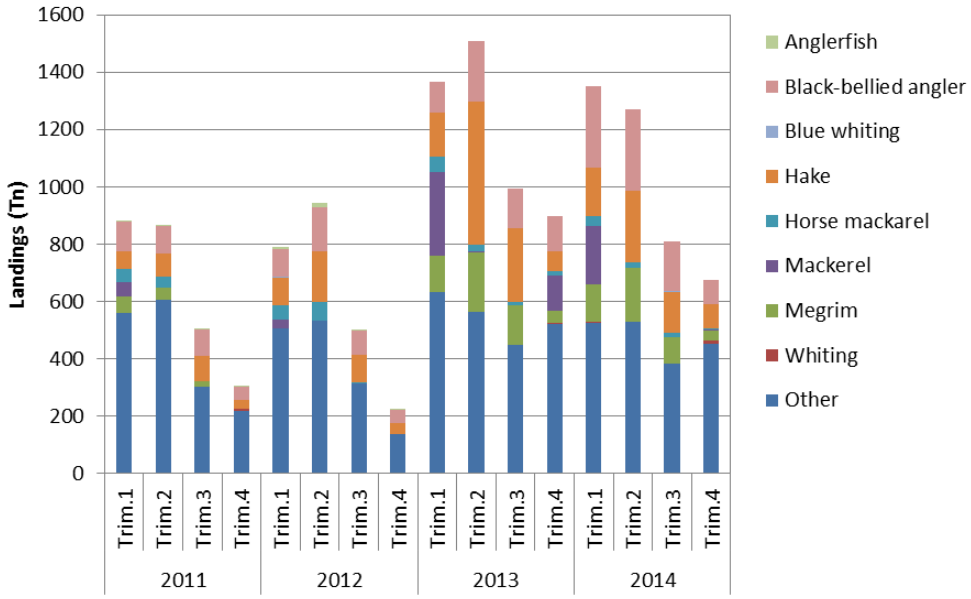

Figure 28: Landings of the OTD fleet in the port of Ondarroa in 2011-2014, distributed by species and seasons (yearly quarters)

Landings by the bottom otter trawlers targeting mixed species in the port of Ondarroa include also a large variety of species, where fluctuations between years can be enormous. Landings of this fleet have were almost non-existent in 2013 and 2014, as can be seen in Figure 29 (SDSP, 2015).

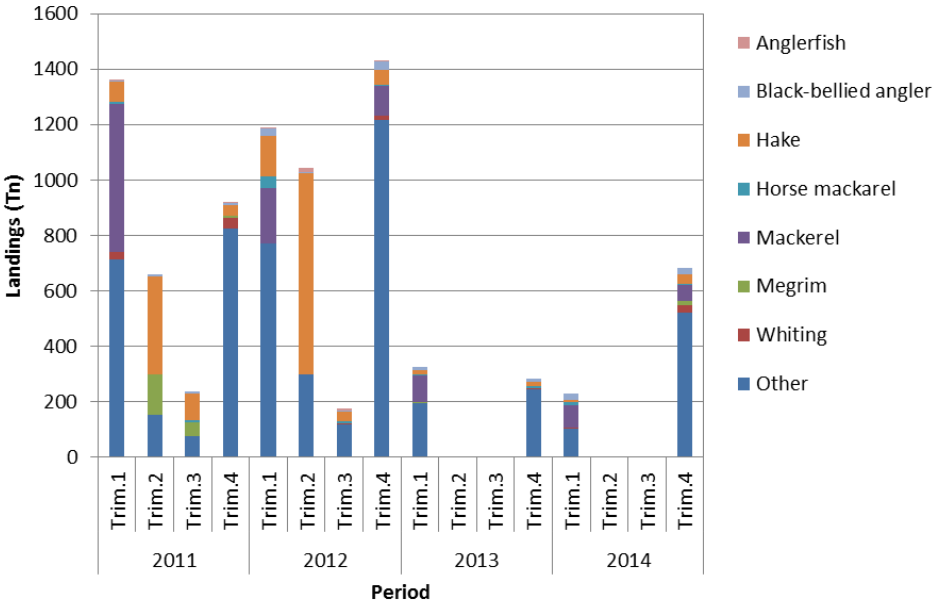

Figure 29: Distribution of fish landings species in the port of Ondarroa for OTM gear.

 doi: 10.5281/zenodo.215293

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These data, correlated with the discard ratios for each trimester, gear and ICSE fisheries zone can be used to estimate future UUC landings under the LO.

2.4.2 Discards of the Basque Country

The metiers that report discards in the Basque country are PTB, OTD and OTM fleets. Close to 60 % of all landings of these metiers are in the port of Ondarroa and they fish in ICES zones VIIIab&d. By comparing landing statistics and the official Spanish discard ratios, collected by on-board observers under the Spanish Discard Sampling Program that is funded under the Data Collection Framework, it is possible to estimate what UUC will be landed once the LO is implemented.

Discard ratios of the PTB fleet in the Bay of Biscay vary significantly between species and years, as can be seen in Table 6 (SDSP, 2015).

Table 6: Discard ratios of the Spanish pair bottom trawl fleet (PTB) in the Bay of Biscay 2011-2013

Species	2011	2012	2013
Anglerfish	0 %	0 %	0 %
Black-bellied angler	1 %	0 %	0 %
Blue whiting	8 %	88 %	39 %
Hake	1 %	5 %	6 %
Horse mackerel	53 %	82 %	85 %
Mackerel	55 %	51 %	15 %
Whiting	0 %	0 %	0 %

As shown in Figure 26 the majority of the landings of the PTB fleet in the port of Ondarroa consist of hake, blue whiting and mackerel. Annual landings of hake have been 4-6 thousand tonnes in recent years, which have distributed relatively evenly by yearly quarters. It could therefore be expected that UUC of hake landed in the harbour of Ondarroa will be close to 250 tonnes (5 % of 5.000 tonnes) once the LO is implemented. It is much more difficult to estimate likely landings of blue whiting and mackerel, as well as most other species, as annual landings and yearly discard rates vary significantly between years. Landings of UUC of blue whiting and mackerel could potentially fluctuate from being just few tonnes a year, to being close to 2.000 tonnes of blue whiting and 250 tonnes of mackerel as reported discards in 2012.

The landings and associated discards of UUC of the OTD fleet for the past few years suggest that landings of previously discarded catches under LO will consist of many species and low volumes of each specie. The OTD fleet has extremely high discard rates in some species and considerable variations between years, as shown in Table 7 (SDSP, 2015).

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Table 7: Discard ratios of the Spanish bottom otter trawlers targeting demersal species fleet (OTD) in the Bay of Biscay 2011-2013

Species	2011	2012	2013
Anglerfish	3 %	0 %	2 %
Black-bellied angler	5 %	2 %	3 %
Blue whiting	98 %	95 %	99 %
Hake	65 %	27 %	39 %
Horse mackerel	94 %	84 %	87 %
Mackerel	99 %	80 %	99 %
Megrim	4 %	1 %	3 %

As shown in Figure 27 the landings of the OTD fleet in Ondarroa comprises of many species. The species with the most volume are black-bellied angler, hake, megrim and mackerel. Discard rates for the black-bellied angler and megrim hare low, which indicates that there will not be significant changes in landings of these species under the LO. Hake and mackerel have on the other hand quite high discard rates, suggesting that annual landings of UUC once the LO has been implemented could reach 300-500 tons of hake and up to 300 tons of mackerel per year. It is though very difficult to predict on this, given the variability in catches and official discard rates for the past few years. The share number of species will also present challenges, as it is evident that landings of UUC under the LO will largely consist of low volumes of many species.

The OTM fleet has similarities with the OTD fleet that its catches comprise of many species and high discard rates for some UUC, as shown in Table 8 (SDSP, 2015).

Table 8: Discard ratios of the Spanish bottom otter trawlers targeting mixed species fleet (OTM) in the Bay of Biscay 2011-2013

Species	2011	2012	2013
Anglerfish	0 %	1 %	1 %
Black-bellied angler	30 %	2 %	0 %
Blue whiting	100 %	98 %	-
Hake	65 %	74 %	77 %
Horse mackerel	100 %	96 %	98 %
Mackerel	97 %	99 %	100 %
Megrim	3 %	-	0 %

As shown in Figure 28 the Ondorroa OTM fleets catches comprise of extremely many species and there were no particular species that contributed significantly to the landings of this fleet in 2013 and 2014. In 2011 and 2012 on the other hand, both hake and mackerel stood out in the landings of the OTM fleet. Both of these species have high discard rates, suggesting that landings of these species could be significant once the LO is implemented. The inconsistency in catches of this fleet make it however very difficult to estimate any volumes.

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The official discard rates for the Bay of Biscay are similar to other discard rates published by the IOE (Spanish Institute of Oceanography), which suggests that the Bay of Biscay and the Basque Country is representative for likely developments in the whole of Spain once the LO is implemented (Valeiras, Pérez, Araujo, Salinas, & Bellido, 2014).

The main reasons for discarding are generally because of either catches below MLS or lack of quota. 88 % of the PTD fleets discards of hake are for example because of MLS and 82 % of the discards of megrim by the otter trawl fleets are because of MLS (Valeiras, Pérez, Araujo, Salinas, & Bellido, 2014).

Estimating likely supplies of UUC in the Bay of Biscay once the LO is implemented is extremely difficult, due to the variability between years and fleets, as well as the extreme number of species. Focusing at the landings in the Basque country it is evident that only few harbours have enough volume to justify significant investments in production facilities for UUC. Much of the UUC that will be landed will be below MCRS, which will require special production streams that produce products that are not intended for direct human consumption. How that will be tackled will be a particular challenge since it is so difficult to estimate likely volumes with any accuracy.

2.5 Iceland

Iceland differs from other case studies in this document in the respect that a landing obligation has been in place there since 1997 (EC, 2007). It has gone through some changes and adaptions as management strategies have progressed from effort- to quota restrictions (Johnsen & Eliasen, 2011). The coverage of the discard ban has also gradually expanded, applying to more and more species. Today it applies to all significant commercial species. Catches that marginally exceed quotas can be legally landed by using quotas for the following year, as there is a built-in flexibility in the ITQ system that permits 5 % of the quota to be transferred between years. Alternatively, fishers can land up to 5 % of catches without deducting it from quota, but will then have to forfeit majority of the catch value. The vessel then receives 20 % of the value and 80 % is allocated to fisheries research funds (Directorate of fisheries, 2015). In 2014 these landings amounted to little over 2.000 tonnes in total. Fishermen are also allowed to land catches below MCRS and to count them only 50 % against quota. There is therefore an incentive for them to land the UUC. In 2014 these landings amounted to 1.350 tons.

Larger overruns and non-target catch can be covered through the purchase of additional quota. Failure to cover non-mandated catch with allowed overages or purchased quota can result in the revoking of fishing licences and fines (Sanchirico, Holland, Quigley, & Fina, 2006).

The capture of juvenile fish is discouraged through immediate area closures if MCRS exceeds proscribed limits (Johnsen & Eliasen, 2011). Non-compliance can lead to revoking of fishing licences, fines or even jail sentences. Catches are monitored onshore by the Directorate of Fisheries, as well as on-board with observers. The coastguard does also inspect vessels, to make sure that catches are reported correctly. Comparisons with catch compositions and length distributions are also used to monitor potential discards. Despite a policy of mandatory landings, discarding still occurs but has gradually declined since the early 1990s. According to annual estimations of the Marine Research

 doi: 10.5281/zenodo.215293

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Institute, haddock discard rates have fallen from 4,36 % in 2003 to 0,12 % in 2013, whilst cod discard rates have not exceeded 2 % since 2001 and represented 0,60 % in 2013 (Palsson, Bjornsson, Gudmundsson, & Ottesen, 2015).

The reliability of the discard estimates made annually by the Marine Research Institute can to a point be questioned. Discards are illegal and fishermen are therefore not going to admit to discarding or provide any documentation on such activities. The estimations are therefore based on calculations that partly rely on observations and sampling. The observations and sampling suggest that the main reasons for discards are related to size i.e. discarding of juvenile fish that is of low commercial value. The discard calculations by the marine Research Institute assume therefore that only juvenile fish are discarded. The general opinion of most stakeholders today is that the estimations are relatively reliable. Figure 30 shows the discard rates for cod and haddock 2001-2013 (Palsson, Bjornsson, Gudmundsson, & Ottesen, 2015).

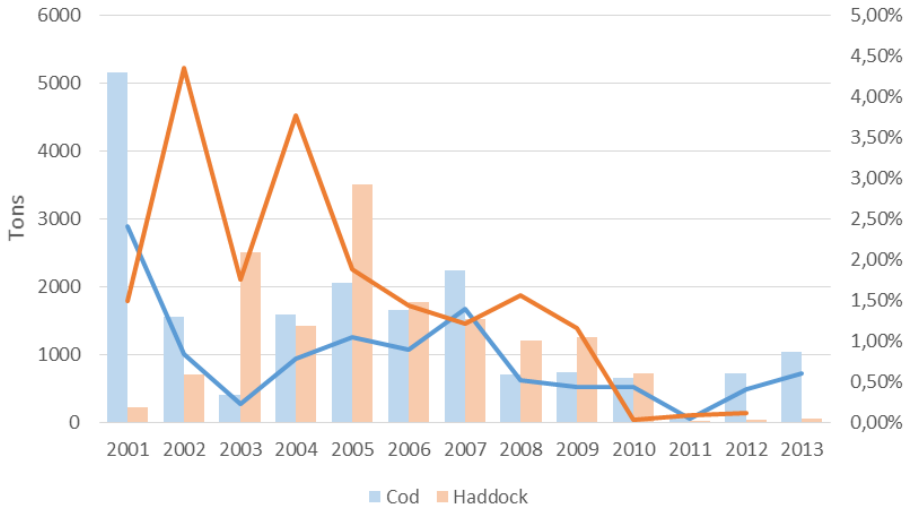

Figure 30: Estimated amount of discarded cod and haddock in Icelandic waters from 2011-2013. The bars show the amount in tons and the lines show the discard rates (discarded fish/total landings).

An important factor in reducing discards in the Icelandic fleet is the extensive consolidation that has occurred over the past 20-30 years in the sector. This consolidation is one of the side-effects of the ITQ system, as smaller businesses that are not able to return healthy profits merge (or are bought up) with larger entities that benefit from economies of scale and better access to capital. Small companies operating with limited quotas, where the owners are working on-board the vessels or in very close personal collaboration with the crew, have almost completely gone out of business. In 1992 the ten largest quota holders owned 24 % of the overall quotas, but in 2014 that proportion had risen to 52 %; today the twenty largest quota holders own 72 % of the quota and the fifty largest own 87 % (Íslandsbanki, 2014). At the same time the number of fishermen has reduced by 35 % as the vessels have become fewer, better equipped and having adequate quotas to be operated at full force all year round. The primary incentives for discarding have therefore been removed. The fishermen working for big seafood companies that possess adequate quotas have no good reasons to discard catches; as it would mean that they would be throwing away part of their income.

 doi: 10.5281/zenodo.215293

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All of the biggest quota holders are large integrated seafood companies that include the catching, processing and marketing links in the value chain. The consolidation means that the processing and marketing is secured more raw material and constant supply all year round. This makes it possible to invest in expensive processing technology and gives competitive advantage at important markets.

Figure 31 shows the estimated discards of haddock from 1988 to 2000 (Pálsson, 2003). The graph displays how the implementation of the ITQ system had a bad effect on discards i.e. the system was fully in place in 1991. It was not until almost a decade later that discards really started to decrease, due to the aforementioned consolidation of quotas and other adjustments in the system, such as a regulation on minimum mesh size that was changed in 1998 (77/1998).

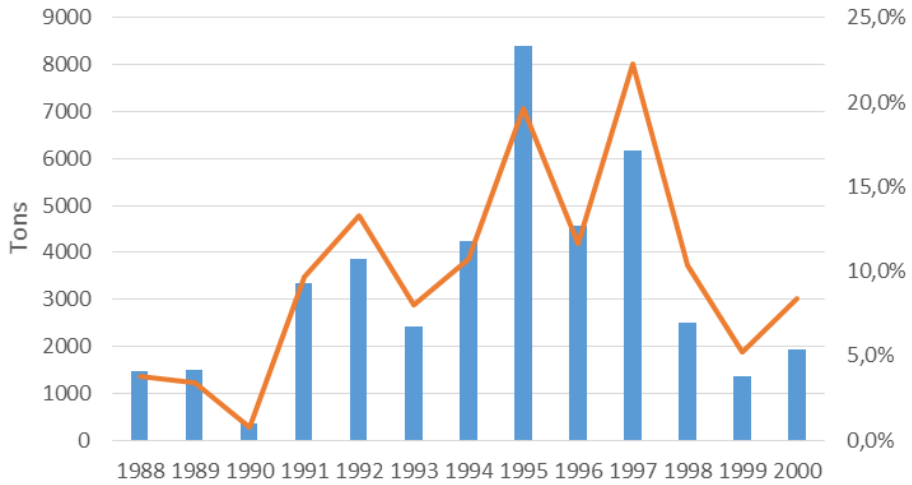

Figure 31: Estimated amount of haddock discards in Icelandic waters from 1988-2000. The bars show the amount in tons discarded and the line show the discard rates

This consolidation is a development that will most certainly continue, as larger companies will become even larger, investing in more efficient vessels, processing technology and more quota share. Recent governmental taxes in the form of a significantly burdening resource rent will only speed up this development, as small operations will not have the operational margin to pay the resource rent.

The Icelandic fishery has developed in such a way that today there are not really any catches that can be defined as UUC. This is however a development that has taken thirty years to gradually improve. When the LO was first implemented in the Icelandic fishery there were significant discards in place, but with a number of concurrent actions and a change in mentality the sector has progressed so that today all catches are regarded as raw material for valuable products. The ITQ system has played the most important part in this progress, as incentives for discarding have been removed and efforts placed on developing products from all catches. The results are that today there are no unwanted catches in Icelandic waters.

A more detailed description of the use of waste products in the Icelandic fisheries is also to be found in DiscardLess D5.1

 doi: 10.5281/zenodo.215293

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2.6 Summary of spatial and temporal distribution of estimated UUC in the selected case studies

Estimating likely spatial and temporal distribution of UUC that will be landed once the LO has been implemented is a difficult task. Basing estimations on future landings on past discards under a regime that obligated fishermen to discard UUC cannot realistically take into consideration changes in behaviour of fishermen that inevitably will occur. Once the LO is implemented the fishermen will change their practises, for example by avoiding areas with high volumes of UUC or by applying more selective fishing gear. The historic discard data can however give some indications on what UUC are likely to be landed in certain areas, as well as when and by which fleets. The case studies discussed in this chapter have focused on doing just that.

The West Mediterranean bottom trawl case has identified that the main challenge once the LO is implemented will be landings of European hake and horse mackerel below MCRS, which cannot be used for direct human consumption. Reported annual discards of horse mackerel below MLS by this fleet have reached up to 70 thousand tonnes in recent years and reported discards of hake below MLS have reached 35 thousand tonnes. This is only reported discards by the bottom trawl fleet landing in Mallorca, but there are of course other fleets that are landing catches in Mallorca. Regardless of how changes in behaviour of fishermen will affect landings of the fleet once the LO is implemented, it is safe to assume that significant volumes of hake and horse mackerel that cannot be used for human consumption will be landed in Mallorca once the LO has been implemented. Considerable volumes of horse mackerel above MCRS have been discarded in the past, but these supplies will not present a major problem under the discard ban, as they can simply supply already available production streams.

Reported discards of the French fleet fishing in the English Channel have fluctuated considerably over the past decade, from being almost non-existent in 2005 to almost 20 thousand tonnes in 2012. There are a few species that stand out with respect to reported discards, with whiting, common dab, Atlantic herring, European Plaice and scallop representing 80 % of the discards 2010-2013. Boulogne-Sur-Mer stands out when looking at where landings associated with discards are reported, representing around 50 % of the total discard amounts that could potentially be landed there. The rest of the 170 harbours are far behind when looking at potential discard volumes, where the harbour with the second highest potential discard volumes represents 7 % of the discards. There are some seasonal variations in the discards, as the volumes have been highest in the first and last quarter of the year. These variations depend largely on the seasonal nature of what species are being targeted, which subsequently has considerable effects on reported discards in some of the harbours i.e. fleets in some of the French harbours are mainly targeting specific species. The datasets analysed do not give information on whether discards have been obligatory MLS discards or not, which makes it difficult to estimate what parts of the UUC that will be landed once the LO is implemented will need to be used for production of products intended for non-human consumption. It is however evident that investment in large scale facilities for processing catches below MCRS for non-human consumption will be concentrated on relatively few harbours, simply because most harbours lack critical mass. Catches below MCRS will most likely have to be transported between harbours and it might even be economically practical to concentrate all of the efforts on the vicinity of Boulogne-Sur-Mer, given that potential discard volumes there exceed the second largest discard harbour sevenfold.

 doi: 10.5281/zenodo.215293

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Reported annual discards of the Danish fleet have varied from 27 to 47 thousand tonnes in recent years, representing 4-11 % discard rate, where Nephrops have accounted for ½ - ¾ of the discards. Other species with significant volumes of reported discards are dab, plaice, shrimp, cod and rays. Discards of dab are around three thousand tonnes a year and discards of the other four species are between one and two thousand tonnes a year, but discards of other species are much lower. The Nephrops discards have been high because of a high MLS in place in Skagerrak and Kattegat. This MLS has been reduced in 2016 with the introduction of the LO, so it is expected that discard quantities will reduce significantly. Additionally, some exemptions for high survivability can be granted for this species, which will also reduce the issue of Nephrops UUC. Making a valuable products out of previously discarded Nephrops will though be challenging, given that the main reasons for discarding Nephrops are small size, broken shell, moulting/soft shell and females with eggs. The below MCRS catches will particularly present a challenge, as such materials it will have to be utilised for non-human consumption. It is not unlikely that solutions for the production of crustaceans for non-human consumption will be different from solutions for roundfish and flatfish species.

There are a handful of harbours that stand out in regards to where the potential discards associated to landings are reported, with the six main harbours representing over 70 % of the potential discards. These harbours are distributed all over Denmark, which will most likely present a challenge when developing solutions for production of products for non-human consumption, as transportation can be difficult. Denmark is on the other hand not a big country and transport within Jutland for example will be relatively simple.

Reported annual landings of the Spanish fleet landing in the Basque country have been around 80 thousand tonnes for the past decade. Significant parts of these catches are coming from the Bay of Biscay. The landing and discard volumes are extremely variable between years, seasons and fleet types, which makes it difficult to predict future landings of UUC when LO comes into effect. The species that represent majority of discards are Horse mackerel, mackerel, blue whiting, hake and whiting. The available data does not give any indications of what the incentives for discarding are, but MLS is the most logical explanation. Harbours with significant landing volumes in the Basque county are few and fairly close to one another. Common facilities for utilising below MCRS catches could therefore be an applicable solution.

Iceland provides an example of where LO has been in effect for decades. Discards today are minor, but that is the results of a long process where many variable factors have contributed to a successful development. The ITQ system, integration of the value chains, consolidation in the industry and negative public opinion of discards play an important role, but an important factor is also that all catches are used for producing as much value as possible i.e. there are no constrains on utilising below MCRS catches for non-human consumption (See further discussion in D.5.1).

 doi: 10.5281/zenodo.215293

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3 Description of Infrastructures at ports in selected case studies

This chapter presents information about existing facilities at harbours in selected case studies i.e. Bay of Biscay - Basque country, Denmark and Iceland. The aim is to identify relevant infrastructure that can potentially contribute to utilising and managing UUC once the LO has been implemented. The selection of the case studies are intended to provide a cross-section of harbours in southern- and northern Europe, as well as in a country with already implemented LO.

3.1 Bay of Biscay – Basque country

A technological surveillance centralised in the Basque Country and neighbouring provinces has been the basis of this study, together with visits to the most representative companies. The information on the different infrastructures will be associated with a geographic information system (GIS) that will later serve to design strategic maps of recovery for relevant companies.

In the Basque Country, there are eleven fishing ports, but more than 90 % of the landings are accounted in five harbours i.e. Ondarroa, Getaria, Hondarribia, Bermeo and Pasaia (Red marks in Figure 32). The main processing facilities are however not necessarily located in those five harbours. The current processors are likely to be the receivers and transformers of the UUC that will be landed once the LO is implemented. These are for example Fishermen´s Organisation, Fish Wholesale markets, Arrancoba S.C.L. and Bermeo freezer Plant. Other potential recipients of previously discarded catches for initial processing can be companies such as Angulas Aguinaga S.A., Ondarroa Project S.A. (POSA), SAU Bakaladera, and BARNA S.A. The fishing harbours and main processing facilities in the Basque country are shown in Figure 32.

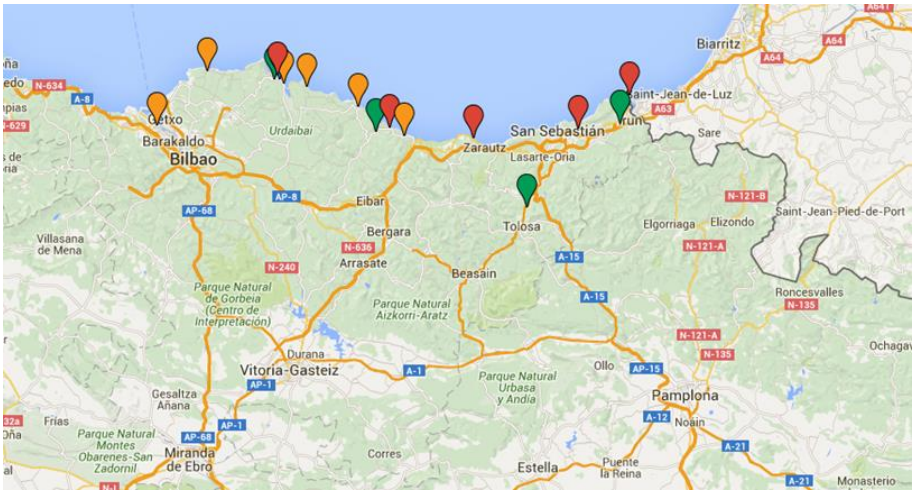

Figure 32: Map with fishing ports (Red and Orange marks) and processing facilities (Green and Blue marks) in the Basque Country

The available landing data suggests that current capacity in the Basque country harbours can handle more than twice the average amount of fish landed there in recent years, as shown in Table 9. Lack of space, facilities or management problems are therefore not foreseen with increased landings due to the implementation of the LO.

 doi: 10.5281/zenodo.215293

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Table 9: Daily management capacity of the main fishing harbours of the Basque Country (data from 2005-2014)

Harbour	Max. Landed in a single day (Ton)	Average Value Landed per day (Ton)	STDEV of Value Landed per day (Ton)
Bermeo	377	29	59
Getaria	879	86	139
Hondarribia	475	51	79
Ondarroa	282	126	115
Pasaia	330	42	47

A different problem may arise with the management of UUC in ports, as the handling need to meet the legal requirements. Separated channels will for example have to be set up for fish under MCRS, as those materials will not be allowed as raw material for products intended for direct human consumption. For that reason have the infrastructures of each major harbour in the Basque country been evaluated.

3.1.1 Ondarroa

The port of Ondarroa receives over 30.000 tons of fish annually, making it the biggest harbour in the area. Hake, mackerel and horse mackerel are the most important species by volume, but landings include an extreme number of different species that will make it challenging to cope with sudden increase in landings when the LO will be implemented. Figure 33 shows the port of Ondarroa and the main processing facilities.

Figure 33: Map of Ondarroa's port. Green zones are freezing facilities and cold storage rooms. Orange zones are ambient temperature storage facilities.

 doi: 10.5281/zenodo.215293

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The existing facilities in Ondarroa fishing port will potentially be used for utilising UUC, redistribution of raw materials, monitoring, control and surveillance. The implementation of the LO will though possibly require that additional infrastructure will be set up. The currently available alternatives are:

Ondarroa Fishermen´s Organisation:

- It includes a fish exhibition area of 18 m x 12 m without any cooling system.
- This facility is not suitable for management, storage and process UUC.

Fish Wholesale markets[2]:

- Throughout the fishing port, there are several small facilities about 5m x 15m belonging to ship-owners where they can exhibit and sell their fishes. They usually include a small cooling room (< 0-5° C) where they can storage the fish for 1-2 days until they sell them.
- These facilities are not suitable for management, storage or processing of UUC.

Arrancoba S.C.L.:

- This facility is owned by the Ondarroa and Lekeitio´s Fishermen´s Organization. It includes several rooms where they storage and process fish:
  - A cooling room (< 0-5 °C) of 10 m x 10 m x 6m for storing fish.
  - A freezing tunnel (< -20 °C) with a frozen capacity of 50 tons per day.
  - A freezing room (< - 20 °C) with a storage capacity of 500-600 tones.
  - In addition, there is a size sorting machine that can be used to classify discards by size.
  - This facility can be suitable for management, storage and processing of UUC.

BARNA´s fish by-products cooling room:

- The fish meal producer BARNA has a cold storage room of 1 m x 6 m where ship-owners can storage fish by-products. Once this room is full of by-products, BARNA picks them up and produces fish meal.
- This facility can be suitable for management, storage and processing of UUC.

Ice factory:

- There is an ice factory in the port of Ondarroa that produces ice that can be used to chill and maintain quality of UUC during storage.

The above shows that the port of Ondarroa has a relatively good infrastructure to cope with increased and different supplies of raw materials associated with the implementation of the LO. There will though most certainly have to be added to these facilities and new production streams developed once the LO comes into force.

[2] http://www.arrankoba.com/ingles/

 doi: 10.5281/zenodo.215293

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3.1.2 Pasaia

The Pasaia port is a great fishing port, where both its own fleet and fleets from other harbours find the appropriate resources to land and market their catches. Since 2012 the annual landings have been around 20.000 tonnes, making it the second biggest harbour in the area. It has two landing zones, which amongst other things includes a fishmarket that is located in a 12.380 m^2 (two storage) building and an ice making factory. The port of Pasaia is shown in Figure 34.

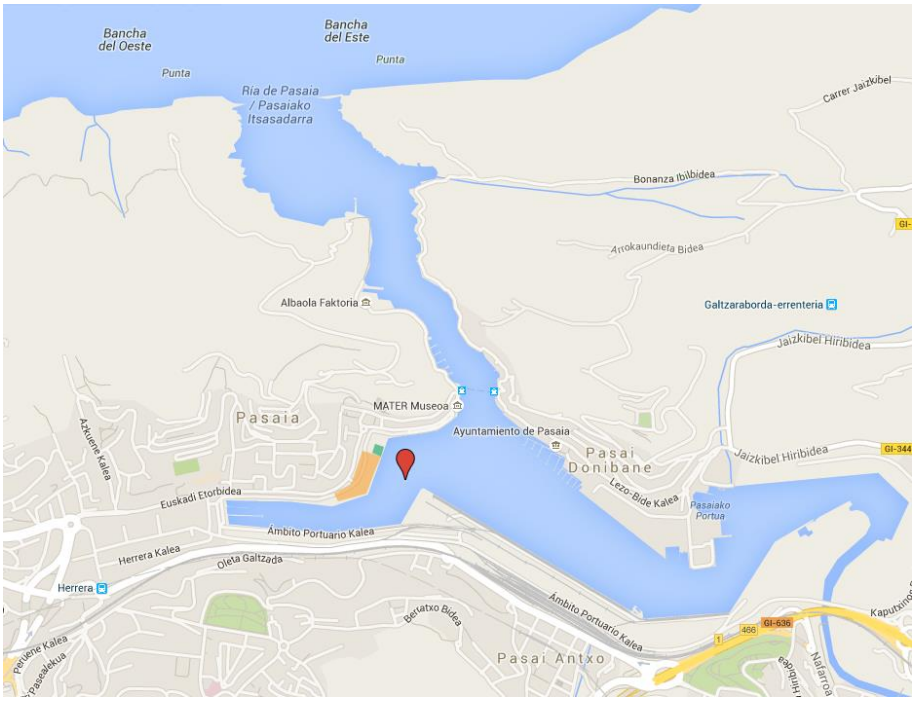

Figure 34: Map of Pasaia's port. Green zones are freezing facilities and cold storage rooms. Orange zones are ambient temperature storage facilities.

The existing facilities in the harbour of Pasaia that can potentially be used for receiving, redistributing, processing and managing UUC once the LO is implemented are as follows:

- Pasaia Offshore fleet Fishermen´s Organisation:
  - This infrastructure is under construction, so it has not been possible to assess the availability of the facilities. It is however expected that this facility could be suitable for management, storage and processing of UUC.
- Pasaia Inshore fleet Fishermen´s Organisation:
  - This infrastructure is under construction, so it has not been possible to assess the availability of the facilities, but it is expected that this facility will be developed with the LO in mind.

These facilities that are currently available will certainly be used to some extent for receiving, redistributing, processing, monitoring, controlling and surveilling UUC. Both the offshore and inshore Fishermen's Organisations are currently having facilities developed that have the potentials to play a leading role in utilising, monitoring, controlling and surveilling UUC once the LO comes into force.

 doi: 10.5281/zenodo.215293

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3.1.3 Getaria

The port of Getaria receives 10-15.000 tons of fish annually, making it the third biggest harbour in the area. The harbour is not nearly as well equipped for receiving UUC as Ondarroa, which will present a challenge when the LO comes into force. There is though some infrastructure already available in Gataria that will potentially be used for processing, redistribution and management of UUC, this infrastructure is shown in Figure 35.

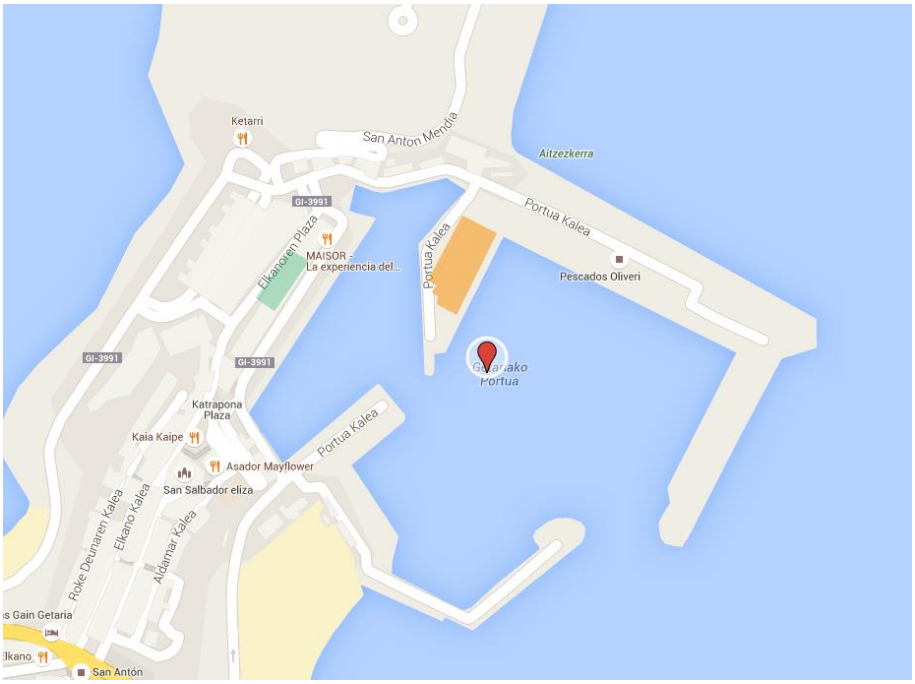

Figure 35: Map of Getaria's port. Green zones are freezing facilities and cold storage rooms. Orange zones are ambient temperature storage facilities.

The harbour of Getaria includes space for reception of fish for wholesalers, with specific attention to inshore fishing. This is housed in 14.000 m² two long docks. Other existing facilities that will potentially be used for processing, redistribution and management of UUC include the following:

- Getaria Fishermen´s Organisation:
  - Reception area fish from the sea, in boxes
  - Bulk transfer fish from boat boxes, by pump
  - Fish reception from trucks
  - Auction Zone: exposure and samples
  - Area ice maker and services
  - Integration of wholesalers (large and small)
- Ice factory

These facilities will most certainly be used to some extent for receiving, redistributing, processing, monitoring, controlling and surveilling UUC. It is though clear that new production streams will have to be developed, particularly for catches below MCRS.

 doi: 10.5281/zenodo.215293

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

3.1.4 Hondarribia

The port of Hondarribia receives around 10.000 tons of fish annually, making it the fourth biggest harbour in the area. The infrastructure is simple and available facilities limited, as can be seen in Figure 34.

harbour is not nearly as well equipped for receiving UUC as Ondarroa, which will present a challenge when the LO comes into force. There is though some infrastructure already available in Gataria that will potentially be used for processing, redistribution and management of UUC, this infrastructure is shown in Figure 36.

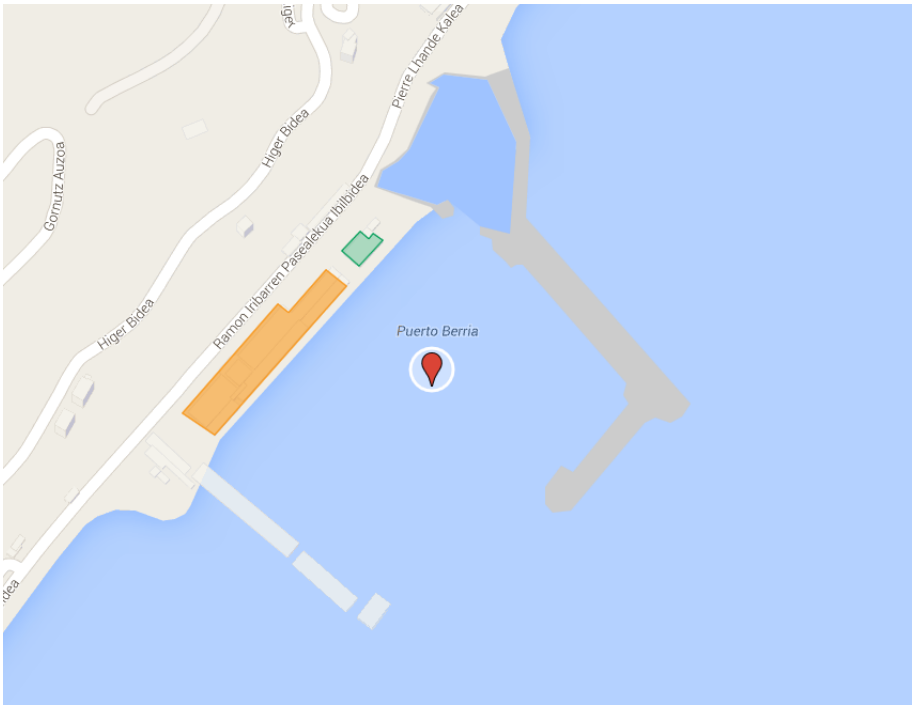

Figure 36: Map of Hondarribia's port. Green zones are freezing facilities and cold storage rooms. Orange zones are ambient temperature storage facilities.

The harbour of Hondarribia includes relatively small freezing and cold storage space, but much larger ambient temperature storage facilities. The existing facilities that will potentially be used for receiving, processing or redistributing UUC are as follows:

- Hondarribia Offshore and Inshore Fleet Fishermen´s Organisation:
  - This facility includes a fish exhibition area without any cooling system. In addition, it includes two 25 m² cooling rooms (< 0-5 °C) that are used occasionally for storing fish for up to 24 hours.
- Ice factory capable of producing up to 90 Tn/day

These facilities will be used to some extent for receiving, redistributing, processing, monitoring, controlling and surveilling UUC. It is though clear that new facilities and production streams will have to be developed, particularly for catches below MCRS. Infrastructure for monitoring, control and surveillance will also have to be developed.

 doi: 10.5281/zenodo.215293

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3.1.5 Bermeo

The port of Bermeo receives 3-5.000 tons of fish annually, making it the fifth biggest harbour in the area. The infrastructure is pretty extensive compared to the other harbours, especially taking the landed volume into account. There port is characterised by many small facilities were fishermen can exhibit and sell their catches, but it also includes a large fishmarket and freezing and cooling facilities, as can be seen in Figure 37.

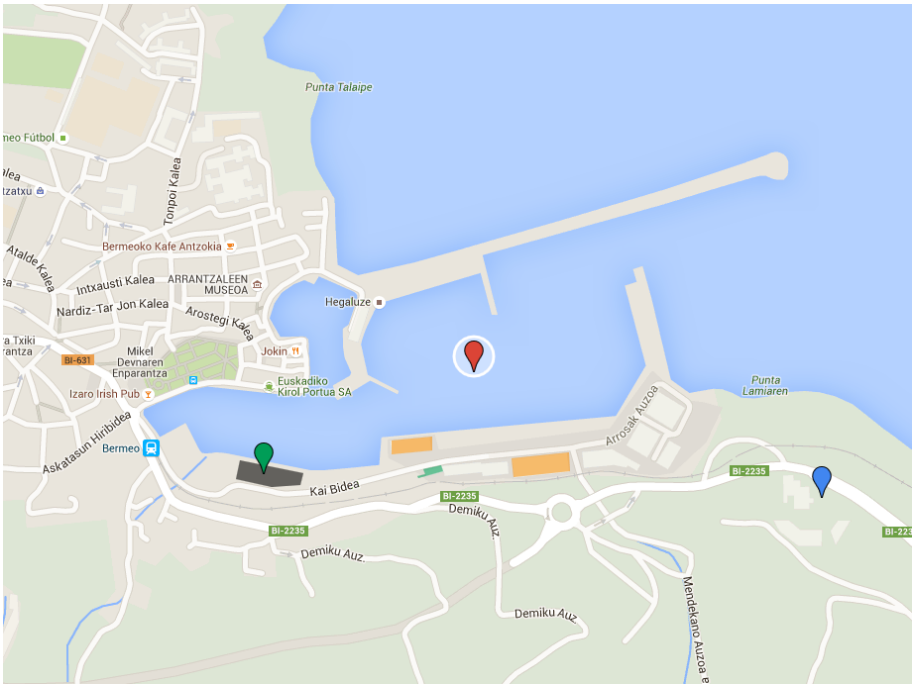

Figure 37: Map of Bermeo's port. Green zones are freezing facilities and cold storage rooms. Orange zones are ambient temperature storage facilities.

The existing facilities in Bermeo fishing port which may be relevant for receiving, redistributing, processing and managing UUC are as follows:

- Bermeo Fishermen´s Organisation:
  - It includes a fish exhibition area of 1000 m² without any cooling system.
  - In addition, it includes two 25 m² cooling rooms (< 0-5 °C) that are used occasionally for storing fish for up to 24 hours. This facility can be suitable for management and storage of UUC.
- Fish wholesale markets
  - Throughout the fishing port, there are several small facilities belonging to fisher where they can exhibit and sell their fishes. They are about 5m x 15m and they usually include a small cooling room (< 0-5° C) where they can storage the fish for 1-2 days until they sell them. These facilities are not suitable for storing and processing UUC.
- Bermeo Freezer plant:
  - This facility includes several rooms where they storage and process fish i.e. Freezing room (< -20° C) with a storage capacity of 2.000 tons. They are currently in full use all year round.
  - Freezing tunnels (< -20° C), each one with a freezing capacity of 20-23 tons per 11h. They are only used at full capacity for parts of the year i.e. main fishing seasons.

 doi: 10.5281/zenodo.215293

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- Grading machine that sorts fish according to size
- Four fish packaging machines.
- Two salting tanks of about 4m x 20m that are underused because of environmental issues.
- One Filleting room with a machine to cut the head of the fish, remove guts and separate fish fillets opening butterfly.
- Moreover, on the second floor, there is a facility with several production lines ready to process fish. These include:
  - Several cooling rooms (< 0-5° C) about 60 m^2.
  - 1 Filleting room.
  - 1 Packing room
  - 1 Freezing room (< - 20° C) about 20 m^2.
  - This facility can be suitable for managing, storing and processing UUC.

- Ice factory

Compared to most other harbours in the area the Bermeo harbour already contains much of the infrastructure needed when the LO will be implemented. There are also facilities and equipment available that can be used for receiving, redistributing, processing, managing, controlling and surveilling the UUC. Catches below MCRS will though present a challenge that fishermen and authorities will have to solve before the LO comes into force.

3.1.6 Other potential recipients of discards for initial processing

The other potential recipients of UUC for initial processing located near fishing ports in the Basque country are:

- Angulas Aguinaga S.A.[3]:
  - This fishing factory is located in a small village in Irura (Gipuzkoa), which is near Pasaia fishing port. This facility includes several cooling and freezing rooms, as well as different process lines to produce different products based on fish. Therefore, they offer modern fish products with the best quality standards. The potentials for processing UUC at Angulas Aguinage are excellent and they will likely use the opportunities presented by the LO to expand on their production.
- Proyecto Ondarroa S.A. (POSA)[4]:
  - This fish factory is located near Ondarroa fishing port. The facilities include a reception and an expedition area, processing area with separate lines, several freezing tunnels (< -20° C), a cooling room (< 0-5° C) with a capacity of 250-300 tons, a cooling room (< 0-5° C) of 11m x 13m that is underused, a freezing room (< -20° C) of 24m x 13m, an ice production machine, a fish by-products cold storage room of 9m x 4m. These facilities will likely be used for processing UUC once the LO comes into force.
- SAU Bakaladera:
  - This fish factory is located near Hondarribia fishing port. The facilities include several cooling and freezing rooms, as well as different processing lines to produce different products. SAU Bakaladera will therefore most likely utilise opportunities for further processing of UUC under the LO.

[3] www.angulas-aguinaga.es/en
[4] www.proyecto-ondarroa.com

 doi: 10.5281/zenodo.215293

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

- BARNA fish meal factory[5]:
    - The facility where BARNA produces its fish meal is located near Bermeo, but they collect raw materials from 400 suppliers located throughout the north of Spain and south-east of France. BARNA already processes 20.000 tonnes of by-products a year and they can easily increase that production capacity. It is therefore obvious that BARNA will be able to benefit from increased supplies of UUC once the LO will have been implemented.

The above mentioned infrastructure, facilities and potential capabilities of dealing with increased supply of UUC is merely a simple identification of available set-up and resources that will be relevant once the LO comes into force. Further analysis will be needed to expand on the potentials of these already available resources, but it is though clear that facilities will need to be added and production streams developed, particularly for catches below MCRS.

3.2 North Sea – Danish harbours

Activities belonging to the fishing sector have variable influence at the local communities. The actual fishing operations normally take place along the coastlines and on the fishing grounds in the nearby waters. This pattern has been broken up in the last fifty years, but the fishermen are rather conservative in their behaviour, which leads to building of fishing vessels and landing of the catch as close to their home town as possible. There have historically been exceptions, such as the Danish landings in Grimsby on the English east coast, and even establishment of local communities in the UK. But as improvements of the chilling facilities on-board the vessels have improved and as the local infrastructure in the ports have improved, landings are generally done in homeports.

The biggest change in recent time influencing the Danish fishing sector was the introduction of the individual quota system in the years from 2005 to 2007. This has led to a reduction of the number of fishing vessels by more than 50 % and a concentration of the ownership of the quotas. This new regime has resulted in an aggregation of fishing activities to a much smaller number of vessels than the actual number of 2000 Danish fishing vessels imply. Today, about 120 vessels fish more than 90 % of the total landings of fish for human consumption. The pelagic fishing is now concentrated on approximately 10 big vessels. The last 10 % of the total catch is fished by 1500 vessels (Agrifish, 2015). This is reflected in the number of important landing places in Denmark. Now there are only five harbours that can be defined as major ports, out of nearly 200 official landing harbours in Denmark.

The Danish fishing sector is divided in two major areas. Industrial fishing for the fishmeal and fish oil industry and fishing for human consumption for the processing industry. In the five major fishing ports there are facilities for reduction to fishmeal and fish oil, but the ownership is concentrated on two companies. The processing industry for producing fish products to human consumption has a much more variated ownership. There are some major companies, mainly using pelagic fish as raw material such as herring and mackerel. But the majority consists of small and medium sized companies. In general the companies are very focused on the local communities. This is due to the area

[5] www.barna.es

 doi: 10.5281/zenodo.215293

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where the major fishing ports are situated. They are far away from the industrial areas of Denmark, and the fish sector has a strong role in the local economy. Some of these small towns with less than 3.000 inhabitants are totally depended on the seafood sector. That has led to a growing competition between the major fishing harbours to offer the best facilities to the fishing fleet and the processing industry. Hanstholm is a good example of these major harbours that have been increasing their share of total landings in Denmark.

3.2.1 Hanstholm harbour

Hanstholm harbour is situated in in North West of Denmark on the "shoulder" of Jutland. It is a relative new harbour, established in the 1967, but gained very quickly importance in the fishing sector. Now the local fish auction is number one in Denmark with an annual turnover of 70 mil Euro. The harbour area was original designed to have both a function as a ferry port and fishing port. The ferry business has been closed, because of difficult sailing conditions in certain weathers conditions. The future plan for the harbour is to enlarge the outer harbour basin to eliminate this problem. The loss of the ferry connections to Norway and the Faroe Islands, meant loss of fish supplies to the local processing industry. The harbour is now under reconstruction, to enlarge the area and make it more viable for the industry. Figure 38 shows the Hanstholm harbour area (Havneguide, 2015).

Figure 38: Hanstholm harbour seen from North-West towards land

As the biggest port in Denmark for landing of fish for human consumption, focus has been on giving the processing industry optimal conditions. The big pier in the middle of the harbour makes room for the unloading of fish boxes directly to two of the harbour's professional handlers of fish – collectors – which handle landings from the smallest vessels to the biggest trawlers. From the collectors the fish is transported to either a cooling storage or to the auction hall (which also is cooled down to between 2 to 5 ^{0}C). After auction the fish boxes are transported to the buyers' storage room, either by front lift truck or by lorry. The two parallel roads flanking the harbour to the surrounding land, is full of different processers, wholesalers etc. A newly developed area approx. 1 km away from the harbour has several processing industries that have been developed in recent years. This has put pressure on the logistic to transport the fish to these facilities. As mentioned the harbour is less than 50 years old, but has developed to meet the increasing demand for better facilities. Ten years ago a new "centre" for

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fresh fish handling opened. The focus has been on chilling the fish and keep it chilled until first sale at the auction. This initiative combined with the implementation of refrigerated holds in the fishing vessels and shorter fishing trips (general no more than 5 days), has improved the overall quality of the landed fish sold at the auction.

The one thing that strikes a visitor to a modern fishing port is the hectic activities of especially fork lifts of every kind. Petrol and gas powered fork lifts are on the roads, and electric fork lifts in the cooling rooms and the auction area. There has been improvements in the transport, e.g. unloading from the fishing vessel can be done using a conveyer belt into the collector's area, where the fish is sorted in different weight classes and quality grades. But if it is busy landing nights, the boxes are unloaded on the quay side and then picked up by fork lifts and transported to a collector or directly into the auction area.

Hanstholm harbour has decided to improve the logistic system to meet the challenges that will arise with the LO. They are expecting that up to 10 % of the landings will be UUC that will primarily be going to the local fishmeal factory, but parts will though be directed to other uses such as fresh feed to the fur industry or possibly as bioactive compounds used by the pharmaceutical industry (Nyman, 2015).

UUC not going directly to fishmeal will require an extra link in the logistic chain, where sorting can take place. This operation can be done manually, but it is preferable to use automatic systems. One of the key elements in this process will be the use of vision technic, to sort the fish from each other. Vision systems are already in use in the collector's automatic sorting facilities, but new algorithms have to be developed to the existing systems. Space for this new operation has to be found in harbour area and new storage facilities have to be built, for not mixing the UUC with other fish that can be used for direct human consumption.

3.2.2 Middle size harbours or landing sites

The big five fishing harbours in Denmark had in 2010 an annual turnover of more than 150 mil DKK. The next segment are the middle sized harbours that are 13 in total, but they had a turnover in excess of 10 mil DKK in 2010 (Nielsen, et al., 2013). Few of these harbours have a local auction, but the normal procedure is to transport the landed fish boxes to one of the major ports for sale. There is access to ice in all of these harbours, as well as to clean fish boxes and chilled storage as intermediate storage before the lorries pick up the boxes. If there are landings that have to go to reduction to fishmeal and fish oil, either transportation in tank lorry or in containers on a lorry is used. This of course is an expenditure that has to payed by the fishermen (Larsen, et al., 2013).

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Based on the experience from the Baltic area, where the LO has been in force since beginning of 2015, the following scenarios have been observed:

- Landings on the island of Bornholm in the western part of the Baltic has been going on as usual
- The fractions of the landed catch that have been UUC have been transported with the rest of the fish to one of the major ports
- The amount of UUC has dropped
- Fish species such as flounders have been discarded, or the fishing grounds with a high proportion of UUC have been abandoned
- The number of fish species caught in the Baltic are normally very low, so the experiences gained from there will only marginally contribute to other areas were catches include a large number of species, such as in the North Sea.
- The UUC are simply sold to the fishmeal and fish oil factories. The cost of the transport, the hire of fish boxes or containers equals the payments of the fish, creating no incentives for fishermen or vessel owners to bring the UUC ashore.
- There are no signs that local industries are exploring opportunities in taking care of UUC.
- There have been no initiatives taken in developing alternative utilisation of UUC, such as silage technology, neither on the vessels nor at shore.

The discussion above suggests that there are already facilities in place in Denmark to process UUC that are likely to be landed once the LO comes into force. The processing facilities are though mostly located in the largest fishing harbours, meaning that UUC will have to be transported long distances. Transporting UUC with current set up will be expensive and fishermen may therefore actually lose money by landing these catches. Judging from the experiences from the Baltic it is unlikely that production streams other than for fishmeal will be developed for catches below MCRS.

3.3 Iceland

There are 83 registered landing sites in Iceland and in 2014 landings were registered at 62 of these sites, 1.073 tonnes in total (Statistics Iceland, 2015). The harbours are distributed all around the island, but they are highly variable in respect to landing volumes, fleet types and species composition. Some of them receive only few tons a year, whilst others receive an excess of 100 thousand tonnes annually. In 2014 there were six harbours where less than fifty tonnes were landed and three harbours where more than 100 thousand tonnes were landed. Harbours in Iceland can to a point be broken into the following five categories:

- Small harbours that mainly service recreational and coastal vessels. These harbours have generally little infrastructure or facilities for processing and most of the landings are transported elsewhere for processing. Landed volumes going through these harbours are usually less than one thousand tonnes a year. A total of 21 harbours would fall into this group according to landings in 2014.
- Harbours where coastal vessels and larger boats land catches that are either processed in the area or sold at auction-markets and processed elsewhere. These harbours are receiving up to 10 thousand tonnes a year of demersal catches and crustaceans. A total of 16 harbours would fall into this group according to landings in 2014.
- Large harbours where demersal catches are landed and processed. These harbours have usually strong seafood companies located in the area that operate their own vessels and

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processing plants. Landed volumes in these harbours can vary from 10 – 50 thousand tonnes of demersal species and crustaceans. Some of them do also process smaller amounts of pelagic species for human consumption. A total of 13 harbours would fall into this group according to landings in 2014.

- Harbours focusing on pelagic species. These are harbours where the main emphasis is on processing of pelagic species, both for human consumption and for fishmeal- and fish oil production. Landed volumes going through these harbours can vary between 50 and 100 thousand tonnes a year. A total of 5 harbours would fall into this group according to landings in 2014.
- Large multi-purpose harbours that service all fleet types and contain large seafood companies that process most or all types of catches. Volumes going through these harbours can reach an excess of 200 - 300 thousand tonnes a year, depending on quotas in pelagic species. A total of 7 harbours would fall into this group according to landings in 2014.

The distribution of the harbours in respect to landing volumes of demersal and pelagic species can be seen in Figure 39 (Statistics Iceland, 2015)

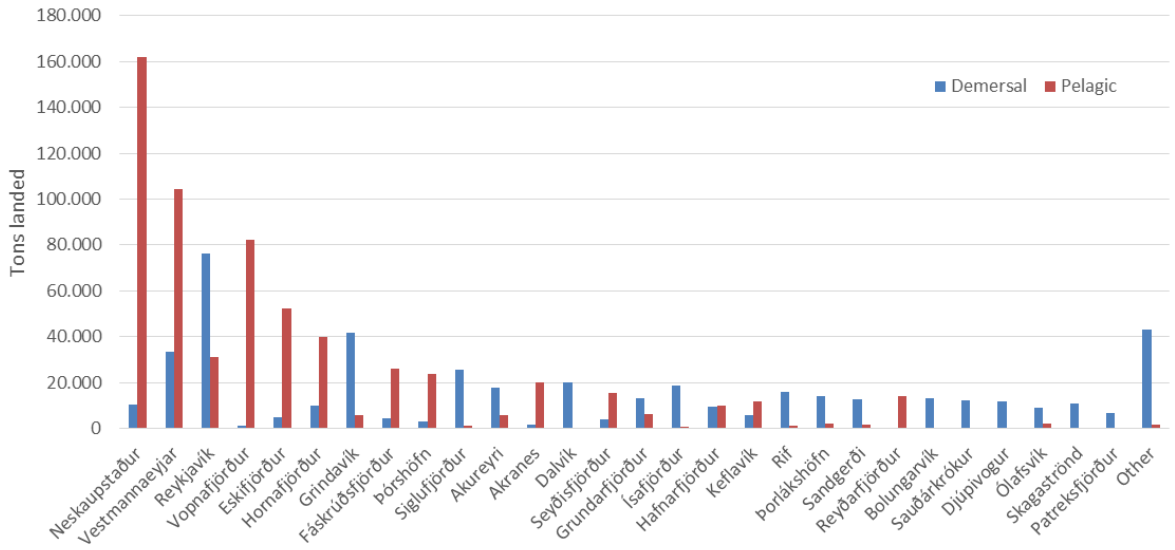

Figure 39: Icelandic harbours with respect to landed volumes in 2014

Pelagic catches accounted for 58 % of the landed volumes in 2014, which is why six of the eight largest harbours contain fish meal factories. Many of the smaller harbours are however quite important, as volume and value does not always go together. Smaller harbours are often the landing sites for cod and haddock that are going for production of fresh fish, which is extremely important for the national economy of Iceland. Following is a discussion on the infrastructure supporting landing, logistics and processing of fish in Iceland, focusing in particular on catches that might be perceived as UUC.

3.3.1 Infrastructure at harbours

One of the main functions of the harbours is to weigh and register landed catches. There is a legal obligation to weigh all catches on special harbour scales at landing sites by official employees of the harbour (Directorate of fisheries, 2015). There is however a possibility for granting a temporary exemption from this and it is also possible to grant exemption for small remote landing sites. But these

 doi: 10.5281/zenodo.215293

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are special exceptions. Therefore, almost all landing sites contain a scale for weighing the landings and a set-up for registering and reporting the landed quantity to the Directorate of fisheries. In few cases, private companies have been granted a license to weigh catches and report to the Directorate, but that is only done if the there is a good external and internal surveillance. The Directorate of fisheries then publishes in real-time* on its webpage all catches and how they have been counted against quotas of each vessel.

Infrastructure at Icelandic landing sites varies to some extent, most of the harbours provide cranes for landing from smaller boats, connection to electricity and water. All the harbours contain a weighing facility while the biggest landing sites contain fish meal factories, fish processing plants, landing cranes, fishmarkets and ice factories often in association with the fishmarkets or the processing plants.

3.3.2 Handling of UUC

The set-up in Icelandic harbours in respect to issues related to the landing obligation is not totally comparable with the EU discard ban. All catch landed in Iceland can be used for human consumption and there is great emphasis placed on maximising value out of every single kilo landed. It is therefore no need for a separate supply streams for UUC. In recent years there have been established a large number of companies that specialise in processing catches that previously would have been regarded as "less desirable". Catches of odd species, variable sizes and catches that within the EU would fall under the "de minimis" exemption are all utilised. This development would not have been possible without strong infrastructure, good logistics and a thigh net of fishmarkets that efficiently brings together fishermen and processors.

Various products, processes, methods and technologies have been developed for handling UUC within the Icelandic fishing industry over the past decades (see deliverable D5.1). Previously discarded catches or raw materials of low value have been turned into valuable products, with the results that there are practically no catches that can be defined as unwanted today. Even viscera, bones and fish skin are being utilised; and biotechnology is as well increasingly being applied in utilising bioactive compounds from by-products. The exceptionally high utilisation ratio in Iceland is largely contributed to the ITQ system and the integration between catching and processing, as seafood companies strive to maximising value out of each kilo caught. The importance of the fishmarkets is also significant, bringing together independent fishermen and processors.

3.3.3 Logistics and fishmarkets

The first auction-market in Iceland opened in 1987, revalorising the sector by creating a platform where suppliers of fish and processors and could sell and source fish on a daily basis. Today there are 14 markets operating in 28 different locations around Iceland, as can be seen in Figure 40 (RSF, 2015). All the markets are connected to a single online auction site, where 200-300 buyers participate in auctions every day.

* *Can be up to 24 hour delay*

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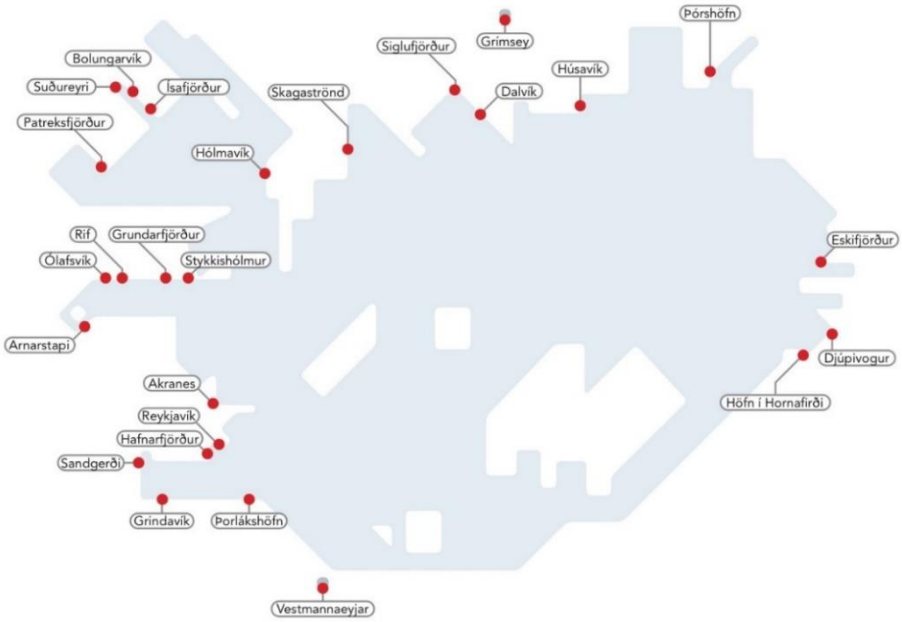

Figure 40: Location of the Icelandic fishmarkets

Most of the fish that is sold at the auctions are supplied by small day-boats i.e. coastal vessels that land catches every day. Most of the catches are sold before it has been landed (in fact even before it has been caught) as fishermen send in reports of expected catches, including species and size description, for the day before 11:00 o'clock in the morning. The auction list is then published so that potential buyers can see expected supplies. The auction starts at 13:00 and it is for the most part a virtual auction i.e. the auction is online and most buyers are sitting at their own offices. There is of course some uncertainty in the actual volumes landed and size distribution, as the catch is not all on-board when auctioned. If the volume landed is higher than the auctioned volume the purchaser has the right to buy it for the same price or decline taking the extra volume. If however the quantity is lower there is nothing that can be done.

After landing in the afternoon the catch is weighted at the fishmarket and then iced properly before being loaded onto trucks. The catch is transported overnight to the processors so that they can start their operation early in the morning. Often this fish is exported to Europe or America the same day via air freight.

In 2014 the auction-markets sold 103 thousand tons of fish and almost all of it were demersal species. Over 20 % of the 479 thousands ton demersal catches were therefore sold at the fish auctions. Roughly 80 % of the fish sold at the auctions was sold before being landed.

A central point in the fishing industry is the logistic part from pier to processor. It does not only serve the buyers at the auction-markets, as it is also common for vessels to operate far from their home ports so that the catches are landed at the nearest harbour and then transported to the processing facilities of the vessel owner. Figure 41 shows how 30-40 % of catches have been transported considerable distances from the landing docks to the processing facilities over the past 15 years (Statistics Iceland, 2015).

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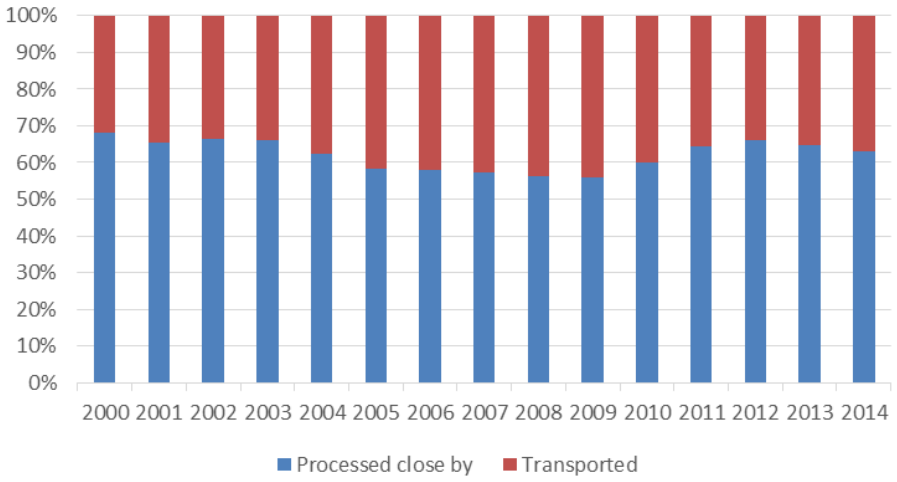

Figure 41: Ratio of demersal catches processed in the same place as landed vs. catches processed in different places than were they were landed 2000-2014

The auction-markets and the extremely efficient transportation systems developed for unprocessed fish have contributed to massive transfer of jobs in processing in Iceland over the past few decades. Many of the small and medium sized fishing harbours are located close to good fishing grounds, resulting in fairly high landings. The processing on the other hand has been increasingly moving towards the south vest part of the country i.e. around the capital area, the international airport and main export harbour. The auction-markets have also allowed processors to specialise in certain products and by-products. The whole system has shown to be dynamic and responsive; it reacts quickly to changes in market demand, catch quantities and areas as well as market- or regulatory changes.

The lessons learned from Iceland suggest that in order to guarantee that UUC are landed there needs to be economic incentives for the fishermen and everyone else in the value chain to bring the catches ashore. The laws of the market then take over and the sector gradually finds the best solutions in utilising all catches. The general consensus amongst Icelandic fishermen are that landing catches with a loss (or low economic benefit) is not an efficient way of ensuring that UUC are landed.

3.4 Summary on infrastructure at ports in selected case studies

This chapter has provided variably detailed information on the available infrastructure at harbours in three case studies. In the Basque country and in Denmark it is likely that available infrastructure will be able to cope with landings of UUC that can be used for human consumption. The below MCRS catches and other catches that cannot be produced into products intended for direct human consumption will however present a challenge. There are relatively few harbours that are likely to represent the mainstay of the landings of such catches, but majority of harbours will not have "critical mass" to justify major investments in facilities and equipment. It is therefore to be expected that solutions intended to utilise below MCRS catches will either have to be simple and inexpensive, or that they will have to be strategically located with good transportation system in place.

 doi: 10.5281/zenodo.215293

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Iceland gives an example of a fishery where LO has been in effect for long time. The infrastructure at harbours there is variable, depending on how much is landed in each harbour. A major factor that has contributed to high utilisation and profitable industry, regardless of where catches are landed, is the extremely efficient auction market system and transportation system that is in place there. The fact that all catches can be used for maximum profit is also important i.e. no constrains on below MCRS catches. The Icelandic seafood sector is also technologically advanced, which also applies to production of low value and non-human products.

 doi: 10.5281/zenodo.215293

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4 Safety and quality criteria for UUC

Different regulations may apply in regards to safety, traceability or quality criteria depending on the intended use of UUC, for example whether it is to be used for human consumption, feed production, extraction of biomolecules or for other uses. Following is a brief discussion on regulations, safety and quality criteria's that need to be considered in regards to UUC.

4.1 Human consumption

Food safety is one of the issues that most concern the food industry, the public administration and the consumer. The safety of UUC is closely related to the quality and need to meet traceability standards.

In 2002, the European Parliament and the Council adopted Regulation (EC) No 178/2002 laying down the general principles and requirements of food law (General Food Law Regulation) establishing the European Food Safety Authority and laying down procedures in matters of food safety' and the 'Hygiene Package', a term that refers to a group of Regulations that came into force on 1st of January 2006: Regulation (EC). 852/04, 853/04, 854/04 and 882/04.

Regulations that are also important in this respect are 'Regulation (EC) 2073/05 on microbiological criteria for foodstuffs', Regulation (EC) 2074/05 and 2076/05, with implementing measures and Transitional arrangements of Hygiene Package respectively.

The on-board handling, the landing and later operations must met the same standards for UUC as for other catches and products intended for human consumption. Table 10 gives an overview of the main regulations for safety, traceability and quality of food.

Table 10: Main regulation for safety, traceability and quality of food

Regulation	Subject
Regulation (EC) 178/2002	General principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety
Regulation (EC) 852/2004	This Regulation lays down general rules for food business operators on the hygiene of foodstuffs
Regulation (EC) 853/2004	Specific hygiene rules for food of animal origin in order to guarantee a high level of food safety and public health
Regulation (EC) 854/2004	Specific rules for the organisation of official controls on products of animal origin intended for human consumption
Regulation (EC) 882/2004	Official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules
Regulation (EC) 2073/2005	Regulation on microbiological criteria for foodstuffs
Regulation (EC) 1333/2008	Food additives

 doi: 10.5281/zenodo.215293

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Regulation (EU) 1169/2011	Provision of food information to consumers
Regulation (EC) 258/1997	Novel Foods and novel food ingredients
Directive 2004/41/EC	Repealing certain Directives concerning food hygiene and health conditions for the production and placing on the market of certain products of animal origin intended for human consumption
Directive 2009/32/EC	Extraction solvents used in the production of foodstuffs and food ingredients
Directive 2002/99/EC	Laying down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption,

Some details of Regulation 853/2004 laying down specific hygiene rules for food of animal origin are shown in Appendix 2. This Regulation supplements the general hygiene requirements for all food business operators.

4.2 Animal feed

Livestock production plays a very important part in the agricultural sector of the EU. Satisfactory results of this activity depend to a large extent on the use of safe and good quality feed. The Regulation (EC) No. 183/2005 lays down general rules governing feed hygiene, conditions and arrangements ensuring traceability of feed as well as conditions and arrangements for registration and approval of establishments. As regarding the scope, the regulation shall apply to: (a) the activities of feed business operators at all stages, from and including primary production of feed, up to and including, the placing of feed on the market; (b) the feeding of food producing animals; (c) imports and exports of feed from and to third countries.

In particular it introduces the following main elements:

- The compulsory registration of all feed business operators by the competent authority.
- Approval of feed business establishments carrying out operations involving the more sensitive substances, such as certain feed additives, pre-mixtures and compound feeding stuffs.
- The approval system for feed businesses for the cases dealing with more sensitive substances will be maintained but provisions are made to extend the current scope for the approval requirement when necessary.
- To ensure that all feed businesses operate in accordance with harmonised hygiene requirements.
- To implement the application of good hygiene practice at all levels of agriculture production and use of feed.
- To introduce the Hazard Analysis Critical Control Point (HACCP) principles for the feed business operators other than at the level of primary production.
- Community and national guides to good practice in feed production.
- To introduce compulsory requirements for feed production at farm level.
- To provide for a European Union framework for guides to good practice in feed production.

 doi: 10.5281/zenodo.215293

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Table 11 gives an overview of the main regulations relevant for safety, traceability and quality of feed within the EU.

Table 11: Main regulation for safety, traceability and quality of feed

Regulation	Subject
Regulation (EC) 1831/2003.	Additives for use in animal nutrition
Regulation (EC) 882/2004	Official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules
Regulation (EC) 183/2005	Requirements for feed hygiene
Regulation (EC) 767/2009	The placing on the market and use of feed
Regulation (EC) 1069/2009	Health rules for animal by-products and derived products not intended for human consumption
Regulation (EC) 142/2011	implementing Regulation (EC) No 1069/2009
Regulation (EU) 68/2013	Catalogue of feed materials

These requirements for animal feeding are laid down in various Community regulations, but the most important is Regulation 1069/2009 laying down health rules for animal by-products and derived products not intended for human consumption. In this regulation, animal by-products are categorised into three specific categories which reflect the level of risk to public and animal health: Category 1, Category 2 and Category 3, demonstrated in Figure 42 .

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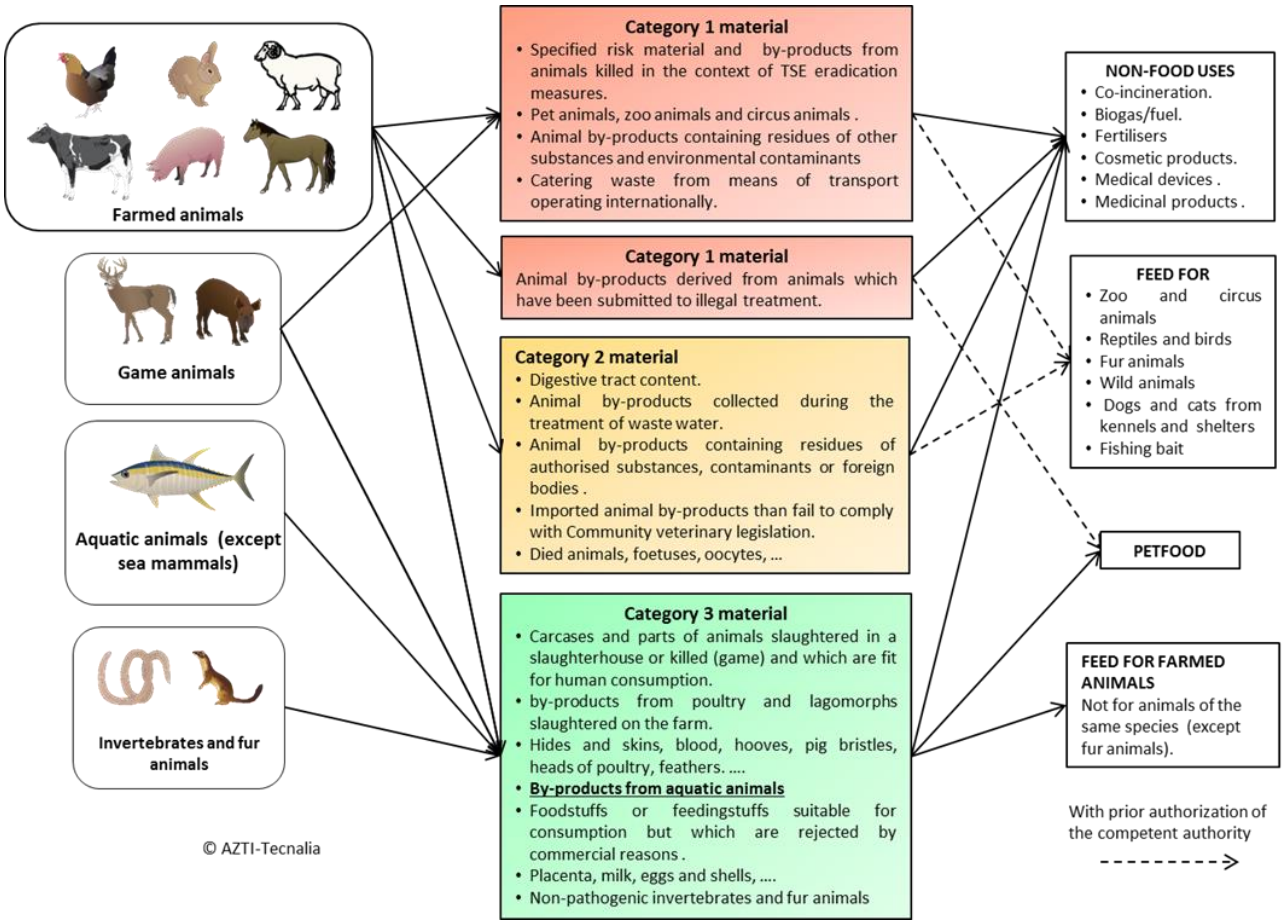

Figure 42: Schema of relation between by-products categories and uses

The Regulation also addresses matters such as:

- Restrictions on use.
- Disposal and use of the different categories of by-products.
- Implementing measures.
- Collection, transport and traceability.
- Registration and approval of establishments or plants.
- General hygiene requirements for establish or plants.
- Handling of animal by-products within food businesses.
- Hazard analysis and critical control points.
- Placing on the market.
- Import, transit and export
- Official controls

The most relevant parts of the regulation are presented in Appendix 3.

 doi: 10.5281/zenodo.215293

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4.3 Other uses

The UUC can be used for different uses than feed and food, as long as it is not used for production of products intended for direct human consumption. These can for example include extraction of biomolecules (for cosmetic or pharmaceutical uses for example) or the generation of bio-energy (bio-gas or bio-fuels as example). For these uses, quality criteria may be more important than safety or traceability.

For the obtaining of high value biomolecules, the on-board handling, landing, transport and other steps in the value chain; from capture to transformation should focus on maintaining the quality and quantity of the specific biomolecule. In most cases the handling and traceability requires similar limitations as for materials intended for direct human consumption.

Bio-energy production has few limitations, as it may use any kind of UUC and condition is generally not a major factor. The value generation potentials can however be affected by biomass degradation and documentation is generally required to validate what raw materials are used for the production.

4.4 Summary of safety and quality criteria's relevant for UUC

Summing-up the most important regulations relevant for safety and quality of UUC and potential products produced from such materials in the EU, the general rule is that all landings intended for human consumption are subjected to the same requirements. It does not make any difference whether the raw materials are from target catches or UUC.

UUC that are not intended for direct human consumption require different treatment and are to be kept separate from catches intended for human consumption. This basically means that treatment, processing and storage needs to be separated early on in the supply chain, possibly immediately after capture and at least before processing. It is important to prevent any chances of cross-contamination, which depends on certain characteristics of the UUC and treatment. In most cases it is necessary no later than in landing ports to define into what production flow the catch is going.

Taking into account that catches will degrade if the storage conditions are not appropriate, they must be stored in accordance with requirements of the final product in mind. Each production alternative requires specific structures for each stage of the supply chain i.e. for stage, crushing; drying or packing etc. Regulation 142/2011 is particularly important in this respect, laying down that unprocessed Category 3 materials destined for the production of feed or pet food must be stored and transported chilled, frozen or ensiled, unless it is processed within 24 hours after collection or after the end of storage in chilled or frozen form.

Safety criteria's relevant for UUC utilisation are fairly straight forward and need to apply to established rules and regulations. There is a fundamental difference in requirements for UUC intended for direct human consumption and catches that are used for other purposes, but traceability and documentation verifying that the products are safe are always required. When it comes to quality criteria's requirements can be more subjective, as long as the products are safe.

 doi: 10.5281/zenodo.215293

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5 Conclusions

This document has provided an overview of historic landings and reported discards in five different areas i.e. West Mediterranean bottom trawl fleet landing in Mallorca, French fleet fishing in the English channel, Danish fleet fishing in North Sea, Skagerrak & Kattegat, Spanish/Basque fleet fishing in the Bay of Biscay and Iceland. These historic datasets have then been used to predict possible changes in landings once the LO has been implemented. The document has also reviewed how current infrastructure in selected case studies (Basque country, Denmark and Iceland) are likely to meet with changing supplies resulting from the implementation of the LO, as well as reflecting on what additional infrastructures will be needed. Finally, the safety and quality criteria most relevant for future UUC landings have been reviewed.

Estimating future landings on past discards under a regime that obligated fishermen to discard UUC cannot realistically take into consideration changes in behaviour of fishermen that inevitably will occur. Once the LO is implemented the fishermen will change their practises, for example by avoiding areas with high volumes of UUC or by applying more selective fishing gear. The historic discard data can therefore only give indications on what UUC are likely to be landed in certain areas, as well as when and by which fleets.

The West Mediterranean bottom trawl case has identified that the main challenge once the LO is implemented will be landings of European hake and horse mackerel below MCRS, which cannot be used for direct human consumption. Reported annual discards of horse mackerel below MLS by this fleet have reached up to 70 thousand tonnes in recent years and reported discards of hake below MLS have reached 35 thousand tonnes. This is only reported discards by the bottom trawl fleet landing in Mallorca, but there are of course other fleets that are landing catches in the island. It is therefore safe to assume that significant volumes of hake and horse mackerel that cannot be used for human consumption will be landed in Mallorca once the LO has been implemented. Mallorca is however a small island and the foreseen volume of below MCRS catches that will be landed there will undoubtedly justify significant investments in solutions for producing products intended for non-human consumption. Considerable volumes of horse mackerel above MCRS have been discarded in the past, but these supplies will not present a major problem under the discard ban, as they can simply supply already available production streams.

Reported discards of the French fleet fishing in the English Channel have fluctuated considerably over the past decade, from being almost non-existent in 2005 to almost 20 thousand tonnes in 2012. There are a few species that stand out with respect to reported discards, with whiting, common dab, Atlantic herring, European Plaice and scallop representing 80 % of the discards 2010-2013. Boulogne-Sur-Mer stands out when looking at where discards are reported, representing around 50 % of the discards. The rest of the 170 harbours trail far behind when looking at reported discard volumes, where the harbour with the second highest discard volumes represents 7 % of the discards. The available data does not give indications on whether discards have been obligatory MLS discards or not, which makes it difficult to estimate what parts of the UUC that will be landed once the LO is implemented will need to be used for production of products intended for non-human consumption. It is however evident that

 doi: 10.5281/zenodo.215293

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investment in large scale facilities for processing catches below MCRS for non-human consumption will be concentrated on relatively few harbours, simply because most harbours lack critical mass. Catches below MCRS will most likely have to be transported between harbours and it might even be economically practical to concentrate all of the efforts on the vicinity of Boulogne-Sur-Mer, given that reported discard volumes there exceed the second largest discard harbour sevenfold.

Reported annual discards of the Danish fleet have varied from 27 to 47 thousand tonnes in recent years, where Nephrops have accounted for ½ - ¾ of the discards. Other species with significant volumes of reported discards are dab, plaice, shrimp, cod and rays. Discards of dab are around three thousand tonnes a year and discards of the other four species are between one and two thousand tonnes a year, but discards of other species are much lower. The Nephrops discards have been high because of a high MLS in place in Skagerrak and Kattegat. This MLS has been reduced in 2016 with the introduction of the LO, so it is expected that discard quantities will reduce significantly. Additionally, some exemptions for high survivability can be granted for this species, which will also reduce the issue of Nephrops UUC. Making a valuable products out of discarded Nephrops will be challenging and in the case of below MCRS catches it will have to be utilised for non-human consumption. It is not unlikely that solutions for the production of crustaceans and other fish for non-human consumption will be different from solutions for roundfish and flatfish species.
There are a handful of harbours that stand out in regards to where the discards are reported, with the six main harbours representing over 70 % of the discards. These harbours are distributed all over Denmark, which will most likely present a challenge when developing solutions for production of products for non-human consumption, as transportation can be difficult. Denmark is on the other hand not a big country and transport within Jutland for example will be relatively simple.

Reported annual landings of the Spanish fleet landing in the Basque country have been around 80 thousand tonnes for the past decade. Significant parts of these catches are coming from the Bay of Biscay. The landing and discard volumes are extremely variable between years, seasons and fleet types, which makes it difficult to predict future landings of UUC when LO comes into effect. The species that represent majority of discards are horse mackerel, mackerel, blue whiting, hake and whiting. The available data does not give any indications of what the incentives for discarding are, but MLS is the most logical explanation. Harbours with significant landing volumes in the Basque county are few and fairly close to one another. Common facilities for utilising below MCRS catches could therefore be an applicable solution. Current infrastructure for products intended for human consumption are for the most parts likely to be sufficient to cope with changing supplies associated with the LO.

The role of Iceland in this report is to provide an example of where a LO has been successfully in effect for decades. Discards in the Icelandic fisheries today are minor, but that is the results of a long process where many variable factors have contributed to a successful development. The ITQ system, integration of the value chains, consolidation in the industry and negative public opinion of discards play an important role, but an important factor is also that all catches are used for producing as much value as possible i.e. there are no constrains on utilising below MCRS catches for non-human consumption. The infrastructure in Icelandic harbours is variable, depending on how much is landed in each harbour and the species composition. A major factor that has contributed to unusually high utilisation and profitability in the industry, regardless of where catches are landed, is the extremely

 doi: 10.5281/zenodo.215293

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efficient auction market system and transportation system that is in place there. The Icelandic seafood sector is also technologically advanced, which also applies to production of low value and non-human products.

Summing-up the most important regulations relevant for safety and quality of UUC and potential products produced from such materials in the EU, the general rule is that all landings intended for human consumption are subjected to the same requirements. It does not make any difference whether the raw materials are from target catches or UUC.
UUC that are not intended for direct human consumption require different treatment and are to be kept separate from catches intended for human consumption. This basically means that treatment, processing and storage needs to be separated early on in the supply chain, possibly immediately after capture and at least before processing. It is important to prevent any chances of cross-contamination, which depends on certain characteristics of the UUC and treatment. In most cases it is necessary no later than in landing ports to define into what production flow the catch is going.

Safety criteria's relevant for UUC utilisation are fairly straight forward and need to apply to established rules and regulations. There is a fundamental difference in requirements for UUC intended for direct human consumption and catches that are used for other purposes, but traceability and documentation verifying that the products are safe are always required. When it comes to quality criteria's requirements can be more subjective, as long as the products are safe.

 doi: 10.5281/zenodo.215293

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Appendices

Appendix 1: Landing and discard statistics from the bottom trawl fleet landing in Mallorca 2004-2015

Landings											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Anchovy	0	0	0	97	0	0	0	0	0	0	0
Annular seabream	99	203	198	261	333	57	1.431	1.370	1.110	1.097	391
Axillary seabream	7.141	6.001	6.590	9.511	11.568	7.582	10.820	10.404	7.214	6.910	9.909
Common pandora	7.976	6.206	9.945	7.654	15.046	12.954	15.280	17.873	16.888	14.170	8.945
Common two-banded seabream	556	1.209	979	780	1.003	1.391	3.048	1.817	2.774	1.831	1.149
Deep-water rose shrimp	6.395	1.440	638	195	1.861	5.731	6.985	4.538	3.895	2.849	4.735
European hake	51.325	77.694	100.663	98.264	68.535	71.276	108.790	83.734	44.165	86.555	91.137
European pilchard	5.782	0	0	173	77	58	119	0	0	0	0
Horse mackerel	50.592	34.027	34.653	63.160	91.172	70.771	67.527	77.975	73.346	58.431	85.825
Mackerel	32	113	330	76	139	0	199	158	0	336	525
Norway lobster	17.904	14.317	8.677	18.699	30.255	19.299	19.241	30.480	18.930	9.013	14.988
Red mullet	20.174	12.362	7.327	13.717	17.448	11.698	17.124	25.434	16.005	3.775	4.616
Red porgy	199	174	0	0	0	0	0	0	0	0	0
Spiny lobster	191	531	0	106	53	0	128	462	375	308	500
Striped red mullet	82.416	80.926	90.899	114.250	81.945	73.986	90.569	92.666	57.877	55.546	49.887
Grand Total	250.782	235.203	260.899	326.942	319.434	274.803	341.264	346.911	242.579	240.820	272.607

Discards											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Anchovy	0	0	0	0	0	0	0	0	0	56	0
Annular seabream	0	0	0	108	0	0	0	0	814	102	0
Axillary seabream	1.354	3.142	0	5.327	1.423	9.484	501	101	1.461	1.383	114
Common pandora	0	513	73	284	52	0	445	68	620	1.233	0
Common two-banded seabream	0	0	0	0	0	0	0	0	0	0	0
Deep-water rose shrimp	509	0	0	322	0	0	0	0	0	0	309
European hake	10.883	10.263	14.565	15.293	3.797	15.362	26.719	6.011	8.278	36.278	12.930
European pilchard	127	911	490	2.327	4.131	94	7.682	0	0	0	0
Horse mackerel	73.761	93.442	180.073	212.932	249.130	149.450	34.469	69.208	19.759	23.678	25.688
Mackerel	0	0	0	0	0	0	0	93	0	0	78
Norway lobster	55	0	0	299	42	153	0	158	0	0	131
Red mullet	0	0	82	0	0	65	117	0	246	0	0
Red porgy	0	0	0	0	0	0	0	0	0	0	0
Spiny lobster	0	0	0	0	0	0	0	0	0	0	0
Striped red mullet	1.666	554	306	401	265	49	254	0	64	60	1.379
Grand Total	88.355	108.824	195.588	237.292	258.841	174.656	70.187	75.639	31.243	62.790	40.630

Discard rates											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Anchovy				0%	65%					100%	
Annular seabream	0%	0%	0%	29%	0%	0%	0%	0%	42%	9%	0%
Axillary seabream	16%	34%	0%	36%	11%	56%	4%	1%	17%	17%	1%
Common pandora	0%	8%	1%	4%	0%	0%	3%	0%	4%	8%	0%
Common two-banded seabream	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Deep-water rose shrimp	7%	0%	0%	62%	0%	0%	0%	0%	0%	0%	6%
European hake	17%	12%	13%	13%	5%	18%	20%	7%	16%	30%	12%
European pilchard	2%	100%	100%	93%	98%	62%	98%				3%
Horse mackerel	59%	73%	84%	77%	73%	68%	34%	47%	21%	29%	23%
Mackerel	0%	0%	0%	0%	0%	0%	0%	37%	0%	0%	13%
Norway lobster	0%	0%	0%	2%	0%	1%	0%	1%	0%	0%	1%
Red mullet	0%	0%	1%	0%	0%	1%	1%	0%	2%	0%	0%
Red porgy	0%	0%									
Spiny lobster	0%	0%		0%	0%		0%	0%	0%	0%	0%
Striped red mullet	2%	1%	0%	0%	0%	0%	0%	0%	0%	0%	3%
Grand Total	26%	32%	43%	42%	45%	39%	17%	18%	11%	21%	13%

 doi: 10.5281/zenodo.215293

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

Appendix 2: REGULATION 853/2004 LAYING DOWN SPECIFIC HYGIENE RULES FOR FOOD OF ANIMAL ORIGIN

The specific hygiene rules for fishing products are in the SECTION VIII of the Regulation and the most important chapters form the point of view of the UUC landings intended for human consumption are the followings.

CHAPTER I: REQUIREMENTS FOR VESSELS

I. STRUCTURAL AND EQUIPMENT REQUIREMENTS

A. *Requirements for all vessels*

1. *Vessels must be designed and constructed so as not to cause contamination of the products with bilge-water, sewage, smoke, fuel, oil, grease or other objectionable substances.*

2. *Surfaces with which fishery products come into contact must be of suitable corrosion-resistant material that is smooth and easy to clean. Surface coatings must be durable and non-toxic.*

3. *Equipment and material used for working on fishery products must be made of corrosion-resistant material that is easy to clean and disinfect.*

4. *When vessels have a water intake for water used with fishery products, it must be situated in a position that avoids contamination of the water supply.*

B. *Requirements for vessels designed and equipped to preserve fresh fishery products for more than 24 hours*

1. *Vessels designed and equipped to preserve fishery products for more than 24 hours must be equipped with holds, tanks or containers for the storage of fishery products at the temperatures laid down in Chapter VII.*

2. *Holds must be separated from the engine compartments and from the crew quarters by partitions which are sufficient to prevent any contamination of the stored fishery products. Holds and containers used for the storage of fishery products must ensure their preservation under satisfactory conditions of hygiene and, where necessary, ensure that melt water does not remain in contact with the products.*

3. *In vessels equipped for chilling fishery products in cooled clean seawater, tanks must incorporate devices for achieving a uniform temperature throughout the tanks. Such devices must achieve a chilling rate that ensures that the mix of fish and clean seawater reaches not more than 3 °C six hours after loading and not more than 0 °C after 16 hours and allow the monitoring and, where necessary, recording of temperatures.*

C. *Requirements for freezer vessels*

Freezer vessels must:

1. *have freezing equipment with sufficient capacity to lower the temperature rapidly so as to achieve a core temperature of not more than -18 °C;*

2. *have refrigeration equipment with sufficient capacity to maintain fishery products in the storage holds at not more than -18 °C. Storage holds must be equipped with a temperature-recording device in a place where it can*

 doi: 10.5281/zenodo.215293

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be easily read. The temperature sensor of the reader must be situated in the area where the temperature in the hold is the highest;

3. *meet the requirements for vessels designed and equipped to preserve fishery products for more than 24 hours laid down in Part B, point 2.*

D. *Requirements for factory vessels*

1. *Factory vessels must have at least:*

a) *a receiving area reserved for taking fishery products on board, designed to allow each successive catch to be separated. This area must be easy to clean and designed so as to protect the products from the sun or the elements and from any source of contamination;*

b) *a hygienic system for conveying fishery products from the receiving area to the work area;*

c) *work areas that are large enough for the hygienic preparation and processing of fishery products, easy to clean and disinfect and designed and arranged in such a way as to prevent any contamination of the products;*

d) *storage areas for the finished products that are large enough and designed so that they are easy to clean. If a waste-processing unit operates on board, a separate hold must be designated for the storage of such waste;*

e) *a place for storing packaging materials that is separate from the product preparation and processing areas;*

f) *special equipment for disposing waste or fishery products that are unfit for human consumption directly into the sea or, where circumstances so require, into a watertight tank reserved for that purpose. If waste is stored and processed on board with a view to its sanitation, separate areas must be allocated for that purpose;*

g) *a water intake situated in a position that avoids contamination of the water supply;*

h) *hand-washing equipment for use by the staff engaged in handling exposed fishery products with taps designed to prevent the spread of contamination.*

2. *However, factory vessels on board which crustaceans and molluscs are cooked, chilled and wrapped, need not meet the requirements of point 1 if no other form of handling or processing takes place on board such vessels.*

3. *Factory vessels that freeze fishery products must have equipment meeting the requirements for freezer vessels laid down in Part C, points 1 and 2.*

II. HYGIENE REQUIREMENTS

1. *When in use, the parts of vessels or containers set aside for the storage of fishery products must be kept clean and maintained in good repair and condition. In particular, they must not be contaminated by fuel or bilge water.*

2. *As soon as possible after they are taken on board, fishery products must be protected from contamination and from the effects of the sun or any other source of heat.*

3. *Fishery products must be handled and stored so as to prevent bruising. Handlers may use spiked instruments to move large fish or fish which might injure them, provided that the flesh of the products suffers no damage.*

4. *Fishery products other than those kept alive must undergo chilling as soon as possible after loading. However, when chilling is not possible, fishery products must be landed as soon as possible.*

 doi: 10.5281/zenodo.215293

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5. *Cancelled.*

6. *Where fish are headed and/or gutted on board, such operations must be carried out hygienically as soon as possible after capture, and the products must be washed immediately and thoroughly. In that event, the viscera and parts that may constitute a danger to public health must be removed as soon as possible and kept apart from products intended for human consumption. Livers and roes intended for human consumption must be preserved under ice, at a temperature approaching that of melting ice, or be frozen.*

7. *Where freezing in brine of whole fish intended for canning is practised, a temperature of not more than – 9 °C must be achieved for the product. The brine must not be a source of contamination for the fish.*

CHAPTER II: REQUIREMENTS DURING AND AFTER LANDING

1. *Food business operators responsible for the unloading and landing of fishery products must:*

   a) *ensure that unloading and landing equipment that comes into contact with fishery products is constructed of material that is easy to clean and disinfect and maintained in a good state of repair and cleanliness;*

   b) *avoid contamination of fishery products during unloading and landing, in particular by:*

      i. *carrying out unloading and landing operations rapidly;*

      ii. *placing fishery products without delay in a protected environment at the temperature specified in Chapter VII;*

      iii. *not using equipment and practices that cause unnecessary damage to the edible parts of the fishery products.*

2. *Food business operators responsible for auction and wholesale markets or parts thereof where fishery products are displayed for sale must ensure compliance with the following requirements.*

   a)

      I. *There must be lockable facilities for the refrigerated storage of detained fishery products and separate lockable facilities for the storage of fishery products declared unfit for human consumption.*

      II. *If the competent authority so requires, there must be an adequately equipped lockable facility or, where needed, room for the exclusive use of the competent authority.*

   b) *At the time of display or storage of fishery products:*

      I. *the premises must not be used for other purposes;*

      II. *vehicles emitting exhaust fumes likely to impair the quality of fishery products must not have access to the premises;*

      III. *persons having access to the premises must not introduce other animals;*

      IV. *the premises must be well lit to facilitate official controls.*

3. *When chilling was not possible on board the vessel, fresh fishery products, other than those kept alive, must undergo chilling as soon as possible after landing and be stored at a temperature approaching that of melting ice.*

 doi: 10.5281/zenodo.215293

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4. *Food business operators must cooperate with relevant competent authorities so as to permit them to carry out official controls in accordance with Regulation 854/2004, in particular as regards any notification procedures for the landing of fishery products that the competent authority of the Member State the flag of which the vessel is flying or the competent authority of the Member State where the fishery products are landed might consider necessary.*

CHAPTER III: REQUIREMENTS FOR ESTABLISHMENTS, INCLUDING VESSELS, HANDLING FISHERY PRODUCTS

Food business operators must ensure compliance with the following requirements, where relevant, in establishments handling fishery products.

A. *REQUIREMENTS FOR FRESH FISHERY PRODUCTS*

1. *Where chilled, unpackaged products are not distributed, dispatched, prepared or processed immediately after reaching an establishment on land, they must be stored under ice in appropriate facilities. Re-icing must be carried out as often as necessary. Packaged fresh fishery products must be chilled to a temperature approaching that of melting ice.*

2. *Operations such as heading and gutting must be carried out hygienically. Where gutting is possible from a technical and commercial viewpoint, it must be carried out as quickly as possible after the products have been caught or landed. The products must be washed thoroughly immediately after these operations.*

3. *Operations such as filleting and cutting must be carried out so as to avoid contamination or spoilage of fillets and slices. Fillets and slices must not remain on the worktables beyond the time necessary for their preparation. Fillets and slices must be wrapped and, where necessary, packaged and must be chilled as quickly as possible after their preparation.*

4. *Containers used for the dispatch or storage of unpackaged prepared fresh fishery products stored under ice must ensure that melt water does not remain in contact with the products.*

5. *Whole and gutted fresh fishery products may be transported and stored in cooled water on board vessels. They may also continue to be transported in cooled water after landing, and be transported from aquaculture establishments, until they arrive at the first establishment on land carrying out any activity other than transport or sorting.*

B. *REQUIREMENTS FOR FROZEN PRODUCTS*

Establishments on land that freeze fishery products must have equipment that satisfies the requirements laid down for freezer vessels in Section VIII, Chapter I, part I. C, points 1 and 2.

CHAPTER IV: REQUIREMENTS FOR CERTAIN PROCESSED FISHERY PRODUCTS

B. *REQUIREMENTS FOR FISH OIL INTENDED FOR HUMAN CONSUMPTION*

1. *Raw materials used in the preparation of fish oil for human consumption must:*

   a) *come from establishments, including vessels, registered or approved pursuant to Regulation 852/2004 or in accordance with this Regulation;*

   b) *derive from fishery products which are fit for human consumption and which comply with the provisions set out in this Section;*

 doi: 10.5281/zenodo.215293

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c) *be transported and stored in hygienic conditions;*

d) *be chilled as soon as possible and remain at the temperatures set out in Chapter VII.*

By way of derogation from point 1(d), the food business operator may refrain from chilling the fishery products when whole fishery products are used directly in the preparation of fish oil for human consumption, and the raw material is processed within 36 hours after loading, provided that the freshness criteria are met and the total volatile basic nitrogen (TVB-N) value of the unprocessed fishery products do not exceed the limits set out in point 1 of Chapter I of Section II of Annex II to Commission Regulation 2074/2005 (28).

2. *The production process for fish oil must ensure that all raw material intended for the production of crude fish oil is subject to a treatment including, where relevant, heating, pressing, separation, centrifugation, processing, refining and purification steps before being placed on the market for the final consumer.*

3. *Provided that the raw materials and the production process comply with the requirements applying to fish oil intended for human consumption a food business operator may produce and store both fish oil for human consumption and fish oil and fish meal not intended for human consumption in the same establishment.*

4. *Pending the establishment of specific Community legislation food business operators must ensure compliance with national rules for fish oil being placed on the market for the final consumer.*

CHAPTER V: HEALTH STANDARDS FOR FISHERY PRODUCTS:

This chapter establishes the health standards for fishery products and, in particular: Histamine, total volatile nitrogen, parasites and toxins harmful to human health.

CHAPTER VII: STORAGE OF FISHERY PRODUCTS

Food business operators storing fishery products must ensure compliance with the following requirements.

1. *Fresh fishery products, thawed unprocessed fishery products, and cooked and chilled products from crustaceans and molluscs, must be maintained at a temperature approaching that of melting ice.*

2. *Frozen fishery products must be kept at a temperature of not more than – 18 °C in all parts of the product; however, whole fish initially frozen in brine intended for the manufacture of canned food may be kept at a temperature of not more than – 9 °C.*

3. *Fishery products kept alive must be kept at a temperature and in a manner that does not adversely affect food safety or their viability.*

CHAPTER VIII: TRANSPORT OF FISHERY PRODUCTS

Food business operators transporting fishery products must ensure compliance with the following requirements.

1. *During transport, fishery products must be maintained at the required temperature. In particular:*

a) *fresh fishery products, thawed unprocessed fishery products, and cooked and chilled products from crustaceans and molluscs, must be maintained at a temperature approaching that of melting ice;*

b) *frozen fishery products, with the exception of whole fish initially frozen in brine intended for the manufacture of canned food, must be maintained during transport at an even temperature of not more than – 18 °C in all parts of the product, possibly with short upward fluctuations of not more than 3 °C.*

 doi: 10.5281/zenodo.215293

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

2. *Food business operators need not comply with point 1(b) when frozen fishery products are transported from a cold store to an approved establishment to be thawed on arrival for the purposes of preparation and/or processing, if the journey is short and the competent authority so permits.*

3. *If fishery products are kept under ice, melt water must not remain in contact with the products.*

4. *Fishery products to be placed on the market live must be transported in such a way as not adversely to affect food safety or their viability.*

 doi: 10.5281/zenodo.215293

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Appendix 3: The requirements applicable to UUC landings intended for animal feed, are the followings articles.

The following requirements for animal feeding are specified in regulation 1069/2009 laying down health rules for animal by-products and derived products not intended for human consumption.

Article 11, Restrictions on use.

1. *The following uses of animal by-products and derived products shall be prohibited:*

    a. *the feeding of terrestrial animals of a given species other than fur animals with processed animal protein derived from the bodies or parts of bodies of animals of the same species;*

    b. *the feeding of farmed animals other than fur animals with catering waste or feed material containing or derived from catering waste;*

    c. *the feeding of farmed animals with herbage, either directly by grazing or by feeding with cut herbage, from land to which organic fertilisers or soil improvers, other than manure, have been applied unless the cutting or grazing takes place after the expiry of a waiting period which ensures adequate control of risks to public and animal health and is at least 21 days; and*

    d. *the feeding of farmed fish with processed animal protein derived from the bodies or parts of bodies of farmed fish of the same species.*

Therefore, cannibalism is prohibited in all cases, except in feeding of fur animals.

Article 21, Collection and identification as regards category and transport

1. *Operators shall collect, identify and transport animal by-products without undue delay under conditions which prevent risks arising to public and animal health.*

2. *Operators shall ensure that animal by-products and derived products are accompanied during transport by a commercial document or, when required by this Regulation or by a measure adopted in accordance with paragraph 6, by a health certificate.*

3. *By way of derogation from the first subparagraph, the competent authority may authorise the transport of manure between two points located on the same farm or between farms and users of manure within the same Member State without a commercial document or health certificate (or an alternative system).*

4. *Commercial documents and health certificates accompanying animal by-products or derived products during transport shall at least include information on the origin, the destination and the quantity of such products, and a description of the animal by-products or derived products and their marking, when such marking is required by this Regulation.*

Article 22, Traceability

1. *Operators consigning, transporting or receiving animal by-products or derived products shall keep a record of consignments and related commercial documents or health certificates.....*

2. *The operators referred to in paragraph 1 shall have in place systems and procedures to identify:*

    a. *the other operators to which their animal by-products or derived products have been supplied; and*

 doi: 10.5281/zenodo.215293

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b. *the operators from whom they have been supplied.*

Article 23, Registration of operators, establishments or plants

1. *With a view to registration, operators shall:*

   a. *before commencing operations, notify the competent authority of any establishments or plants under their control which are active at any stage of the generation, transport, handling, processing, storage, placing on the market, distribution, use or disposal of animal by-products and derived products;*

   b. *provide the competent authority with information on:*

      I. *the category of animal by-products or derived products under their control;*

      II. *the nature of the operations performed using animal by-products or derived products as starting material.....*

Article 24, Approval of establishments or plants

1. *Operators shall ensure that establishments or plants under their control are approved by the competent authority, where such establishments or plants carry out one or more of the following activities:*

   a. *processing of animal by-products by pressure sterilisation, by processing methods referred to in point (b) of the first subparagraph of Article 15(1) or by alternative methods authorised in accordance with Article 20;*

   b. *disposal, as waste, by incineration of animal by-products and derived products, excluding establishments or plants which have a permit to operate in accordance with Directive 2000/76/EC;*

   c. *disposal or recovery of animal by-products and derived products, if they are waste, by co-incineration, excluding establishments or plants which have a permit to operate in accordance with Directive 2000/76/EC;*

   d. *use of animal by-products and derived products as fuel for combustion;*

   e. *manufacturing of pet food;*

   f. *manufacturing of organic fertilisers and soil improvers;*

   g. *transformation of animal by-products and/or derived products into biogas or compost;*

   h. *handling of animal by-products after their collection, by way of operations such as sorting, cutting, chilling, freezing, salting, removal of hides and skins or of specified risk material;*

   i. *storage of animal by-products;*

   j. *storage of derived products intended to be … (landfill, feed, fertilisers)....*

Article 25 General hygiene requirements

1. *Operators shall ensure that establishments or plants under their control carrying out the activities referred to in Article 24(1)(a) and (h):*

   a. *are constructed in a way permitting their effective cleaning and disinfection and where appropriate the construction of floors facilitates the draining of liquids;*

 doi: 10.5281/zenodo.215293

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b. *have access to adequate facilities for personal hygiene such as lavatories, changing rooms and washbasins for staff;*

c. *have appropriate arrangements for protection against pests, such as insects, rodents and birds;*

d. *keep installations and equipment in good condition and ensure that measuring equipment is calibrated regularly; and*

e. *have appropriate arrangements for the cleaning and the disinfection of containers and vehicles in place to avoid risks of contamination.*

2. *Any person working in the establishment or plant referred to in paragraph 1 shall wear suitable, clean and, where necessary, protective clothing.*

a. *persons working in the unclean sector shall not enter the clean sector without first changing their work clothes and shoes or without having disinfected them;*

b. *equipment and machinery shall not be moved from the unclean to the clean sector without first being cleaned and disinfected; and*

c. *the operator shall establish a procedure relating to the movements of persons in order to monitor their movements and describe the correct use of footbaths and wheel baths.*

3. *In establishments or plants carrying out the activities referred to in Article 24(1)(a):*

a. *animal by-products shall be handled in such a way as to avoid risks of contamination;*

b. *animal by-products shall be processed as soon as possible. After processing, derived products shall be handled and stored in such a way as to avoid risks of contamination;*

c. *where appropriate, during any processing applied to animal by-products and derived products every part of the animal by-product and derived products shall be treated to a given temperature for a given period of time and risks of re-contamination shall be prevented;*

d. *the operators shall check regularly the applicable parameters, particularly temperature, pressure, time, size of particles, where appropriate by automatic devices;*

e. *cleaning procedures shall be established and documented for all parts of the establishments or plants.*

Article 26 Handling of animal by-products within food businesses

1. *The treatment, processing or storage of animal by-products in establishments or plants approved or registered in accordance with Article 4 of Regulation (EC) No 853/2004 or in accordance with Article 6 of Regulation 852/2004 shall be carried out under conditions which prevent cross-contamination and if appropriate in a dedicated part of the establishment or plant.*

2. *Raw materials for the production of gelatine and collagen not intended for human consumption may be stored, treated or processed in the establishments specifically authorised in accordance with Regulation 853/2004, Annex III, Section XIV, Chapter I, point 5, and Section XV, Chapter I, point 5, provided the transmission of disease risk is prevented by segregation of such raw materials from the raw materials for the production of products of animal origin.*

 doi: 10.5281/zenodo.215293

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

REGULATION 142/2011 IMPLEMENTING REGULATION 1069/2009 LAYING DOWN HEALTH RULES AS REGARDS ANIMAL BY-PRODUCTS AND DERIVED PRODUCTS NOT INTENDED FOR HUMAN CONSUMPTION

Annex VIII, Section 2 Temperature conditions

1. *The transport of animal by-products destined for the production of feed material or raw pet food must take place at an appropriate temperature, in the case of animal by-products from meat and meat products which have been destined for purposes other than human consumption, at a maximum of 7 °C, unless they are used for feeding purposes in accordance with Chapter I of Annex II, in order to avoid any risk to animal or public health.*

2. *Unprocessed Category 3 material destined for the production of feed material or pet food must be stored and transported chilled, frozen or ensiled, unless: (a) it is processed within 24 hours after collection or after the end of storage in chilled or frozen form, if the subsequent transport takes place in means of transport in which the storage temperature is maintained; (b) in the case of milk, milk-based products or milk-derived products which have not been subject to any of the treatments referred to in Part I of Section 4 of Chapter II of Annex X, it is transported chilled and in insulated containers, unless risks can be mitigated by other measures, due to the characteristics of the material.*

 doi: 10.5281/zenodo.215293

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

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 doi: 10.5281/zenodo.215293