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THE LANDING OBLIGATION AND ITS IMPLICATIONS ON THE CONTROL OF FISHERIES

STUDY

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POLICY DEPARTMENT B: STRUCTURAL AND COHESION POLICIES

FISHERIES

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STUDY

This document was requested by the European Parliament's Committee on Fisheries.

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Abstract

This study reviews the impacts of the new Common Fisheries Policy (CFP) rules requiring catches in regulated fisheries to be landed and counted against quotas of each Member State ("the landing obligation and requiring that catch of species subject to the landing obligation below a minimum conservation reference size be restricted to purposes other than direct human consumption. The study estimates the level of discarded fish likely to be covered by the new rules, the impact of the rules on EU fisheries and the regulatory challenges and responses to them.

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LIST OF ABBREVIATIONS

ABP	animal by-products
AFMA	Australian Fisheries Management Authority
AIS	automated information system
ALK	age length keys
CCTV	closed circuit television
CFP	Common Fisheries Policy
CQMS	catch quota monitoring scheme
DATRAS	Database of Trawl Surveys
DCF	Data Collection Framework
EFAD	European Fish Auction DataNet
ELB	electronic log book
EM	electronic monitoring
EMFF	European Maritime and Fisheries Fund
ER	electronic reporting
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FDF	fully-document fishery
ICES	International Council for the Exploration of the Sea
IMR	Institute of Marine Resources (Norway)
ITQ	individual transferable quota
MCRS	minimum conservation reference size
MCS	monitoring, control and surveillance

MLS minimum landing size

MRIP Marine Recreational Information Program (United States)

MS Member State

NMFS National Marine Fisheries Service (United States)

REM remote electronic monitoring

RTC real-time closure

STECF Scientific, Technical and Economic Committee on Fisheries

TAC total allowable catch

uMLS under minimum landing size

VMS vessel monitoring system

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EXECUTIVE SUMMARY

Background

The **'new CFP basic Regulation'** (European Parliament and Council Reg. No.1380/2013) establishes a phased introduction of a landing obligation (also known as the discard ban) under which catches of regulated species (principally fish which are subject to catch limits, or in the Mediterranean, minimum sizes) must be landed and counted against quotas of each Member State. The **landing obligation** starts on 1 January 2015 for pelagic fisheries, and introduces other fisheries through to 1 January 2019. The introduction of the landing obligation to land all catches was one of the most significant reform elements in the new CFP, and represents a fundamental shift in the management approach to EU fisheries as quotas now control what is caught at sea, rather than what is landed onshore.

Under **Article 15(11)** of the new CFP basic Regulation, which deals with the landing obligation, use is restricted to purposes other than direct human consumption, including fish meal, fish oil, pet food, food additives, pharmaceuticals and cosmetics. The expectation is that the landing requirement combined with the restriction to non-human consumption purposes will encourage fishers to **internalise the costs of catching unwanted fish** and motivate them to avoid unwanted catch, for example by altering their fishing practices. However, these measures can only go so far and unwanted catches will inevitably continue to occur. Consequently, Member States need to address the problem of how to manage these unwanted catches and how to control them once they have arrived in port.

Aim

The study addresses **two key aspects** of the landing obligation. The first focuses on problems generated by the new rules on ports related to the landing of juvenile fish not intended for human consumption. The second focuses on the control and enforcement side of this new rule regarding the landing obligation.

Problems related to landing obligation of juveniles

The study aims to **estimate**, by revising existing scientific data and studies on landing obligation, the **volume of unwanted catches** produced by the main fisheries and to assess which ports are likely to be affected. It will also analyse the potential final destinations of these catches and the needs for Member States to adapt to potential new markets for non-human consumption. It will analyse how this new provision can encourage fishermen to direct their fishing operations for immature fish for those potential new markets, and how to avoid unwanted fisheries targeting immature fish.

Control of the landing obligation:

The second part of the study focuses on what changes might be needed to adapt the existing regulations on control and technical measures (taking account also of the adaptations proposed in the so-called "Omnibus Regulation"). It will review the potential approaches and measures that Member States might use to improve control of the landing obligation. It will **identify new methods and technologies** which can play a positive role in the implementation of the reform in terms of ensuring simplification and resource maximization, taking stock of innovative control measures already in place around the world.

Based on these analyses, the study seeks to make **substantiated recommendations** on the way the European Parliament can help Member States and the Commission move forward on the implementation of the landing obligation.

Main elements of the study

1) **High-levels of discards** have been considered an issue in European and global fisheries for many years. Although discards globally are recognised to be substantial, there are **no recent reliable estimates**. They have previously been estimated to be as much as 33% of global marine catch in commercial fisheries. Discards vary throughout EU fisheries – in some cases representing more than 60% of the catch, while in other cases – including pelagic fisheries – being very low.

2) The **need to reduce discards** in European fisheries has long been recognised, and the elimination of discarding and unwanted catches was identified as one of the main objectives under the 2012 reform of the Common Fisheries Policy. In the new CFP basic Regulation (adopted in 2013), the EU introduced new rules on discards including:

    a) a "**landing obligation**" under which all catches of regulated species must be landed and counted against quotas of each Member State; and

    b) a requirement that catch of species subject to the landing obligation below a **minimum conservation reference size** be restricted to purposes other than direct human consumption.

3) The new obligation was introduced on **1 January 2015** for small and large pelagic and industrial fisheries and some Baltic Sea fisheries and will be introduced for various other fisheries according to a specific schedule ending on **1 January 2019**.

4) A preliminary question underlying the impact of the landing obligation and the related requirements concerns **estimation of the volume of unwanted catches** produced by the fisheries affected by the new rules. Under the rules, only bycatch [or: formerly discarded fish] under the minimum landing size will have to come ashore and put to the non-human consumption market; there will be no unwanted over-quota fish. Existing catch data sources do not provide the proportion of undersized fish in the discarded component of the catch, so a specific methodology was therefore developed in order to develop the estimates required.

5) The overall discard rates (based on all regulated species and including over-quota (large fish) and under minimum landing size discards (uMLS) (small fish) varied between **1%** in gears such as pots and traps, dredges and longlines and **60%-70%** for beam and otter trawlers. The gears with highest mean discard rates were the beam and the otter trawlers, with **34%** and **25%** discard rates across all countries.

6) Estimations indicated that **11% (around 44,000 tonnes)** of the total catches (excluding pelagic species) were of fish under minimum landing size, across all the countries from which data were available. These estimations assume that there are no changes in fishing behaviour and gear selectivity and full compliance with the landing obligation. Data showed that the Netherlands, United Kingdom, France and Belgium are the countries that potentially will be most affected with landings for non-human markets, while the gears with the highest catches of under sized fish were the beam and the otter trawlers, with **15%** and **10%** of catches were undersized, respectively.

7) Based on a demersal landing estimation (1.4 million tonnes/year) and on the proportion of undersized fish (4%), the **total volume of undersized fish** being landed in the European ports could be **estimated at 56,000 tonnes**.

8) The introduction of the landing obligation generates a number of specific practical considerations for ports, and it is helpful to develop an assessment of the key ports likely to be affected by the new regulations, and reviews their readiness (in terms of infrastructure and services) to handle the new landings. Among the challenges to be addressed by ports are the need to ensure that the **equipment, infrastructure and logistics are sufficient** to deal not only with an increase in landings, but also landings subject to separate regulatory conditions and destined for separate markets

9) Based on the proportion of historical landings, the landings of undersized fish for the non- human consumption market will be concentrated in a **few main ports**. There will also be many small ports where small quantities will be landed, however, collectively these ports could also receive large quantities of undersized discards. In larger ports, there are some existing arrangements for **onshore processing of non-human consumption fish** (predominantly the collection of fish by-products for fishmeal production) but for the collection of shellfish by-products, these facilities currently appear much more limited. There is little evidence available on the ability for smaller ports to handle fish for the non-human consumption market. It is assumed that there is currently little infrastructure at these ports to support the landing of this material.

10) Potentially one of the most challenging impacts of the landing obligation is the need to find uses for the unwanted catches. The combined effect of the requirements to land fish and to restrict use for non-human consumption is to increase the supply of fish (of different species) for the non-human consumption market. There are already some market opportunities for these catches, but it is clear that **new markets will need to be developed** if the supply is to be fully utilized. This presents some market opportunities and some market challenges.

11) While there are potential new uses, potential new markets and potential for existing market expansion for the newly landed fish (and evidence of commercial and investment interest in these opportunities) there are some **challenges for commercial development**. For example, the onward infrastructure and logistics to handle this material onshore may not exist in every location or might be ineffectively or inefficiently set up towards using these fish. There may need to be adaptations both in port and in business organisation. Most significantly, however, the commercial / investment environment is difficult. Currently, it is difficult to estimate both the level of supply of these fish (and the location of that supply) and the demand (since some of the markets are new). Moreover, since the overriding objective of the new discard rules is to reduce unwanted catches as far as possible, and since it is anticipated that unwanted catches will be reduced – for example through enhancements in fishing gear selectivity and changing fishing patterns and behaviour – the supply of this fish has the potential to decrease over time.

12) One of the key challenges implicit in the landing obligation is the need to consider and develop **regulatory and enforcement adaptations**. The implementation, monitoring and control of the landing obligation each generate new challenges. In particular, the focus of monitoring and control shifts from landing to activities at sea.

13) In this context, there is much focus on **electronic technologies** (electronic reporting and electronic monitoring systems) which represent a potentially cost-effective means to widen observation of activities at sea, and several countries have begin to develop and implement EM systems.

14) European **trials of REM technologies** in pelagic fisheries illustrate both (1) very strong potential to use CCTV-based REM to monitor fishing vessels and (2) potential cost savings in the long-term for both fishing vessels and public administration (although initial set-up costs are high). There is more doubt, however, about the capacities of REM to monitor more complex fisheries effectively. Trials in a mixed

bottom-trawl fishery exposed limitations, for example in the ability to distinguish small numbers of cod in catches.

15) In addition to REM, consideration must be given to adapting other aspects of the regulatory and enforcement approach. **Complementary enforcement measures** such as using catch composition comparisons based on a reference fleet are demonstrating advantages in supplementing scientific, management and MCS data. Existing MCS methodologies, such as VMS and on-board observer programmes, will continue to be needed but will need to be adapted to integrate with any new regulatory and enforcement measures.

16) Attention must also be given to **adapting and developing technical measures**. Key technical measures to avoid bycatch and discarding include spatio-temporal management and flexible development of more effective gear technologies and methods.

17) Social and behavioural impacts are often under-estimated in fisheries management, and frequently inadequately addressed***.*** It is anticipated the new discard rules will influence the **decisions made by fishers** about **where**, **when** and **how to fish** and that they will be motivated to avoid catching low value fish.

18) The **motivation to change selectivity** is based on three assumptions: (1) there is an **economic advantage** to avoid small and juvenile fish; (2) fishers have the **ability to change selectivity**; and (3) there is **effective enforcement and control**. Regarding (1), the relatively low value of fish for non-human consumption markets means it is unlikely that there will be incentive for fishers to target more of the fish currently discarded, meaning in turn that there will be an economic advantage to avoid small and juvenile fish. Regarding (2), it is recognized that fishers in general do have the ability to change selectivity and trials in European fisheries are generating positive results. Regarding (3), instrumental incentives including economic gains and deterrence are crucial for the behaviour of fishers. Fishers' acceptance of regulations is influenced by whether the implementation effects are considered fair, whether the imposed regulations are perceived as meaningful and whether there is compatibility between the regulation and the traditional fishing patterns and practices.

19) There is a risk that the measures will **stimulate new black market trade**, given that catches could reach higher prices on human consumption black markets than non-human consumption markets. It is also recognised that the landing obligation may facilitate illegal trade because it will be usual to transport undersized specimens in the hold (whereas previously, such fish had to be discarded and could not be brought to land with risk of detection at sea).

Recommendations

Recommendation 1 (Remote electronic monitoring trials). Remote electronic monitoring is demonstrating sufficient potential to be **pursued more extensively**. In the short-term, further trials should be developed and implemented and analysis made of outstanding technical and governance issues. These should continue to be industry-led and reward based. Proposals at the regional level should be developed for other reward-based schemes. Funding in support of these initiatives should be made available through the EMFF.

Recommendation 2 (Remote electronic monitoring Regulation). Without displacing the option to develop specific REM plans at the regional or fishery level, the European Commission should develop a **proposal for a Regulation on a governance and legal framework for REM**. The Regulation should clarify the distribution of responsibilities between the scientific and control institutions to ensure adequate quality proofing and use of the data (including, for example, storage and access to data, legal obligation to delete videos, choice of hauls to be monitored, estimation methods, coupling of FDF data with e-log information, etc.) and the role and use of REM data in enforcement processes.

Recommendation 3 (Reference fleet). Using reference fleet (catch composition comparisons) could supplement remote electronic monitory systems, as well as provide additional data for scientific assessment and management decision-making. European level rules would need to be developed concerning matters such as harmonised management approaches and enforcement and legal implications of comparisons in individual cases, but specific fishery schemes could be developed at the regional level.

Recommendation 4 (Data needs). Data needs in support of the landing obligation need to be fully assessed. A specific **short to medium term strategy is needed** to permit the full use of control and monitoring tools applicable to the enforcement of the landing obligation, taking into account the development and compilation of data necessary for their implementation, capacity building for industry and administrations in the use of new technologies and the development of the technical infrastructure.

Recommendation 5 (Accompanying measures). Industry needs to play a leading role in **developing and trialling new technical and management measures** to accompany enforcement efforts, and this needs to be facilitated though co-management approaches. Industry schemes to reward vessels that are successful in increasing selectivity should be developed.

Recommendation 6 (Gear selectivity). The development and implementation of technical measures needs to accommodate a **culture shift**, based on a flexible framework designed **to ensure better management**, rewarding good practices and relying less on detailed and prescriptive technical rules. Fishing gear and method adaptations should be developed within the regional framework, in close cooperation with industry. Thus, while basic or default requirements can be set at European level, there should be the option to override these at regional and specific fishery level.

Recommendation 7 (Spatio-temporal closures). Wider use should be used of spatio-temporal closures and a technical measure. There is scope to develop a Europe-wide regulation setting out basic requirements to **change the fishing ground (move-on)** when the **fishing operation begins to contravene the regulations**, for example whenever bycatch limits or the permitted intermixture of undersized fish have been exceeded. At the same time, regional planning and regional schemes could be developed which determine the practical modalities of the scheme and create information sharing platforms that would enable move-on decisions to be made and communicated quickly.

Recommendation 8 (Quota and discarding flexibilities). In the medium to long-term, strategies and proposals should be developed to utilise the quota and discarding flexibilities in Article 15 of the CFP. In the short-term, the focus should be on further research and on developing pilot projects (e.g. pilot projects aimed at increasing the survival rates).

Recommendation 9 (Utilisation of landed bycatch). In the short-term, close cooperation between industry and the public sector is needed to minimise uncertainties that act as a constraint to investment. Governments and sector leaders need to encourage the necessary parties to **initiate collaborative pilot projects relating to logistics and marketing opportunities**, including supporting feasibility studies and pilot projects where there is a need. Financial support (including through the EMFF) should be provided to such schemes.

Recommendation 10 (Utilisation of landed bycatch). The long-term efficacy of the marketing rules needs to be kept under close scrutiny. The possibility should also exist in future evaluations, for **incentive-based systems** to be developed at the regional level and for different schemes to be developed in different regions, or even within the same region but for different fisheries/products – this would enable successful markets to continue, but provide alternatives where the measure was not working.

Recommendation 11 (Adapting the regulatory approach). Guidelines (and, if necessary, regulatory requirements or inter-institutional agreements) need to be introduced on the consultation process and requirements for regional discard plans.

Recommendation 12 (Adapting the regulatory approach). In the longer-term, more extensive **regional co-management needs to be developed**. This needs to be set out in a specific Regulation, dealing with the distribution and delegation of roles, responsibilities and decision-making authority and the oversight mechanism for the European Commission.

GENERAL INFORMATION

KEY FINDINGS

- **High-levels of discards** have been considered an issue in European and global fisheries for many years.
- Although discards globally are recognised to be substantial, there are **no recent reliable estimates**. They have previously been estimated to be as much as 33% of global marine catch in commercial fisheries.
- **Discards vary** throughout EU fisheries – in some cases representing more than 60% of the catch, while in other cases – including pelagic fisheries – being very low.

Globally, high levels of discards in many fisheries have been considered an issue for many years. And within the EU, the fishing industry has been under increasing pressure both to reduce bycatch and discards and, more recently, seek ways to avoid waste from incidental captures. Discarding, where a portion of catch taken by a fishing vessel, is returned to the sea dead or alive (FAO 2010), occurs for various reasons – for example, catches might be discarded if they are in excess of a quota limit, or of poor quality, small size, of a non-commercial species or a low market value (Catchpole, et al. 2005). However, the practice is widely regarded as a waste of living resources (human food and economic resources, biological resources) and a source of unaccounted mortality as long as this catch is unreported and mortality rates of releases uncertain, increasing the uncertainty of stock assessments (Diamond and Beukers-Stewart 2011, Cardinale and Svedäng 2008, Jensen and Vestergaard 2002).

It is widely perceived that discarding is not just a consequence of non-selective fishing practices, but also of non-existent, inadequate or clumsy management regulations (Bellido, et al. 2011, Cardinale and Svedäng 2008, Hall and Mainprize 2005). Looking at examples such as that of Norway, which adopted discarding bans for cod and haddock in 1987, extending to the majority of species in 2009, European public opinion has in recent years pressed for changes in EU policy to limit discarding (Uhlmann 2013, Fish Fight 2011, European Commission 2007).

The discard problem

Mortality rates associated with bycatch can be very high. Thus, bycatch represents a suboptimal use of marine resources: adding to the depletion of already heavily exploited stocks, delaying or preventing the recovery overfished stocks, depleting prey resources for other fisheries, and causing the early closure of fisheries when catch or bycatch quotas of commercial or protected species are exceeded. The economic impact of these effects can be substantial. The global opportunity cost of depleted and overcapacity fisheries has been projected to be 44.8 billion Euros a year (Arnason et al., 2009).

The full impacts on marine communities of discarding are not well understood (Catchpole et al., 2005). However, given that species caught and subsequently discarded from fishing vessels could die as a result, discarding leads to a loss of potential income and food for humans, as well as impacting on marine ecosystems. Income is lost through the loss of potential growth and contribution to stock replacement when small or juvenile commercial fish are caught and killed. Extensive discarding of commercial species results in substantial forgone potential yield and for declining stocks, discarding impedes rebuilding (ICES 2003).

Global context of fisheries discards

According to the UN Food and Agricultural Organisation (FAO), bycatch and discards remain a major concern, globally (FAO, 2014). Although the overall global bycatch situation is not well understood, two studies commissioned by FAO (although neither recent) provide some indication of the scale of the problem. The first assessment (Alverson *et al.* 1994) estimated that between 17.9 and 39.5 million tonnes (averaging 27 million tonnes – equivalent to about 33% of the then total global marine catch) of fish are discarded each year in commercial fisheries.

Ten years later, a second estimate (Kelleher 2005) applied a different methodology and estimated the weighted average rate of discards in the world's fisheries to be substantially lower at 7.3 million tonnes. Recognising that differences in methodologies meant the two studies were not directly comparable, Kelleher put forward three reasons for a discard decline: (1) decrease in effort and change of target species in some major trawl fisheries, (2) changes in regulatory regimes that required greater selectivity in fishing, and (3) changes in regulatory regimes leading to a greater incentive to utilise what would otherwise be discarded.

European context of fisheries discards

In the European Union, discards represent a major source of undocumented (or poorly documented) mortality, contributing to the overfishing of European fish stocks (European Commission, 2011a). Discarding levels in EU fisheries vary between locations, gears, species and fishing grounds (Sigurðardóttir 2015, Uhlmann et al. 2013). In general, it is clear that there is a relationship between the selectivity of the fishing gears and the percentage of catch discarded. The use of gears of large mesh size incurs less discarding (10-15% by weight) than the use of gears of small mesh size (50% or more in some cases) (Villasante 2015).

The discarded proportions in trammel net fisheries vary between 20% in the Northeast Atlantic to 40% in the North Sea (Tzanatos 2007, STECF 2006). Similarly, proportions discarded by trawl fisheries will vary with fishing ground, and also between trawl types (Uhlmann et al. 2013, Feekings 2013). Northeast Atlantic pair trawlers discard from 40% to 60% of their catch, while single bottom trawlers discard between 20% and 40% of their catch throughout the Northeast Atlantic (STECF 2006). In the Mediterranean, discard ratios from bottom trawlers show high differences among areas and operations, varying from 20% to 65% (Tsagarakis 2014, Bellido 2014). For pelagic fisheries discard ratios are generally known to be low, although the discards data available for these fisheries is very limited.

There is little available data or analysis which directly address the composition of discards in terms of being undersized fish (i.e. fish discarded on account of it being undersized) or quota-driven discards (i.e. larger fish – over the legal minimum landing size, or "minimum conservation reference size", as it is termed in the new CFP basic Regulation, but discarded due to lack of quota). A key challenge of the present study therefore was to analyse the data that does exist, in order to provide meaningful estimates of discards of undersized fish.

1. THE LANDING OBLIGATION

KEY FINDINGS

- The **elimination of discarding and unwanted catches** was identified as one of the main objectives under the 2012 reform of the Common Fisheries Policy (CFP).
- In the new CFP basic Regulation (adopted in 2013), **the EU introduced new rules on discards including**:

a) a "**landing obligation**" under which all catches of regulated species must be landed and counted against quotas of each Member State; and

b) a requirement that catch of species subject to the landing obligation below a **minimum conservation reference size** be restricted to purposes other than direct human consumption.

- The **new obligation was introduced on 1 January 2015** for small and large pelagic and industrial fisheries and some Baltic Sea fisheries and will be introduced for various other fisheries according to a specific schedule ending on **1 January 2019**.

The elimination of discarding and unwanted catches was identified as one of the main objectives under the 2012 reform of the Common Fisheries Policy (European Commission 2011, 2011a, 2011b). The new Common Fishery Policy (CFP) basic Regulation[1] introduced a new provision on the so-called "landing obligation" under which all catches of regulated species must be landed and counted against quotas of each Member State. The new obligation was introduced on 1 January 2015 for small and large pelagic and industrial fisheries and some Baltic Sea fisheries and will be introduced for various other fisheries according to a specific schedule ending on 1 January 2019.

In particular, for the purposes of the present study, Article 15(11) establishes that "for the species subject to the landing obligation as specified in paragraph 1, the use of catches of species below the minimum conservation reference size shall be restricted to purposes other than direct human consumption, including fish meal, fish oil, pet food, food additives, pharmaceuticals and cosmetics." This means that Member States need to address a number of new problems, including how to promote and ensure selectivity in the fisheries concerned, how to manage the unwanted catches and ensure compliance with the discarding rules and how to control them once they have arrived in port. In practice, successful implementation of the new discarding rules in going to require support through a range of measures and approaches, including those addressing technical, commercial, social, legal or regulatory and enforcement aspects.

1.1. History of discards management in the EU

Before the recent reform the EU Common Fisheries Policy, the general approach to discards was to prohibit the landing of catch that did not match certain prescribed catch compositions, legal minimum landing sizes (MLS) or Total Allowable Catches (TACs) (European Commission, 2002). Catch which could not lawfully be landed, therefore had to be discarded. A key rationale to this was that fishers ought to be discouraged from catching non-target or non-quota fish if they could not land it, but in practice the regulatory

[1] Regulation (EU) of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, Official Journal L 354/22, 28.12.2013.

approach had various flaws. For example, only those fish that were landed were deducted from a quota allocation, which meant (since there was no limit on the quantity of fish that fishers could throw back to the sea) that determined TACs did not effectively limit the removal of fish from the stock. It also meant that fishers were motivated to maximise the catch of marketable fish for which they had quota, without having to consider how much unwanted fish was also caught. During the progression of the CFP, various technical and some control measures were introduced to mitigate the discarding problem, but it was not until the 2013 reform that a substantially new approach was introduced.

1.2. The landing obligation

The reformed Common Fisheries Policy represents a fundamental shift in fisheries management by switching the focus from the regulation of landings to the regulation of total catches. There are three changes related to the practice of discarding that have been introduced, all with the aim of improving the control of fishing mortality and the management of fish resources. The first is that all catches of regulated fish will be deducted from a quota; this includes fish that are caught under the **Minimum Conservation Reference Size** (MCRS), previously known as the **Minimum Landing Size** (MLS). The second is that once a quota has been fulfilled, no further fish can be caught from that stock, and fishing operations that catch fish from that stock will stop. The third is that all regulated fish will have to be retained on-board the vessel and landed.

Box 1: **The "Landing obligation"**

Art. 15(1): All catches of species which are subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes [...], caught during fishing activities in Union waters or by Union fishing vessels outside Union waters in waters not subject to third countries' sovereignty or jurisdiction, in the fisheries and geographical areas listed below **shall be brought and retained on board the fishing vessels, recorded, landed and counted against the quotas where applicable**, except when used as live bait [...].

Source: CFP basic Regulation, Art. 15(1), emphasis added

Further to these changes is the market restriction introduced for fish below a prescribed length for regulated species. All fish below the Minimum Conservation Reference Size will have to be landed, but can only be sold for non-human consumption purposes. The Regulation lists certain non-human consumption purposes (such as fish meal, fish oil, pet food, etc.) but it is clear that the list is not exhaustive. The principle behind this restriction is based on the assumption that the profits available from non-human consumption markets are substantially lower than that from the human consumption market. Therefore, fishers should be discouraged from targeting small fish below the MCRS, and instead target the sizes classes of fish for the human consumption markets which are of highest value and give the highest economic return. At the same time, any undersized fish that are not caught will not be wasted, as they must still be landed.

Box 2: **Requirements for undersized fish**

Art. 15(11): For the species subject to the landing obligation as specified in paragraph 1, **the use of catches of species below the minimum conservation reference size shall be restricted to purposes other than direct human consumption**, including fish meal, fish oil, pet food, food additives, pharmaceuticals and cosmetics.

Source: CFP basic Regulation, Art. 15(11), emphasis added

The CFP basic Regulation envisages that specific monitoring and control measures will be taken to help ensure compliance with the landing obligation. Such measures need to be provided through "adequate capacity and means", but subject to the principle of "efficiency and proportionality".

Box 3: **Requirements for monitoring compliance**

Art. 15(13): For the purpose of monitoring compliance with the landing obligation, Member States shall ensure detailed and accurate documentation of all fishing trips and adequate capacity and means, such as observers, closed-circuit television (CCTV) and others. In doing so, Member States shall respect the principle of efficiency and proportionality.

Source: CFP basic Regulation, Art. 15(13)

In order to mitigate the strict implications of the new discarding rules, and provide a degree of flexibility to the fishing industry, the Regulation contains a number of – limited and strictly proscribed – exceptions to the discarding and landing rules. They include:

a) The ability to deduct catches of a species, for which quota is no longer available, from the quota of another species, by up to 9% of the quota of the target species, a mechanism referred to as interspecies flexibility.

Box 4: **Inter-species flexibility derogation**

Art. 15(8): By way of derogation from the obligation to count catches against the relevant quotas in accordance with paragraph 1, catches of species that are subject to the landing obligation and that are caught in excess of quotas of the stocks in question, or catches of species in respect of which the Member State has no quota, may be deducted from the quota of the target species provided that they do not exceed 9% of the quota of the target species. This provision shall only apply where the stock of the non-target species is within safe biological limits.

Source: CFP basic Regulation, Art. 15(8)

b) The availability of year-to-year flexibility, sometimes referred to as the banking and borrowing provision, whereby up to 10% of a quota can be utilised in addition to the full quota or saved to be utilised in the next year.

Box 5: **Year-to-year flexibility derogation**

Art. 15(9): For stocks subject to the landing obligation, Member States may use a year-to-year flexibility of up to 10% of their permitted landings. For this purpose, a Member State may allow landing of additional quantities of the stock that is subject to the landing obligation provided that such quantities do not exceed 10% of the quota allocated to that Member State.

Source: CFP basic Regulation, Art. 15(9)

c) The ability to gain exemption from the landing obligation under specific agreed circumstances, namely, proven high survival of discarded fish, proven difficulties in improving selectivity and evidenced disproportionate costs of handling the otherwise discarded material. These last two are included within the *de minimis* provision, under which up to 5% (7% and 6% in the first 2 years respectively) of the total annual catch can be exempted from the landing obligation.

Box 6: De minimis exemption

Art. 15(4): The landing obligation referred to in paragraph 1 shall not apply to [...] catches falling under *de minimis* exemptions.

Art. 15(5): Details of the implementation of the landing obligation referred to in paragraph 1 shall be specified in multiannual plans referred to in Articles 9 and 10 and, where relevant, further specified in accordance with Article 18, including [...] provisions for *de minimis* exemptions of up to 5% of total annual catches of all species subject to the landing obligation referred to in paragraph 1.
The *de minimis* exemption shall apply in the following cases:
(i) where scientific evidence indicates that increases in selectivity are very difficult to achieve; or
(ii) to avoid disproportionate costs of handling unwanted catches, for those fishing gears where unwanted catches per fishing gear do not represent more than a certain percentage, to be established in a plan, of total annual catch of that gear. [...].

Source: CFP basic Regulation, Art. 15(4) and (5), emphasis added

1.3. Implementation of the landing obligation

The expectation is that the requirements will encourage fishers to internalise the costs of catching unwanted fish and will motivate fishers to avoid the catch of low value and the most quota-restricted species. It is expected that for fishers to maximise the revenue from their quotas, fishing methods will need to change. However, these measures can only go so far in addressing the problem of unwanted catches. Given the mixed nature of many fisheries, and the current scale of unwanted catches, along with other technical, social and economic factors, unwanted fish will continue to be caught and previously discarded fish will have to be landed. This means that Member States need to address the problem of how to manage those unwanted catches and how to control them once they have arrived in port.

The new landing obligation also generates a need to review and update the control and technical regulations, and will require new methods, practices and technologies to control the application of the landing obligation from Member States. In particular, the focus of monitoring and control shifts from landing to activities at sea, while other challenges exist in ensuring products do not find their way into black markets or, once landed for the non-human consumption market back into the human consumption market.

The landing obligation will be applied fishery by fishery. Details of the implementation will be included in multi-annual plans, or in specific discard plans when no multi-annual plan is in place. These details include the species covered, provisions on catch documentation, minimum conservation reference sizes, and exemptions (for fish that may survive after returning them to the sea, and a specific *'de minimis'* discard allowance under certain conditions). Quota management will also become more flexible in its application to facilitate the landing obligation. The first five discard plans were adopted by the Commission in October 2014, in preparation of the implementation of the landing obligation for pelagic and industrial fisheries and Baltic cod fisheries.[2]

[2] Commission Delegated Regulation (EU) No 1392/2014 of 20 October 2014 establishing a discard plan for certain small pelagic fisheries in the Mediterranean Sea; Commission Delegated Regulation (EU) No 1393/2014 of 20 October 2014 establishing a discard plan for certain pelagic fisheries in north-western waters; Commission Delegated Regulation (EU) No 1394/2014 of 20 October 2014 establishing a discard plan for certain pelagic fisheries in south-western waters; Commission Delegated Regulation (EU) No 1395/2014 of 20 October 2014 establishing a discard plan for certain small pelagic fisheries and fisheries for industrial purposes in the North Sea; Commission Delegated Regulation (EU) No 1396/2014 of 20 October 2014 establishing a discard plan in the Baltic Sea.

2. ESTIMATION OF UNWANTED CATCHES

KEY FINDINGS

- The **overall discard rates** (based on all regulated species and including over-quota (large fish) and under minimum landing size discards (uMLS) (small fish) varied between 1% in gears such as pots and traps, dredges and longlines and 60%-70% for beam and otter trawlers. The gears with highest mean discard rates were the beam and the otter trawlers, with 34% and 25% discard rates across all countries.
- Estimations indicated that **11% (around 44,000 tonnes) of the total catches (of species with MLS, excluding pelagic species) were of fish under minimum landing size**, across all the countries from which data were available. These estimations assume that there are no changes in fishing behaviour and gear selectivity and full compliance with the landing obligation.
- Data showed that **the Netherlands, United Kingdom, France and Belgium** are the countries that potentially will be most affected with landings for non-human markets.
- The gears **with the highest catches of under sized fish were the beam and the otter trawlers**, with 15% and 10% of catches were undersized, respectively.
- Based on a demersal landing estimation (1.4 million tonnes/year) and on the proportion of undersized fish (4%), **the total volume of undersized fish being landed in the European ports could be estimated at 56,000 tonnes**.

A preliminary question underlying the impact of the landing obligation and the related requirements concerns estimation of the volume of unwanted catches produced by the fisheries affected by the new rules. Under the rules, only discarded fish which are under the minimum landing size will have to come ashore and put to the non-human consumption market; there will be no unwanted over-quota fish. Such estimations can provide not only an indication of the scale and nature of the problem, but also inform later questions in this study concerning the ports that will be affected, the final destinations of catches, potential uses, etc.

Using existing catch data to estimate the proportion of undersized fish and the proportion of quota-driven discards (i.e. over the legal minimum landing size) in overall discards is difficult, however, since the data sources do not provide the proportion of undersized fish in the discarded component of the catch. A specific methodology was therefore developed in order to develop the estimates required. The following section provides an overview of data used and a description of how the discard and landings estimates were produced. Any issues of data quality are considered and highlighted in the text supporting the tables.

2.1. Materials and methods

The (historical) data need to be analysed to assess what proportion of discards were undersized (small) fish and what proportion were quota-driven discards (large fish) i.e. over the legal minimum landing size. Only currently discarded fish which are under the minimum landing size (Minimum Conservation Reference Size) will have to come ashore and put to the non-human consumption market. It is assumed that all fish currently discarded, which are above the legal Minimum Landing Size, will be put to the human consumption market.

Information on the volume of fish landings is recorded according to the control regulation (Regulation (EC) 1224/2009). Logbooks or sales slips record the volume of landings by species and size grade per management area. The control regulation also prescribes that fishers have to report all discards above 50 kg per species per trip, however, only very limited information on discards is registered in the logbooks and these data are not considered reliable to use in analyses.

Discard information is collected according to provisions in the Data Collection Framework (DCF) where Member States are obliged to carry out at-sea data collection programs. Under the DCF, national on board observer programs estimate the catch of commercial marine fisheries, in particular of those fish discarded at-sea. Observer programs provide good quality data from the sampled trips, but they are costly and therefore often have low coverage; typically around 1% of the fishing activities are covered. The low sampling levels and the inherent variation in discarding levels between trips can lead to high variability in the data.

The main source of data used for this report was the EU's Scientific, Technical and Economic Committee on Fisheries (STECF) database compiled by the STECF Expert Working Group on the Evaluation of Fishing Effort Regimes in European Waters (STECF 13-21), using national data supplied by each Member State, under the DCF requirements (http://stecf.jrc.ec.europa.eu/web/stecf/ewg1313). The STECF discard database details landings and discards estimates for a range of fisheries, areas and species covering 2003-2012. For a detailed description on how the STECF data are generated read STECF 13-21 report (STECF, 2013). As data is more reliable in more recent years, and the focus of the report is on those species subject to the landings obligation, only information on TAC (Total Allowable Catch) regulated species covering the years 2010-2012 are presented in the report.

2.1.1. Description of the STECF data presented

The STECF data are aggregated according to the geographical areas and fisheries or metiers (as defined in the Council Regulation 1342/2008). For the report, data were aggregated by country and fishery. The information on gear used and mesh size range is aggregated to provide fishery specific discard estimates (according to definitions in Council Regulation 1342/2008) and the gear/metier were grouped in higher levels of aggregation as follows (**Table 1**):

Table 1: Fishery aggregations and descriptions used in presentations of discards estimates

FISHERY	GEAR / METIER	DESCRIPTION
OTTER TRAWLS	TR1	Bottom trawls and seines of mesh size ≥ 100 mm
	TR2	Bottom trawls and seines of mesh size ≥ 70 mm < 100 mm
	TR3	Bottom trawls and seines of mesh size ≥ 16 mm < 32 mm
BEAM TRAWLS	BT1	Beam trawls of mesh size ≥ 120 mm
	BT2	Beam trawls of mesh size ≥ 80 mm ≤ 119 mm
NETTERS	GN1	Gillnets, entangling nets
	GT1	Trammel nets
LONGLINES	LL1	Longlines
DREDGE	DRB	Dredges
SEINES	SSC	seine
POTS & TRAPS	FPO	Pots and Traps

All the geographical areas presented in the STECF database were considered for this analysis and were aggregated by country. The Mediterranean area data was also compiled and presented in a separated table. The STECF areas, annexes and corresponding ICES management areas are described in **Table 2**.

Table 2: Overview of the STECF and ICES areas included in the report

STECF ANNEX	STECF AREAS	AREA	ICES MANAGEMENT AREAS
IIa	3a	Kattegat	IIIa
IIa	3b1	Skagerrak	IIIa
IIa	3b2	North Sea	IVabc
IIa	3b3	Eastern Channel	VIId
IIa	3c	Irish Sea	VIIa
IIa	3d	West Scotland	VIa
Cel1	7bcefghjk	Celtic Sea	VII bcefghjk
BoB	8a-BoB	Bay of Biscay	VIII ab
Bal		Baltic Sea	SD 22-32
IIb	8c-9	Southern Waters	VIIc and IX
WW	10	Western Waters	V, X, XII
Med	Med	Mediterranean	--

STECF landings and discard estimates are presented for regulated species only, covering the years 2010-2012. The mean landings, discards and discard rate (%DR) are presented for the three years 2010, 2011 and 2012 and the estimates are expressed in tonnage (weight). Only TAC regulated species and those subject to a minimum conservation reference size (MCRS) in the Mediterranean, were included in the analyses because only these will be subject to the landing obligation (**Annex 1**).

The report includes only data for the demersal fisheries, all the pelagic fisheries were removed from the analysis (STECF gear definitions: PEL_TRAWL; PEL_SEINE; PELAGIC TRAWLS and r-PEL_TRAWL). The pelagic fisheries were excluded from the analysis because discard ratios are generally low for the pelagic fisheries; no specific observer programmes are conducted on the pelagic and industrial fisheries in most of the Member States, so the discards data available for pelagic fisheries is very limited. Although only demersal fisheries were included, pelagic species data were included because they were caught in some demersal fisheries.

The data sources described above **do not provide the proportion of undersized fish in the discarded component of the catch**. To estimate the proportion of undersize fish in the discarded component a number of data sources were used:

- STECF landings and discards numbers-at- age: (http://stecf.jrc.ec.europa.eu/web/stecf/ewg1313)
- Age Length Keys (ALKs) ICES Database of Trawl Surveys (DATRAS): (http://www.ices.dk/marine-data/data-portals/Pages/DATRAS.aspx)
- Weight-at-age estimated for each fish stock, derived from ICES assessment working groups - WGNSSK, WGCSE, WGBIE, WGBFAS.

An age-length-key enables the conversion between the length and the age of fish. The numbers of fish discarded at length was inferred from the numbers discarded at age available in the STECF database. The ICES DATRAS Database has age-length-keys (ALKs) generated by several trawl surveys covering the Baltic Sea (BITS), Skagerrak, Kattegat, North Sea (NS_BITS), Bay of Biscay (EVHOE), English Channel, Celtic Sea, Irish Sea, West of Scotland and Southern waters (SWC-IBTS). At present, there are more than 15 years of continuous time series data in DATRAS, but we only used data between 2010 and 2012. The species with ALKs available were: cod, haddock, whiting, saithe, megrim, sole and plaice. Other species with minimum landing size (MLS), such as hake, pollack, ling, blue ling and bass did not have ALK information and they were not included for the undersized discards analyses. Using the ALKs for each geographical area (North Sea, Baltic, North Western Waters and Southern Waters), the proportion of fish under and over MLS at age was estimated. If no ALK was available for a certain species in a geographical area, it was borrowed from the nearest area.

The STECF landings and discards at age has number-at-age and, to estimate the biomass-at-age, weight-at-age information, from the ICES assessment working group reports, was applied for each stock (ICES, 2013; ICES, 2014a; ICES, 2014b; ICES, 2014c). For each year, between 2010 and 2012, landings and discards biomass at age (tonnes) was estimated by multiplying the weight-at-age with the number-at-age. The mean biomass at age of landings and discards for the three years 2010, 2011 and 2012 were calculated. To ensure consistency, the aged biomass of landings and discards were adjusted with the overall landings and discards (where these differed).The proportion of fish under MLS at age was multiplied with the biomass-at-age to estimate the biomass at age that was under MLS.

2.2. Landings and Discards by Country and Fishery

This section includes only data for the demersal fisheries, however some pelagic species are included in the overall catches because they were caught in some demersal fisheries. The data presented here are available in the STECF database, without omissions or deletions.

According with the STECF data, the countries with the highest average demersal catches between 2010 and 2012 were: Denmark, United Kingdom, Netherlands and France, with 269, 206, 150 and 135 thousand tonnes of fish caught across all fisheries. The countries that showed the highest discard of quota species (including large and small fish) were Netherlands (54% DR), Belgium (34%), Germany (26%) and France (21%).

The overall discard rates (including large and small fish) varied between 1%, in gears, such as pots and traps, dredges and longlines and 60%-70% for beam and otter trawlers. The fisheries that discarded the most were the beam and the otter trawls, with 34% and 35% discard across all countries. The discard rates in each fishery varied greatly among countries; the otter trawlers discard rates varied between 4% in Lithuania and 75% the Netherlands, the beamers discard rates varied between 13% in the UK and 73% in Germany. The netters discard rates were, on average, 8% and varied between 1% in Germany and 29% in the Netherlands (**Annex 2, Table 1**).

The landings and discard data from the Mediterranean area can be found in the STECF database, however these data are not used nor analysed by the STECF Expert Working group on the Evaluation of Fishing Effort Regimes in European Waters. The data are incomplete and unreliable, which makes it difficult to derive meaningful conclusions on the landings and discard rates. Only Spain, Italy and Slovenia provided discard data. According with the data, the discards rates in the Mediterranean Sea are lower in relation to the North Atlantic equivalent fisheries (**Annex 2, Table 2**)

Some of the fisheries in several countries did not have discards estimations. The lack of discard estimation in some of the fisheries/gears such as dredges, longlines and pots and traps, from some countries is due to low or null sampling coverage in these fisheries.

These discard estimations include over-quota and under minimum landing size discards (uMLS). Under the Landing Obligation, there will be no unwanted over-quota fish; only currently discarded fish which are under the minimum landing size will come ashore and be put to non-human consumption market. It is assumed that all fish over the current MLSs will be put to the human consumption market. The next section will analyse how much of the historical total discards were under minimum size, per country and fishery.

2.2.1. Estimation of discards under minimum landing size (uMLS)

A substantial challenge of this work was in estimating what proportion of historical discards were undersized fish and what proportion were quota-driven discards i.e. over the legal minimum landing size (MLS). Only discarded fish which are under the minimum landing size will come ashore and be put to non-human consumption market; it is assumed that there will be no unwanted over-quota fish.

Table 3 summarizes the average landings and discards between 2010 and 2012, considering only the quota species with a minimum landing sizes (MLS): cod, whiting, haddock, saithe, megrim, sole and plaice. The STECF catch at age database does not have data for all countries nor all fisheries operating in the European waters. The data presented are the best that are publically available and can inform management decisions.

Overall estimations showed that around 44,000 tonnes of under the minimum landing size will be landed in European ports and sold to non-human markets. This volume corresponds to 11% of the total catches of species with MLS and to 4% of the overall catches (including species with and without MLS).

These estimations assume that there are no changes in fishing behaviour and gear selectivity and full compliance with the landing obligation. It is also assumed that the fishing seasons are not curtailed and fishing opportunities are not reduced due to the exhaustion of quota. Data showed that the Netherlands, United Kingdom, France and Belgium are the countries that potentially will be most affected with landings for non-human markets. This estimate does not include all countries. No estimate could be derived from counties and fisheries for which no data were submitted to STECF, however, the estimate is considered to account for the main European fishing countries and fisheries within those countries.

The proportion of undersized discards varied between 10%, for the netters in Ireland and UK, and 89% for the beam trawls from Denmark. In most of the fisheries, the undersized component of discards were around 30-40% of the total discards, indicating that most of discards of the considered species in the European countries are due to quota restrictions and/or are market driven. In terms of proportional catches, the countries that will be most affected by landing small juvenile fish, which will have to go to non-human consumption market, are Belgium, Netherlands and United Kingdom, with, 13%, 10% and 8% of the total catches being undersized fish. In terms of the total weight of undersized discards, the countries which will have the largest volume of undersized catches are Netherlands (11,026 t), UK (10,610 t) and France (4,593 t) (**Figure 1**).

In most of the countries examined, most of undersize catches are derived from the otter and beam trawlers. On average, across the countries, 15% and 10% of the total catches from beamers and otter trawlers, respectively, are of undersize fish. Regarding the total volume, the otter trawlers catch more undersize fish, with around 29,600 tonnes of undersized fish, followed by the beam trawlers with 13,350 tonnes of undersized fish. The netters, longlines and seines have, in general, have low catches of undersized fish (**Figure 2**). Although this might be true when compare with the other gears, the total volume of discards might be an underestimate due to low or zero discard sampling coverage for these gears.

The proportion of undersize discards for otter trawlers varied between 2% in Lithuania (54 tonnes) and 20% in Spain (about 2,000 tonnes). However, the countries with the highest volume of undersize discards is the United Kingdom, with approximately 10,000 tonnes of undersize fish caught by the otter trawlers, followed by France, with 4,500 tonnes. The beam trawlers undersize discards varied between 34 tonnes in France and 8,600 tonnes in the Netherlands.

Fishers and vessels operating with these gears will potentially be the most affected by the landing obligation, if the gear selectivity and fishing behaviour (timing and fishing location) do not change. These fishers will be incentivised to avoid catching fish under MLS, because it will be deducted from their catch quota and have to be sold for non-human consumption markets, with lower profit than that which can be achieved from the human consumption market.

Generally, the netters have low discards levels and a small component is under MLS, indicating that most discards, even low, might be due to quota restrictions or market driven. The longlines, seines and pots and traps are the gears with the lowest discards and lowest catches of undersize fish.

Figure 1: Estimated undersized discards (t) generated by fishery and country (beam trawls, otter trawls)

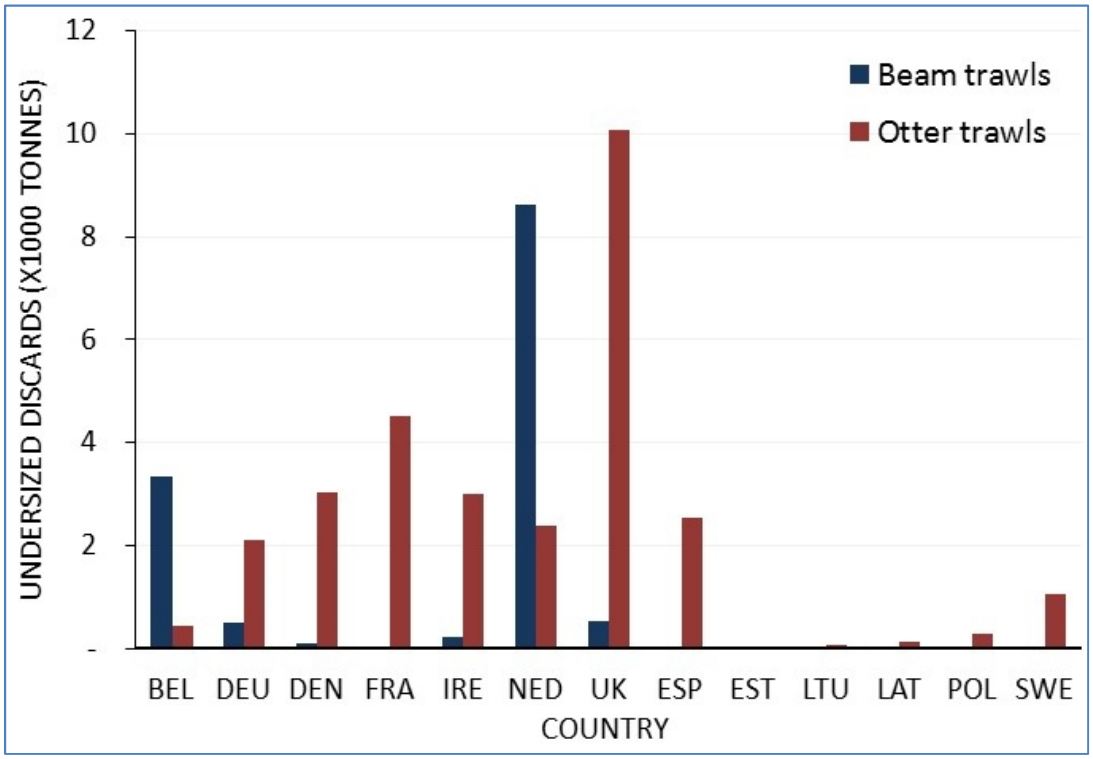


Figure 2: Estimated undersized discards (t) generated by fishery and country (netters, longlines, seines)

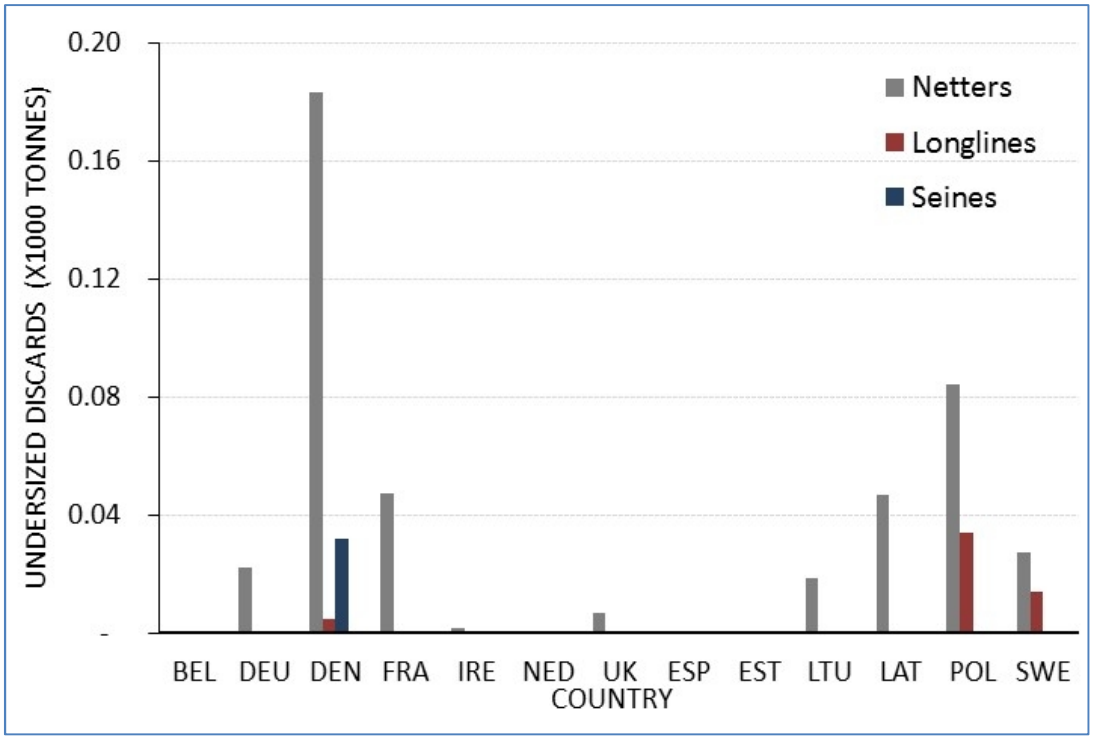


Table 3: Landings (t), discards (t) and proportion of discards under minimum landing size (uMLS), by country and gear; table sorted in descending order on the average catch 2010-2012 within each country

Country	Gear	Landings (t)	Discards (t)	Catch (t)	Proportion Discards (%)	Discards (t) oMLS	Discards (t) uMLS	Proportion discards uMLS	Proportion catch uMLS
Belgium	Beam trawls	10,138	5,663	15,801	36%	2,315	3,344	59%	21%
	Otter trawls	1,131	1,598	2,730	59%	1,147	451	28%	17%
	Netters	100	2	102	2%	1	1	30%	1%
Germany	Otter trawls	19,594	7,578	27,172	28%	5,466	2,111	28%	8%
	Beam trawls	1,794	1,484	3,278	45%	996	487	33%	15%
	Netters	1,656	57	1,713	3%	35	22	39%	1%
	Longlines	25	0	25	1%	0	0	47%	0%
	Pots & traps	7	0	7	1%	0	0	62%	0%
Denmark	Otter trawls	46,009	7,628	53,636	14%	4,585	3,043	40%	6%
	Netters	8,843	846	9,689	9%	661	183	22%	2%
	Beam trawls	1,323	115	1,438	8%	12	103	89%	7%
	Seines	569	76	646	12%	44	32	42%	5%
	Longlines	441	11	452	2%	6	4	41%	1%
	Dredge	7	1	7	8%	-	1	100%	8%
	Pots & traps	62	1	63	1%	0	0	60%	1%
Spain	Otter trawls	1,543	10,929	12,472	88%	8,403	2,526	23%	20%
	Netters	2	0	2	3%	0	0	2%	0%
Estonia	Otter trawls	519	89	607	15%	60	29	33%	5%
France	Otter trawls	22,141	13,006	35,147	37%	8,494	4,512	35%	13%
	Netters	2,351	248	2,599	10%	201	47	19%	2%
	Beam trawls	558	108	666	16%	75	34	31%	5%

Country	Gear	Landings (t)	Discards (t)	Catch (t)	Proportion Discards (%)	Discards (t) oMLS	Discards (t) uMLS	Proportion discards uMLS	Proportion catch uMLS
Ireland	Otter trawls	12,547	6,495	19,042	34%	3,503	2,991	46%	16%
	Netters	1,371	19	1,390	1%	17	2	10%	0%
	Beam trawls	1,254	825	2,079	40%	607	218	26%	10%
Lithuania	Otter trawls	2,487	153	2,640	6%	99	54	35%	2%
	Netters	326	50	376	13%	32	18	37%	5%
Latvia	Otter trawls	2,690	408	3,098	13%	275	133	33%	4%
	Netters	1,796	147	1,943	8%	100	47	32%	2%
Netherlands	Beam trawls	35,401	26,273	61,674	43%	17,637	8,637	33%	14%
	Otter trawls	5,913	9,256	15,169	61%	6,866	2,389	26%	16%
	Netters	253	2	255	1%	1	0	23%	0%
Poland	Otter trawls	7,714	1,114	8,827	13%	832	282	25%	3%
	Netters	3,533	254	3,787	7%	170	84	33%	2%
	Longlines	1,082	82	1,164	7%	48	34	41%	3%
	Pots & traps	2	0	3	7%	0	0	66%	5%
Sweden	Otter trawls	11,955	3,012	14,967	20%	1,956	1,057	35%	7%
	Netters	1,956	70	2,026	3%	43	27	39%	1%
	Longlines	667	35	702	5%	21	14	41%	2%
	Pots & traps	8	0	8	1%	0	0	54%	0%
United Kingdom	Otter trawls	71,734	25,316	97,050	26%	15,150	10,068	40%	10%
	Beam trawls	3,183	1,474	4,657	32%	939	535	36%	11%
	Netters	660	67	726	9%	60	7	10%	1%
Total		285,347	124,488	409,835	30%	80,858	43,527	35%	11%

2.2.2. Estimation of discards uMLS by country and species

Table 4 describes the landings and discards of quota species with a minimum landing size (MLS) and how the landings of fish under MLS of those species could affect each country.

Table 4: Landings, discards and proportion of discards under minimum landing size (uMLS), by country and species; table sorted in descending order on the average catch 2010-2012 within each country

Country	Species	Landings (t)	Discards (t)	Catch (t)	Proportion Discards (%)	Discards (t) oMLS	Discards (t) uMLS	Proportion discards uMLS	Proportion catch uMLS
Belgium	Plaice	5,970	5,443	11,413	48%	2,429	3,015	55%	26%
	Sole	3,428	302	3,730	8%	100	199	67%	5%
	Cod	960	180	1,139	16%	83	97	54%	9%
	Haddock	278	844	1,123	75%	534	310	37%	28%
	Megrim	575	160	735	22%	155	5	3%	1%
	Whiting	158	333	491	68%	163	171	51%	35%
	Saithe	2	0	2	4%	0	0	6%	0%
Germany	Cod	9,523	994	10,517	9%	609	385	39%	4%
	Saithe	9,882	249	10,131	2%	231	18	7%	0%
	Plaice	3,843	7,858	11,701	67%	5,678	2,181	28%	19%
	Haddock	692	88	779	11%	39	48	55%	6%
	Sole	445	28	473	6%	12	16	57%	3%
	Whiting	90	51	141	36%	12	39	77%	28%
Denmark	Cod	27,138	3,795	30,933	12%	2,686	1,109	29%	4%
	Plaice	19,754	3,761	23,516	16%	2,186	1,576	42%	7%
	Saithe	7,219	195	7,414	3%	176	19	10%	0%
	Haddock	2,461	888	3,349	27%	244	643	72%	19%
	Sole	673	26	699	4%	18	6	25%	1%
	Whiting	94	23	117	20%	7	16	69%	14%
Spain	Haddock	38	10,015	10,052	100%	7,579	2,435	24%	24%
	Megrim	1,504	912	2,416	38%	823	90	10%	4%
	Whiting	4	2	5	31%	1	0	24%	7%
Estonia	Cod	885	143	1,028	14%	91	52	36%	5%

Country	Species	Landings (t)	Discards (t)	Catch (t)	Proportion Discards (%)	Discards (t) oMLS	Discards (t) uMLS	Proportion discards uMLS	Proportion catch uMLS
France	Haddock	8,030	9,500	17,530	54%	6,464	3,036	32%	17%
	Cod	3,699	1,750	5,449	32%	751	1,000	57%	18%
	Saithe	4,439	3	4,442	0%	3	0	3%	0%
	Whiting	2,927	1,042	3,969	26%	705	337	32%	8%
	Megrim	1,976	418	2,395	17%	379	39	9%	2%
	Plaice	1,755	607	2,361	26%	442	164	27%	7%
	Sole	2,228	42	2,270	2%	26	17	40%	1%
Ireland	Haddock	4,241	3,652	7,893	46%	1,870	1,782	49%	23%
	Whiting	5,100	2,077	7,177	29%	1,271	806	39%	11%
	Megrim	2,956	589	3,545	17%	553	37	6%	1%
	Cod	1,304	611	1,915	32%	203	408	67%	21%
	Saithe	1,128	5	1,134	0%	5	1	15%	0%
	Plaice	267	431	698	62%	242	189	44%	27%
	Sole	177	11	189	6%	10	2	13%	1%
Lithuania	Cod	2,889	221	3,110	7%	144	77	35%	2%
Latvia	Cod	4,675	609	5,284	12%	409	200	33%	4%
Netherlands	Plaice	30,217	32,090	62,307	52%	23,274	8,816	27%	14%
	Sole	8,644	1,461	10,104	14%	707	754	52%	7%
	Cod	2,152	251	2,403	10%	145	106	42%	4%
	Whiting	424	1,582	2,007	79%	277	1,306	83%	65%
	Haddock	145	146	291	50%	101	45	31%	15%
	Saithe	17	0	17	1%	0	0	11%	0%
Poland	Cod	12,414	1,369	13,783	10%	1,033	336	25%	2%
	Plaice	45	117	162	72%	43	74	63%	46%
Sweden	Cod	12,946	2,526	15,472	16%	1,683	843	33%	5%
	Saithe	1,361	184	1,545	12%	167	17	9%	1%
	Plaice	233	350	582	60%	181	168	48%	29%
	Haddock	277	134	411	33%	31	103	77%	25%
	Whiting	43	4	47	9%	1	4	86%	8%
	Sole	23	0	23	1%	0	0	24%	0%

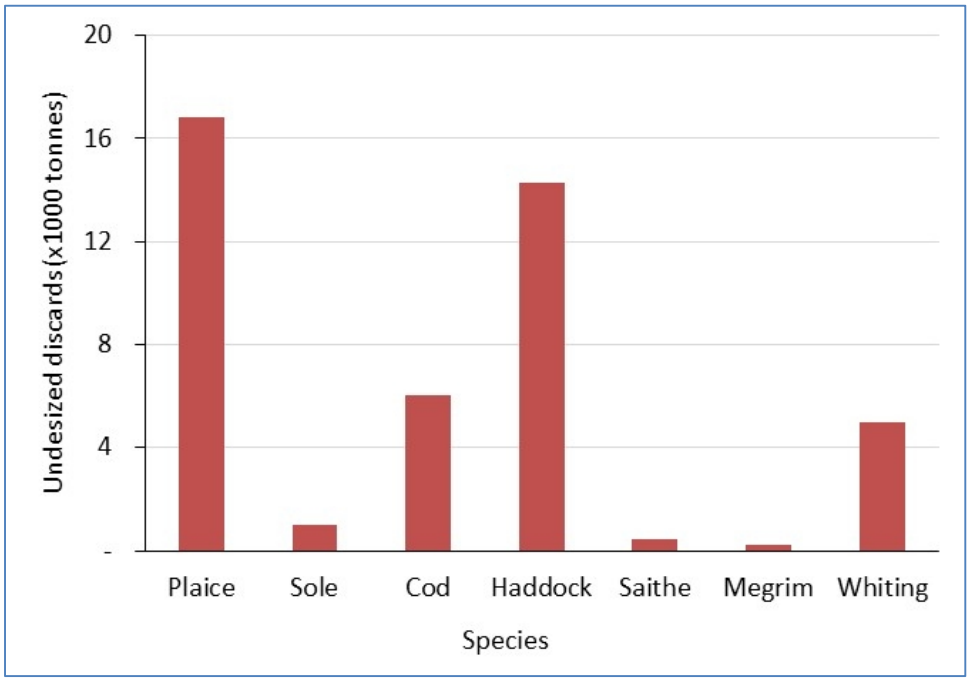
Country	Species	Landings (t)	Discards (t)	Catch (t)	Proportion Discards (%)	Discards (t) oMLS	Discards (t) uMLS	Proportion discards uMLS	Proportion catch uMLS
United Kingdom	Haddock	29,688	9,748	39,436	25%	3,902	5,845	60%	15%
	Saithe	13,991	4,776	18,767	25%	4,396	380	8%	2%
	Cod	12,908	4,903	17,811	28%	3,486	1,416	29%	8%
	Whiting	9,235	5,032	14,267	35%	2,731	2,301	46%	16%
	Plaice	4,476	1,795	6,271	29%	1,081	617	36%	10%
	Megrim	4,563	585	5,148	11%	542	43	7%	1%
	Sole	787	22	809	3%	14	8	35%	1%
Total		287,993	124,936	412,929	30%	81,127	43,707	35%	11%

The species with the highest estimations of undersized discards were plaice and haddock, with 18 and 14 thousand tonnes of undersize fish being landed in European ports, followed by whiting and cod, with 5 and 6 thousand tonnes of undersized discards (**Figure 3**). Megrim and saithe have the lowest proportion of undersize discards, with 450 and 200 tonnes respectively.

Countries have different key species of undersized fish; in Germany, Netherlands and Sweden the species with the highest undersized discards is whiting, while in France and Ireland, cod is the species with the highest proportion of discards under MLS. Undersize haddock is the species that potentially will present more problems in the UK and Denmark. These data will be influenced by the spawning success of these fish during the observation period. The estimates are provided are the mean of three years to reduce the influence in the data of particularly strong year classes that occurred for some species.

Depending on the life history and population dynamics of each species, yearly or occasional high pulses of recruitment will dictate the catches of undersized and juvenile fish. The population dynamics of some stocks are characterized by periods of low recruitments with occasional strong year classes that ultimately come to dominate the stock. Therefore, these data present what the likely key species would have been in the period 2010-12, however, it is possible other species may be the most important during implementation period of the landing obligation.

Figure 3: Estimated undersized discards (tonnes), by species



2.3. Quality of the data

It is important to understand the quality and the limitations of the data presented in the report. The results presented are based on the best publically available data, the official STECF database, which holds the landings and discards per country and gear and catch at age data, between 2003 and 2012 (at the time this report was written). While every attempt is made by STECF to provide robust estimates of discards for the fisheries and species, low coverage of national sampling programmes mean that confidence bounds around discard estimates are wide and in some cases discard estimates for fisheries 'borrow' information from other fisheries where no specific discard information is available for that fishery under the assumption that discard patterns are comparable. Discard data are sampled and recorded for less than 2% of all fishing operations, and these data are extrapolated to the fleet level. Where no data exist for a fishery, fill-ins are used from data from related fisheries, as is standard practice. If an estimate is largely derived from such filled-in data it may be less accurate. It needs to be realised the data available in the STECF database and its quality is an outcome of the data collected, estimated and submitted to the STECF effort Working Group by each Member State and in this report we did not omit or delete any of the data.

During the production of the North Sea and North Western Waters Discard Atlases, errors and uncertainties in the data were found and widely discussed (Anon, 2014a; Anon, 2014b). Errors with the Spanish and French data were found in the STECF database, during the production of the North Western Waters Discard Atlas. These countries re-submitted the landings and discard data to the STECF effort Working group in 2013, but the "corrected" data were not available at the time of this report. It should be taken into account that, at least, the French and Spanish data presented in this report are unreliable and unrealistic.

The overall landings provided by the STECF database (including pelagic and demersal landings) differ from the European Market Observatory for Fisheries and Aquaculture Products (EUMOFA) report (2014). According with the EUMOFA report, the EU-29 landings

in 2011 were **4 million tonnes** (EUMOFA), while in the STECF database the total landings (pelagic and demersal) in 2011 were nearly **3.5 million tonnes**. The difference might be due to the different data sources used in each database; in the EUMOFA report the main data sources are: EUROSTAT, national administrations of the EU and Joint Research Centre – European Commission; while for the STECF the different countries submit the National landings and discards data into the different Effort Management Regimes which can lead to missing or duplicated data.

For this report we excluded all the pelagic fisheries and only selected quota demersal species that will be subjected to the landing obligation. Under these premises, the STECF landings estimated were around 850,000 tonnes (around 25% of the total landings from STECF database). According with the EUMOFA report, the landings of pelagic, bivalves, crustaceans, cephalopods, tuna and tuna-like species and other marine fish in the EU ports make up 82% of the overall landings (EUMOFA, 2014), and the remaining proportion of the landings (35%) are from groundfish (12%), flat fish (5%) and other marine fish (18%). Based on the EUMOFA estimations, around 1.4 million tonnes would be for demersal fish. If we applied the 4% undersized discard estimations to these EUMOFA landings, the estimated undersized discards would be 56,000 tonnes of undersized fish. **It should be noted that this is a cursory estimation and that care should be taken in the use and interpretation of these estimations.**

It should be considered that the estimations of the total undersized discards do not reflect the overall undersize proportion of discards because some key quota species with MLS were not included in the analysis due to lack of information and the assumptions used to calculate the proportion of undersize fish may lead to inaccuracies in the estimations. The inclusion of those species would increase the total amount of undersized discards and would probably result in a different proportion of discards estimated to be under MLS.

On the other hand, when we applied the proportion of undersized fish (11%) to the EUMOFA landings for demersal fish (1.4 million tonnes), the undersized discard estimations are probably over estimated because the EUMOFA landings include regulated and non-regulated species and species with and without MLS.

3. PORTS AFFECTED BY THE LANDING OBLIGATION

KEY FINDINGS

- The introduction of the landing obligation generates a number of **specific practical considerations for ports**, including the need to ensure that the equipment, infrastructure and logistics are sufficient to deal not only with an increase in landings, but also landings subject to separate regulatory conditions and destined for separate markets
- Based on the proportion of historical landings, the **landings of undersized fish for the non- human consumption market will be concentrated in a few main ports**. There will also be many small ports where small quantities will be landed, however, collectively these ports could also receive large quantities of undersized discards.
- **In larger ports, there are some existing arrangements for onshore processing** of non-human consumption fish (predominantly the collection of fish by-products for fishmeal production) but for the collection of shellfish by-products, these facilities currently appear much more limited.
- **There is little evidence available on the ability for smaller ports to handle fish for the non-human consumption market**. It is assumed that there is currently little infrastructure at these ports to support the landing of this material.

The introduction of the landing obligation generates a number of specific practical considerations for ports, including the need to ensure that the equipment, infrastructure and logistics are sufficient to deal not only with an increase in landings, but also landings subject to separate regulatory conditions and destined for separate markets (meaning that there is also a need to ensure that end users are ready to receive these fish). It is anticipated that many ports and fish markets will need to make some level of adaptations to their handling procedures and infrastructure to take account of the changes in the composition and size distribution of fish that are landed and to respond to the regulatory changes associated with those landings. This Chapter identifies the key ports likely to be affected by the new regulations, and reviews their readiness (in terms of infrastructure and services) to handle the new landings.

3.1. Materials and methods

To identify the European ports likely to be most affected by the landing obligation and understand how the landings of undersized catches could affect those ports, two approaches were used: 1) Estimation of quantity of **undersized discards per port**, assuming they are proportionate to the landings in that port; and 2) A **questionnaire** was developed for scientists and policy officials dealing with implementation of the new CFP in the various Member States.

To develop an estimate of how ports will be affected by the landing obligation and undersized catches, the main European ports receiving fish from EU fleets were identified from **European Fish Auction DataNet**. The only source of information available on the overall landings (tonnes) per port was the European Fish Auction DataNet report (EAFPA, 2005), with landings information in 2003, for seven EU countries - Ireland, UK, Portugal, Netherlands, Denmark, France, and Belgium. Although these data are historic, these are the only official landings data promptly available. The proportion of landings in each port in

relation to the total landings in the country was estimated and applied to the undersized discards estimates per country, to estimated undersize discards per port.

It is important to note that it is very difficult to estimate accurately how much undersize fish could be received by each port. These estimations should be taken cautiously because they are based on the assumption that the undersized discards are proportional to the total landings (all regulated and non-regulated species). The estimations of unwanted catches by port are based on estimates of undersize discards per country and historic landings information by port from different periods.

It was only possible to compare estimated quantities of fish for non-human consumption derived from the analyses with that from the questionnaires from only two countries: Ireland and UK. In both countries, the ports identified as the most affected by the landings of undersized fish matched with the data analysed. However, the estimated quantities varied greatly, which is due to the different estimation procedures. The method of estimation used by respondents to the questionnaire were not provided and was likely different between respondents.

The questionnaire was also designed to elicit the respondents' views on the level of infrastructural readiness and the potential adjustments that might be needed. The questions focused on gathering details from each Member State on the state of infrastructure at each key port where the unwanted catches would be landed. Respondents were asked to indicate the status of infrastructure for storage, handling, sorting and grading, logistics, security etc. that is needed or available to handle unwanted catches landed for non-human consumption market in the various ports in their country.

3.2. Estimation of undersized discards per landing port

Based on the information available it was only possible to make a cursory analyses on how each port will be affected by the landing obligation. Belgium only have three ports and the two that will be most affected are Zeebrugge and Oostende. In Denmark the landings are more spread out among the ports and the ports that potentially, will more impacted by landing of unwanted undersized landings are Skagen, Esbjerg, Thyboron and Elvrige Eavne. The French ports most affected by the undersize landings will be Bolougne de Mer, Le Guilvinee and Lorient. In the United Kingdom, the ports with the highest landings are in Scotland, Peterhead, Fraserburg and Lerwick. In England the ports that will be most affected with the flux of undersize fish are Newlyn, Brixham and Plymouth. Ireland has a major port, Killybegs that supports 46% of the landings in Ireland and most certainly it will be most impacted by the landing obligation. Finally, the ports in Netherlands most affected by the landing obligation will be Yerseke and Urk.

For Spain and Portugal, no landings information per port was available, so a list of ports per country is provided in **Annex 2**. For other European countries, such as Sweden, Latvia, Lithuania, Poland there was no information on landing ports or sales auctions.

Based on the proportion of landings, there are a few ports per country that will have largest quantities of undersized fish being landed to the non- human consumption market, while there are a lot of small ports where few undersized fish will be landed. However, collectively these ports could also receive large quantities of undersized discards. Although the quantities of undersized fish that will be landed to the different ports is difficult to predict, data from EU observer programmes indicates that where trawl and static net fisheries are operating there is likely to be some catches of unwanted fish, which could have to be landed.

Prior to implementation, there had been only one simulation of a discard ban in the EU. The English discard ban trial, conducted in four English ports, to assess how fishing practices, catch handling, storage and transport could change as a result of the landing obligation, including costs and logistics of landing the whole catch. The trial covered smaller (Hastings) and larger (Brixham, Newlyn, and Plymouth) ports, under and over 10m vessels, using different fisheries. The trial highlighted that some of the ports, particularly the smaller ports, will have problems of congestion, logistical difficulties and added cost (for staff and transport) to deal with the previously discarded fish (Catchpole et al. 2014).

Many of smaller ports have limited physical space to install infrastructures to store and transport this material. In this study, it was identified companies that could potentially collect and store fish material, from several local ports, in cold stores until sufficient quantity has been accumulated to make transport viable. There was an example of this business model identified in the study. The study concluded that with the potential for various exemptions, and uncertainty around the precise timing of implementation, it is very difficult to predict the levels of material will be landed and therefore the level of investment for additional infrastructures required (transport, storage bins, physical space, freezers, cold rooms).

Also, the estimations of undersized discards per port should be taken cautiously for several reasons; the estimations of unwanted catches per port were based on estimated undersize discards per country, the landings information available are historic and may not represent the actual landings profile in the countries and the landings information includes pelagic landings, which were not considered in the undersized discards analyses. These estimations are only indicative of the volume of unwanted catches will be landed in each European ports, but variability of theses estimations can vary greatly.

It should be stressed that great care should be taken in the interpretation and use of discard estimates and particularly on the estimations of undersize discards owing to the incomplete nature of information on discarded fish and the assumptions used to proceed with the estimations. However these are the best publically available discard data at the European level and all the efforts were made to use all the data sources available in order to provide the best estimations possible.

3.3. Status of infrastructure to handle unwanted catches

Table 5 summarises the major ports affected from the responses and the corresponding volume of unwanted catches that could be landed by each Member State that has performed the analyses by port. Overall, infrastructure for storage, handling, sorting and grading is available in all major ports that can be used both for commercial fishes and unwanted catches. However, given that discards are **animal by-products (ABP)** not intended for human consumption, they must fulfil all requirements provided in the Regulation (EC) 1224/2009, such as having a physical barrier to avoid cross contamination with catch destined for human consumption.

As such, the existing infrastructure appears limited in all Member States because there are currently no facilities in place to handle ABPs produced by the catching sector. For example, in England larger ports have existing arrangements for the onshore processing sector (predominantly the collection of fish by-products for fishmeal production) while smaller ports or for the collection of shellfish by-products, these facilities are currently much more limited. In Germany, infrastructure to collect undersized fish, its temporary storage and transport to a fish meal plant need to be set up in nearly all landing ports in the country. This could be problematic especially on the Baltic coast where there are many small ports with little quantities of undersized fish expected to be landed, the fishers have a low income and the nearest fish meal factory is several hundred kilometres away. The situation is

similar in Spain and Ireland where specific structures for each stage of the valorisation process (storage, crushing, drying or packing) are lacking.

Policy officials maintained that while they are happy to support the fishing industry through funding programmes such as the European Maritime and Fisheries Fund, it is the responsibility of fishers to find and ensure they have the right infrastructure to handle unwanted catches.

3.4. Comments

Overall, infrastructure for storage, handling, sorting and grading is available in major ports within countries that responded to the questionnaire; and this can be used both for commercial fishes and unwanted catches. However, currently there are no facilities in place to handle ABPs produced by the catching sector.

In general the larger ports, are able to handle at least some non-human consumption landings as they already process industrial landings. However, it is not known how smaller ports may deal with these issues as they do not possess most of the infrastructure required. The logistics for the transport of bycatches to a central collection point and the acquisition of cooling will increase costs of handling this material. Storage facilities will likely be required to enable the aggregation of sufficient quantities of material from smaller ports to make subsequent transport or treatment more cost-effective.

It can be concluded that, in general, the Member States are not yet ready to receive these unwanted catches and have some way to go before having sufficient infrastructures and logistics in place to deal with it.

Table 5: Summary of the major ports where unwanted catches would be landed estimates of the volume (tonnes) that would be landed and assessment of the infrastructure that is in place to handle unwanted catches destines for non-human consumption.

Germany

MAJOR PORTS AFFECTED	ESTIMATED QUANTITY OF UNWANTED CATCHES (T)	INFRASTRUCTURE	REMARKS
Cuxhaven (North Sea)	Saithe = 10	All necessary infrastructure is available for the processing of unwanted catches.	The need to set up the infrastructure to collect undersized fish, its temporary storage and transport to a fish meal plant applies generally to all other ports in Germany. This poses a particular problem on the Baltic coast with its many small ports with little quantities of undersized fish and fishermen with a low income and the nearest factory in Germany over several hundred kilometres away.
Fedderwardersiel (North Sea)	Flatfish = 0.5	In both places there are no processing facilities for offal (and therefore also for undersized fish). Undersized fish would need to be transported at a high cost to Cuxhaven or Bremerhaven.	
Brake (North Sea)	Flatfish = 80		
Wismar, Warnemünde (Baltic Sea)	Herring, sprat	The establishment of the logistics for the transport of bycatches to a central collection point and the acquisition of cooling installations	
Timmendorf (Baltic Sea)	Salmon		
Barhöft, Schaprode, Glowe, Gager, Freest (Baltic Sea)	Cod = 100 - 150		

Spain

MAJOR PORTS AFFECTED	ESTIMATED QUANTITY OF UNWANTED CATCHES (T)	INFRASTRUCTURE	REMARKS
Ondarroa	790	Infrastructure is available that can be used both for catches destined for human consumption and unwanted catches. Given that discards are animal by-products and derived products not intended for human consumption, they must fulfil all requirements provided in the Regulation (EC) 1224/2009, such as a physical barrier between both products that avoids cross contamination.	Specific structures for each stage that involve the valorisation process: storage; crushed; drying or packing are therefore needed.

Denmark

MAJOR PORTS AFFECTED	ESTIMATED QUANTITY OF UNWANTED CATCHES (T)	INFRASTRUCTURE	REMARKS
Skagen, Hanstholm, Hirtshals, Thyborøn, Hvide Sande, Grenaa, Neksø, Strandby, Gilleleje, Thorsminde	Cod, herring, industrial species, Saithe, plaice, hake, monkfish, mackerel, Norway lobster, turbot, lemon sole, sole, common shrimp, weever, salmon	It is the opinion of the Danish Agrifish Agency that it is the responsibility of fishermen to find the right infrastructure to handle unwanted catches. The ministry will support the industry through the national operational programme of the European Maritime and Fisheries Fund.	

Ireland

MAJOR PORTS AFFECTED	ESTIMATED QUANTITY OF UNWANTED CATCHES (T)	INFRASTRUCTURE	REMARKS
Howth, Ros A Mhill, Dunmore East	*Nephrops* = 1600	A port like Killybegs could presumably handle unwanted landings as they already process industrial landings. It is not known how smaller ports may deal with these issues as they do not possess fish meal facilities. In the absence of such facilities it is assumed that unwanted catches will be either transported to Killybegs or disposed of through landfill, both of which will incur significant handling and disposal costs.	It is likely that some unwanted catches will be used for the commercial bait market for shellfish trap fisheries. This would require on-board storage (and possible on-board freezing) as well as cold storage facilities at each of the ports.
Killybegs, Greencastle,	Haddock = 5000		
Dunmore East	Whiting = 3300		
Castletownbere, Kilmore Quay, Union Hall	Megrim = 900		
Castletownbere, Dingle, Greencastle	Hake = 900		
Castletownbere	Monkfish = 400		
Dunmore East	Cod = 160		
Howth	Plaice = 1400		
Killybegs, Dingle, Castletownbere, Dunmore East	Saithe = 70		

Sweden

MAJOR PORTS AFFECTED	ESTIMATED QUANTITY OF UNWANTED CATCHES (T)	INFRASTRUCTURE	REMARKS
SESIM - Simrishamn	Baltic Cod = 400	Storage and handling of unwanted catches really comes down to how the fish will be utilized. In all listed ports, there is storage for unwanted catches but the amount of storage is limited. The biggest problem at present is how the unwanted catches will be handled on-board vessels.	
SEKKT- Karlskrona	Baltic Cod = 350		
SESLE- Skillinge	Baltic Cod = 70		
SEOCO - Öckerö	*Nephrops,* Pandalus, Cod, Haddock, Saithe = 160		

United Kingdom (England)

MAJOR PORTS AFFECTED	ESTIMATED QUANTITY OF UNWANTED CATCHES (T)	INFRASTRUCTURE	REMARKS
Brixham	5201	Storage and transport facilities for discards not intended for human consumption will be required in the different ports where they are landed. Storage facilities will be required to enable the aggregation of sufficient quantities of material which will make subsequent transport or treatment cost-effective.	Existing storage infrastructure is assumed to be limited because there are currently no facilities in place to handle ABPs produced by the catching sector. In larger ports, there are existing arrangements for the onshore processing sector (predominantly the collection of fish by-products for fishmeal production) but in smaller ports or for the collection of shellfish by-products, these facilities are currently much more limited.
Newlyn	1906		
Whitby	1355		
Plymouth	980		
Rye	682		
Shoreham	662		

4. FINAL DESTINATIONS OF CATCHES

KEY FINDINGS

- Across the Member States, the final destinations of the unwanted catches include processing into **fish meal and fish oil, food ingredients, biogas, pet food, pharmaceuticals, cosmetics and pot bait**.
- Of these utilisation routes, processing into **fishmeal and fish oil appears to show the highest potential**. This utilisation route is already well developed to utilise all finfish species, in Germany, Spain, England and Sweden.
- Other utilisation opportunities include p**et food, food ingredients and as food for minks** (fur industry) are already developed in Germany, Sweden and Denmark.
- Some utilisation opportunities such as **biogas** are partially developed or under development in England and Germany, while others such as **pharmaceuticals** and **cosmetics** are yet to be developed.
- There are indications of serious interest in some areas from businesses, although in practice the potential for business development will vary from sector to sector, and locality to locality.

The combined effect of the requirements to land fish and to restrict use for non-human consumption is to increase the supply of fish (of different species) for the non-human consumption market. There are already some market opportunities for these catches, but it is clear that new markets will need to be developed if the supply is to be fully utilized. This presents some market **opportunities** and some market **challenges**.

For example, among the uses of for non-human consumption are fish oil production, fish meal, ensiling, composting, anaerobic digestion with energy recovery, as pot bait, etc. (Mangi and Catchpole 2014). Several attempts have also been made to develop and demonstrate processing techniques and technologies that can yield valuable produce of other types, including obtaining molecules and compounds (including omega-3 lipids, enzymes, proteins) that can be used in chemical or pharmaceutical products or industrial products. (Adler 2014, European Fisheries Technology Platform 2012).

While there are potential new uses, potential new markets and potential for existing market expansion for the newly landed fish (and evidence of commercial and investment interest in these opportunities) there are some challenges for commercial development. For example, the onward infrastructure and logistics to handle this material onshore may not exist in every location or might be ineffectively or inefficiently set up towards using these fish. There may need to be adaptations both in port and in business organisation. Most significantly, however, the commercial / investment environment is difficult. Currently, it is difficult to estimate both the level of supply of these fish (and the location of that supply) and the demand (since some of the markets are new). Moreover, since the overriding objective of the new discard rules is to reduce unwanted catches as far as possible, and since it is anticipated that unwanted catches will be reduced – for example through enhancements in fishing gear selectivity and changing fishing patterns and behaviour – the supply of this fish has the potential to decrease over time.

4.1. Materials and methods

Various literature has already surveyed the potential new markets for the non-human consumption fish landings, and this was reviewed. In addition, Member States were surveyed on the potential uses for unwanted catches. Respondents were asked to state utilisation opportunities that are available to use unwanted catches, and for each opportunity to provide the species used, whether the utilisation opportunity was already developed or yet to be developed and any comments including whether there are potential barriers in using discards.

4.2. Utilisation opportunities for unwanted catches

Across the Member States, the final destinations of the unwanted catches include processing into fish meal and fish oil, food ingredients, biogas, pet food, pharmaceuticals, cosmetics and pot bait (**Table 6**). Of these utilisation routes, the most popular final destination of the unwanted catches is for processing into fishmeal and fish oil. Information provided by respondents from each Member State indicate that apart from Ireland, the reduction of the unwanted catches into fish meal and oil is already well developed to utilise all finfish species in the other responding countries including in Germany, Spain and England. Other utilisation opportunities that are popular and already developed include the conversion of the unwanted catches into pet food, food ingredients and as food for minks (fur industry). Some utilisation opportunities such as biogas are partially developed or under development while others such as pharmaceuticals and cosmetics are yet to be developed.

It is worth noting that information on the availability and status of utilisation opportunities for unwanted catches need to come from commercial companies dealing with waste products. Apart from England where Cefas collected these data from commercial outlets (Mangi and Catchpole 2014) no similar study has been undertaken in the other Member States. Findings from Mangi and Catchpole (2014) show that each utilisation opportunity has its own merits and should be considered in terms of existing infrastructure and its availability to the catching sector.

Overall, across the member states utilisation opportunities for finfish discards are greater than those for shellfish discards. Further, finfish discards could potentially generate an income if supplied for fishmeal production while supplying shellfish discards to commercial companies are more limited and are more likely to be at a cost to the fishers. Other practical issues in taking the utilisation opportunities forward by fishers is the member states need to consider the condition of the catch (freshness, hygiene), oil content (pelagic vs non-pelagic), and transport costs that are likely to be substantial relative to the revenue from the end product.

One of the English discard ban trial objectives was to consider the costs and analysed the markets for the unwanted catches. The main utilisations for this material were fishmeal and pot bait. The pot bait market would be more profitable than the fishmeal, however it is seasonally limited. Other potential outlets will be pet food and mink feed industries. According with the study, the different markets for this material could generate profit or loss, depending on the scale of handling, transport and seasonal variability in demand for this material. There are a number of outlets for the material and there will be competition for the material (Catchpole et al. 2014).

Table 6: Summary of utilisation opportunities across Member States

Germany

UTILISATION	SPECIES USED	STATUS	REMARKS
Fish meal (North Sea)	All species	Already developed in Cuxhaven and Bremerhaven	No remarks
Food ingredients (North Sea)	All species	Already developed in Cuxhaven	
Fish meal, fish oil (Baltic Sea)	Cod	Already developed	
Biogas (Baltic Sea)	Cod	Already developed	

Spain

UTILISATION	SPECIES USED	STATUS	REMARKS
Food additives	All species	Yet to be developed for unwanted catches	Freshness; Mixture of species; Hygienic handling
Fish meal-fish oil	All species	Developed	Freshness; Hygienic handling
Pet-food	All species	Yet to be developed for unwanted catches	Freshness; Mixture of species; Hygienic handling
Pharmaceuticals	All species	Yet to be developed for unwanted catches	Freshness; Mixture of species; Hygienic handling
Cosmetics	All species	Yet to be developed for unwanted catches	Freshness; Mixture of species; Hygienic handling

Ireland

UTILISATION	SPECIES USED	STATUS	REMARKS
Fish meal	Non-pelagic	Not developed	Very limited value due to low oil content of non-pelagics. Transport costs likely to substantially outweigh revenue from product.
Bait	Non-pelagic	Partially developed	Potentially substantial market but will require freezing facilities on board and ashore. Some soft bodied species may not be appropriate
Alternative products	Unknown	Not-developed	Cannot be predicted

Sweden

UTILISATION	SPECIES USED	STATUS	REMARKS
Food for minks (fur industry)	Baltic cod	Developed	The fur industry has a limited demand for fish.
Fish meal	Baltic cod	Developed	No remarks
Bio gas	Baltic cod	Under development	If discards are to be used, its related to a steady supply of ?

United Kingdom (England)

UTILISATION	SPECIES USED	STATUS	REMARKS
Reduction to fishmeal and fish oil	Finfish, Small pelagic	Well developed	Processing plant in Grimsby. Established transport links to UFI in North East, North West, East and South West with the onshore processing sector.
Ensiling	Finfish	Developed	Investment required in ensiling plants in England; or transport to Scotland
Composting	Finfish Shellfish	Well developed	There are a number of licensed composting facilities in the UK which could be utilised for the utilisation of discards
Anaerobic digestion with energy recovery	Finfish Shellfish	Partially developed	There are 31 anaerobic digestion sites currently listed to take waste materials for processing and licensed for animal by-products
Rendering	Finfish Shellfish	Developed	They will charge the catching sector to transport the discards
Freezing prior to use as bait	Finfish	Developed	Available only to vessels of one company (Interfish)

4.3. Commercial viability

As noted at the beginning of this Chapter, a key challenge is to maintain long-term commercial viability for any new businesses built on the unwanted fish landings. A number of studies conducted in the UK appear to indicate that the commercial potential may exist. The first study (Seafish 2012), based on interviews with commercial outlets, indicated significant interest from commercial bulk outlets to utilise unwanted fish for a range of uses, including as fishmeal and fish oil, ensiling, composting, anaerobic digestion and freezing (prior to use as bait).

Whilst the report recognised that many of these commercial outlets are not located near to the main landing ports, there were good transport links in many instances that would enable providers to cover even remote ports. Bulk use managers also thought their current processing capacity would be sufficient to accommodate the extra material. Some of the outlets even went so say far as to say that they would consider setting up new processing facilities at ports if high levels of material were available. The outlets also thought they would be able to generate a profit through processing unwanted fish, although the financial return for fishermen would be low (Seafish 2012, Mangi and Catchpole 2014).

Another study on the use of discards for bait (Seafish 2014) found that the estimated demand for bait is significantly larger than the potential supply that could come from unwanted fish. Trials confirmed that any whitefish quota species could be effectively used as bait by potters targeting crabs. A further Seafish research programme (Seafish 2011) looked at why certain fish species are currently discarded and gathered industry insight into how more under-utilised fish species could be brought to market and drive value for fishermen. It was also noted that Producer Organisations will also have a significant role to play in developing marketing plans that seek to derive maximum value for all the catches their members make.

4.4. Comment

Across the Member States, the final destinations of the unwanted catches include processing into fish meal and fish oil, food ingredients, biogas, pet food, pharmaceuticals, cosmetics and pot bait. Of these utilisation routes, the most popular, and the one which appears to be the most promising for utilisation of fish discards is for processing into fishmeal and fish oil. This utilisation route is already well developed to utilise all finfish species, in Germany, Spain, England and Sweden. On the other hand, while fish meal offers the most consistent economic return potential, pot bait is more lucrative than fish meal with high seasonal demand and low transport costs. Other utilisation opportunities also currently exist and show potential for development; for example, pet food, food ingredients and as food for minks (fur industry) are popular and already developed in Germany and Sweden. Some utilisation opportunities such as biogas are partially developed or under development in England and Germany, while others such as pharmaceuticals and cosmetics are yet to be developed.

Moreover, the experience from the studies conducted in the UK indicate that there is realistic commercial potential, and serious interest from businesses in developing these markets, at least for those that came within the relevant studies. In practice, however, the potential for business development will vary from sector to sector, and locality to locality.

5. NEW REGULATORY APPROACHES

KEY FINDINGS

- **The landing obligation necessitates a review of certain aspects of the CFP regulatory framework**, and that the challenges of implementing successfully might require new regulatory approaches.
- **Remote electronic monitoring (REM) systems**, using electronic logbooks, CCTV devices and other electronic monitoring tools, **are showing considerable promise**, including in relation to monitoring fisheries discards.
- **European trials of REM technologies in pelagic fisheries illustrate both (1) very strong potential** to use CCTV-based REM to monitor fishing vessels and (2) **potential cost savings** in the long-term for both fishing vessels and public administration (although initial set-up costs are high).
- **There is more doubt, however, about the capacities of REM to monitor more complex fisheries effectively**. Trials in a mixed bottom-trawl fishery exposed limitations, for example in the ability to distinguish small numbers of cod in catches.
- In addition to REM, **consideration must be given to adapting other aspects of the regulatory and enforcement approach**. Complementary enforcement measures such as using catch composition comparisons based on a reference fleet are demonstrating advantages in supplementing scientific, management and MCS data. Existing MCS methodologies, such as VMS and on-board observer programmes, will continue to be needed but will need to be adapted to integrate with any new regulatory and enforcement measures.
- **Attention must also be given to adapting and developing technical measures**. Key technical measures to avoid bycatch and discarding include **spatio-temporal management** and **flexible development of more effective gear technologies and methods**.

It is recognized that the introduction of the landing obligation necessitates a review of certain aspects of the CFP regulatory framework, and that the challenges of implementing successfully might require new regulatory approaches. The most prominent regulatory challenge is frequently cited to be enforcement, in particular as the focus of monitoring and control shifts from landing to activities at sea. This shift requires that fishing and discarding practices are monitored around the vessel, at a rate of 100 per cent during fishing activities, in order to detect what is caught and whether there is discarding. Currently applied electronic and on-board MCS methods, including satellite monitoring, enforcement patrols and on-board observer programmes, can meet this need only to some extent. In this regard, increasing attention is being applied to electronic monitoring systems as a means to attain 100 per cent monitoring of fishing activities. The need to adapt the regulatory framework does not just concern enforcement systems, however, and other measures, including adaptations to the technical measures framework, also need to be considered. This Chapter provides a brief review of some of the current innovations and practices that are of relevance.

5.1. Electronic monitoring systems

Remote electronic monitoring (REM) systems are showing considerable potential as a means to complement observer schemes and other enforcement activities. REM has been implemented in Canada since the early 2000s (McElderry et al., 2003) and trialled in many

fisheries around the world (see the reviews of published and unpublished reports by Mangi et al., 2013, and Wallace et al., 2013). At least where it has been applied for some time, the technology is well tested in practice and the technical reliability has been proven (IMCSN 2013) although there various issues present themselves in developing systems within new jurisdictions, for specific fisheries and with respect to specific regulatory requirements.

While systems vary, REM is increasingly being developed as a component of a fully document fisheries (FDF) programme. FDF entails detailed recording of activities by the master together with e-monitoring and supported when needed by complementary monitoring and control approaches, including VMS, on-board observers and inspection patrols. The e-monitoring system entails the recording of fishing vessel activities through a system of sensors on fishing machinery and CCTV cameras which record footage of fish catching and processing.[3] The data and imagery is then reviewed onshore by compliance analysts. The monitoring systems are able to record the entire fishing trip, each (or almost each) fishing operation, catches and catch handling procedures, species, fish size and retention of all catch on board. In retrospect, the whole fishing trip can be recreated through CCTV footage, GPS and sensor data and may be audited at any time.

REM and FDF systems are increasingly being considered to have the potential to provide substantial benefits, not only in terms of compliance but also in terms of providing additional scientific data and additional management information. Although e-monitoring programmes are yet to be implemented extensively (and so far mainly through pilot programmes or as a complement to observer schemes), over the past decade REM has proven to be a reliable and effective system of monitoring. Nevertheless, in the context of monitoring a regulatory obligation such as the landing obligation, key questions must be considered. The include whether REM be applied effectively in the context of discards (i.e. is it able to adequately record the fishing activities that need to be monitored) and whether it is a practical alternative – in terms of costs – to more traditional enforcement methods. Additional questions also arise concerning what administrative and legislative adaptations are needed to implement the systems and access, use and rely on the data (these questions are considered in later chapters).

5.1.1. Application in the context of discards

The most basic question concerning the use of REM in monitoring compliance with the landing obligation concerns its ability to do so. As will be seen in the next Chapter, international experience demonstrates that REM can be applied to a wide range of monitoring needs. For example, they have been used cost-effectively to monitor compliance with technical regulations for minimizing interactions with protected species and to monitor catch offloads – including recording the fish being unloaded from the boat, recording transport arrangements, observing persons who approach the boat, counting the number of boxes that come off the boat and corroborating against logbooks and other data.

Moreover, the application of REM to monitor discards in European fisheries has shown high capability levels, at least for some fisheries. An analysis made in the Scottish catch quota monitoring scheme (Dinsdale 2013) illustrated that the REM sampling scheme was able to accurately obtain all data required for the purposes of monitoring discards and catch activities. A key advantage of the systems, of course, is their ability to record continuously

[3] Other electronic tools are also available; for example, some sonar systems can be used to identify specific species.

and record large numbers of trips (compared to traditional on-board observer schemes) but additionally, they were able to record catch handling procedures, catch and discard activities and to provide count and length discard sampling data.

Figure 4: Capabilities comparison – single observer vs. single REM vessel / analyst

	Onboard Observer Scheme	REM Sampling Scheme
Counts	Yes	Yes
Lengths	Yes	Yes
Age	Yes	No
Sample whole haul	No	Yes
Sample every haul in trip	Yes	No
Trips sampled	Few	Many

Source: Dinsdale (2013)

The capabilities of REM systems may be more limited in more complex fisheries, however. A more recent study (van Helmond et al. 2015) evaluated the efficacy of EM for cod catches on vessels in a mixed bottom-trawl fishery and tested the hypothesis that cod catches are difficult to detect with video monitoring, specifically in catches with large volumes of bycatch. This mixed bottom-trawl fishery differs from fisheries where EM was proven to be successful method, e.g. hook and line or single-species fisheries with low bycatch volumes. The study concluded that distinguishing small numbers of cod in catches of mixed bottom-trawl fisheries was difficult because there is a low correlation between logbook and video data, and it was anticipated that there could be similar difficulty in other mixed demersal trawl fisheries with large bycatch volumes, when similar-looking species are targeted. Furthermore, implementing the landing obligation could pose large challenges for fisheries with large volumes of bycatch.

As noted by the study authors, limitations in the applicability of EM to control one of the most common types of fisheries in Europe will be a burden on the implementation of the European landing obligation. Improved protocols and technical adaptations may reduce some of the limitations encountered.

5.1.2. Costs

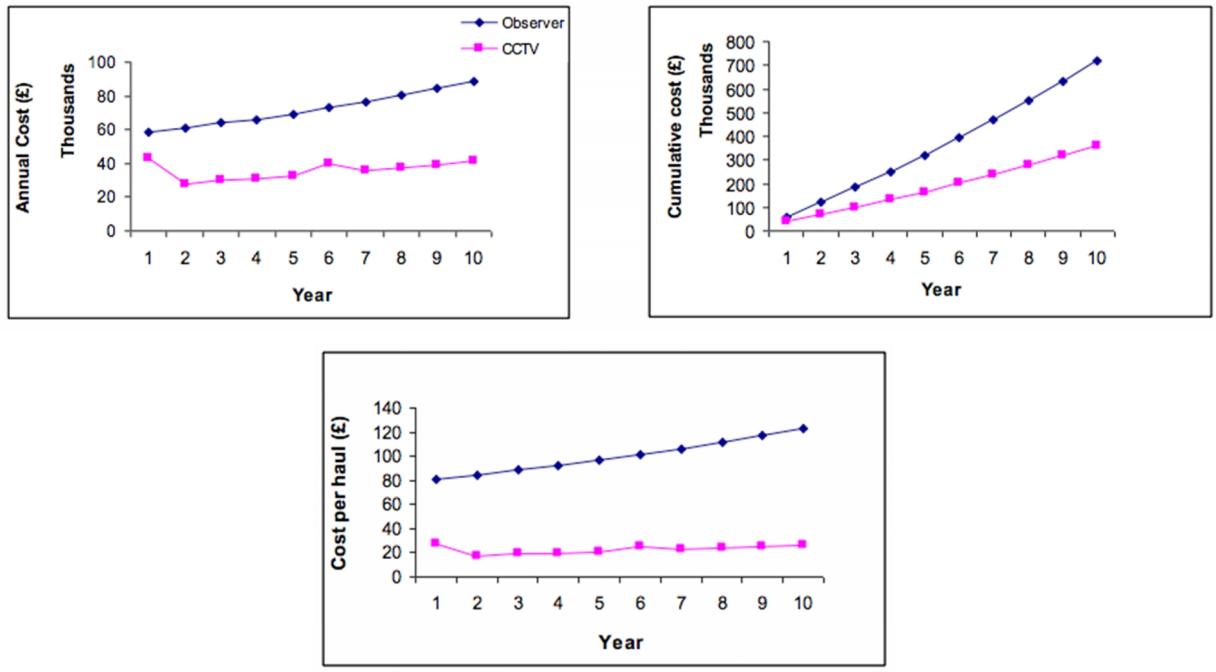
It is clear that the use of REM systems involves some significant initial (and recurring) capital costs and significant on-going / running costs. The major costs associated with implementing REM concern regulatory processes, REM related permitting processes, equipment, data transmission, data analysis and data management and storage (NOAA 2015a). Nevertheless, while there appear to be no extensive studies of the costs of implementing REM (at least in Europe), it is likely that in the long-term REM would represent a cost-effective method of enforcement with some potentially significant cost advantages over on-board observer programmes.

A case study comparing the costs of on-board observers and REM based on data from the Scottish catch quota monitoring scheme (Dinsdale 2013), indicated that while costs varied greatly depending on a range of factors (in particular the numbers of analysts, equipped

vessels and observers), REM costs are high in year 1 but are vastly reduced in subsequent years and cost per haul were cheaper for REM. Comparing the cost of a single observer against a single REM vessel and analyst over 10 years indicated that the cumulative costs for the REM vessel were less than half that of the observer-covered vessel (see **Figure 5**). Applying a hypothetical model, applying 20 per cent observer coverage (116 observers) as against 400 REM vessels, requiring 11 REM analysts, the case study illustrated even more substantial cost savings over 10 years from the REM deployments (see **Figure 6**). (An example of the actual costings involved is presented in **Table 7**).

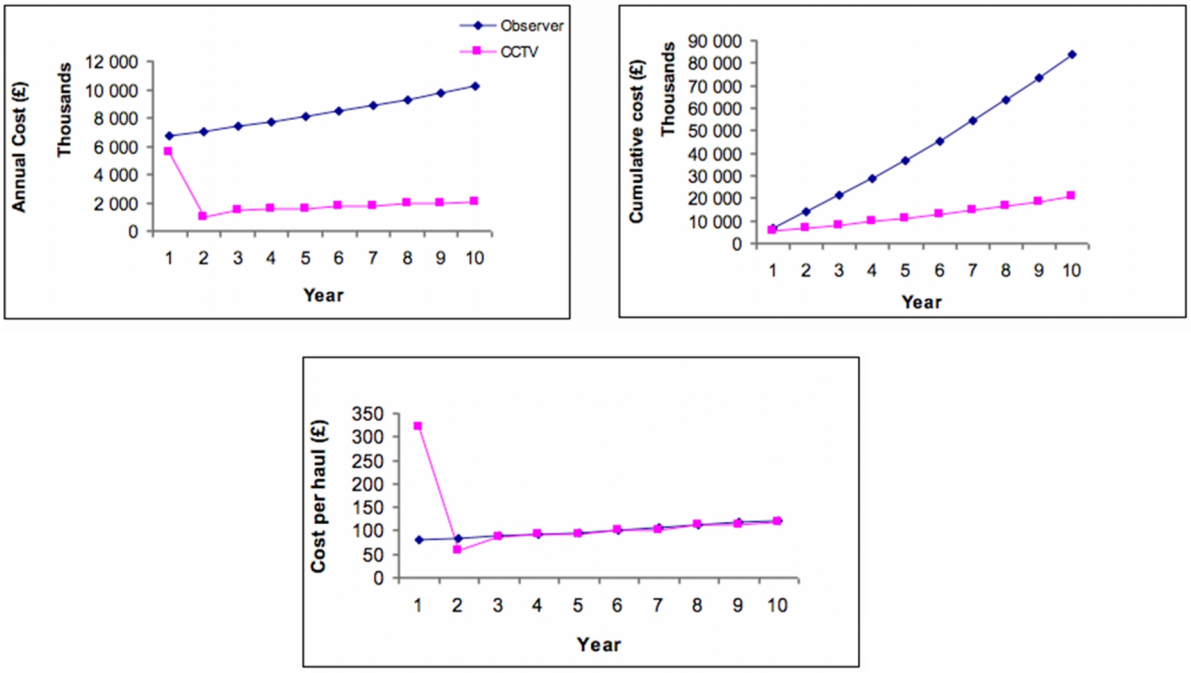
Obviously, the financial analysis in any particular case will be highly variable depending on the wide number of specific factors, but the results at least indicate that there are unlikely to be any long-term financial deterrents to the development REM in many fisheries (indeed, there are likely to be long-term financial advantages). However, there will be a specific need to address the substantial initial investments in developing REM – both at the administrative/public level and at the industry level.

Figure 5: Cost comparison – single observer vs. single REM vessel / analyst



Source: Dinsdale (2013)

Figure 6: Hypothetical 20% observer coverage: 116 Observers 400 REM Vessels 11 REM Analysts



Source: Dinsdale (2013)

Table 7: Comparison of costs of on-board observers and REM/CCTV

Costs	Observer (EUR)	CCTV (EUR)	Recurrence
Salary	25,233	25,233	annual
Training	2,570	2,570	once
REM Equipment		12,238	once
Scots PC	2,040	2,040	annual
PC		6,658	5 years
Transport	68		trip
Vessel Payment	34		daily
Sea Allowance	238		daily
Sea Gear	272		annual
Medical	109		2 years
Sea Survival Training	204		5 years
Courier		54	weekly
Software licence		3,638	annual
System Installation		3,264	once
Equipment Maintenance		1,631	annual
Hard drive replacement		95	4 years
Camera replacement		680	3 years

Source: Dinsdale (2013)

While this analysis appears favourable, there are some concerns that the costs of managing a comprehensive REM system could be prohibitive. In its impact assessment concerning implementation of the landing obligation for demersal fisheries, the UK government concluded that fitting REM equipment on all vessel in the main segment of the demersal fleet (vessels over 15m) would render this approach prohibitively expensive due to the high costs to Government of analyzing the electronic records and purchasing the necessary equipment (Defra 2015). Similarly, an independent study into the Scottish catch quota monitoring scheme identified a risk that science monitoring and analysis resources could become overwhelmed (Needle et al. 2015).

5.2. Other control measures

5.2.1. Catch composition comparison based on a reference fleet

An increasingly utilised approach to supplement monitoring and control efforts is to use catch composition comparisons based on catches made by a specifically-established reference fleet. The detailed findings of reference vessels involved in at sea monitoring (in the form of either on-board observers or REM and land based sampling) can be used to validate another vessels' (in the same fleet segment) self-documentation of catches and

discards (using logbooks). Where appropriate, and beneficial, at sea observations from a reference fleet may also be used to collect relevant scientific evidence relating to fisheries assessment, gear selectivity and species survivability.

The data from such fleets can contribute significantly to research, management and control efforts. However, from the specific perspective of control consideration needs to be given to the administrative and regulatory / legal implications of data in specific cases. For example, how is the information to be used in decision-making on specific courses of action concerning a vessel, and what evidentiary value might be placed on the data in court.

5.2.2. Other MCS activities

Existing MCS activities will continue to be required, even if new CCTV systems are implemented. Satellite vessel monitoring systems, for example, will continue to record data separate to that collected by CCTV systems, and can also corroborate other components of an electronic monitoring system, such as information in the electronic logbook. As part of an integrated REM, data from VMS, CCTV and electronic logbooks can be linked.

At the same time, there may be a continued need for control observers, at least in some fisheries. Observer programmes place observers on a defined percentage of fishing trips conducted by fishing vessels (in line with the available budgets). Observers are able to closely monitor fishing activities including accurate identification of catches that are brought on board and wider fishing practices. Observer programmes are however costly to run; as such the number of voyages that could be subject to observer coverage would likely be significantly less than the number of voyages which could be covered through the use of REM systems.

Finally, the needs for at sea controls (e.g. sea patrols and aerial surveillance) and landing controls continue although they need to be aligned with the requirements of the landing obligation. Inspectors can examine the catches of fish of board the vessel, the fishing gears that are in use and the records kept by the master of the vessel to ensure that they are in compliance with fisheries regulations, and can provide more extensive and potentially mode durable compliance checks than through other observation methods. Controls at landing are currently one of the main tools used by enforcement authorities to ensure compliance with fisheries regulations. This includes but is not limited to checks on the catch weights that have been recorded, the size of fish that is landed as well as checks against quota holdings. Catches can also be assessed against the reference fleet catch compositions.

5.3. Technical measures

A key driver for compliance, and a fundamental objective of the overall policy, is to create conditions whereby those fish which have until now been discarded are no longer caught. A ban on discarding, supplemented by control measures, can only ensure compliance to a certain level and the wider other regulatory measures are from enabling or encouraging fishers to reduce discards, the more pressure there will be to avoid the discard ban.

Measures to support discard reduction can include both incentive measures (e.g. access to a certain area and / or at certain times will only be granted to those using specific approved gears, or that those using approved gears benefit from additional quota or effort allocations), disincentive measures (e.g. a requirement to keep reject fish aboard and stowed separately) or technical measures – either at the level of the gear through enhanced selectivity, or by spatial and temporal avoidance.

Achieving the right balance in these respects is difficult, and a key challenge is to recognize that different technical measures may be more suitable in different fisheries, and even within particular fisheries different fishing gears, technologies and methods may produce similar results but imply different costs and burdens on the fishing vessel. It is also recognized that the introduction of the discard ban in itself is seen as a driving force for

developing more selective gears and methods. There is therefore considerable force in an approach which allows for flexibility at the level of a specific fishery to deploy the most suitable and effective technical adaptations.

5.3.1. Spatio-temporal closures

A key measure in some regulatory frameworks, and also applied specifically in discard policies, is the use of spatio-temporal fishery closures as part of the technical measures. These have been used to reduce bycatch of both protected and commercial species and have proven to increase fishing selectivity by prohibiting fishing in areas with high bycatch to catch ratios (Hooker and Gerber 2004; Hall and Mainprize, 2005) although still remain relatively under-used as a specific method to manage bycatch (Dunn et al. 2011). This reflects the experience within the CFP, where closed areas and closed seasons are used as conservation measures but not as a specific bycatch management tool.

To an extent, spatio-temporal adaptations can be complementary to commercial fishing practices and – as such – these adaptations may not create significant compliance resistance. As part of normal operations, fishers will make a decision on where and when to fish based on where and when they believe they will catch marketable fish. There is also anecdotal evidence that fishers will avoid areas and periods where there are high concentrations of unwanted fish. However, there is little evidence on the possibility and level of ability of fishers to use spatio-temporal changes in fishing practice to match quota allocations with catch compositions. As with changes to the selectivity of the fishing gear used, the level of incentive to avoid catching unwanted fish is lower than is expected under the landing obligation.

5.3.2. Technical regulations

Improved selectivity of fishing gears remains a primary and important tool to avoid discards. Fishers have the ability to change selectivity. A wide range of gear-based technical measures to reduce the capture of unwanted fish during fishing operations have been developed and trialled in numerous European fisheries, and a substantial amount of work has focussed on improving the selective properties of trawls. Some of these have been developed specifically in response to adaptation to the discard ban, and have delivered positive results.

An exhaustive review of the potential modifications is not possible, and in any case would need further development and consideration at the level of specific fisheries. The range and potential for technical adaptation is illustrated by the following modifications:

- Coverless trawls (cutaway trawl): designed to allow unwanted fish to escape over the top of the trawl, successfully used for haddock and whiting , e.g. (Revill et al., 2006).
- Escape panels (Square mesh panels, benthos release panels): sections of conventional netting in the trawl replaced with netting of larger mesh size or with meshes at different orientation to facilitate the escape of unwanted catches, e.g. (Revill and Jennings, 2005).
- Selection grids (separator grids, inclined panels): additional material, rigid, flexible grid or netting that is attached to the inner circumference of the trawl. Marine organism unable to pass through the grid are instead guided to their escape. Successfully used to separate shrimps and prawns from fish, e.g.(Valentinsson and Ulmestrand, 2005; Catchpole et al., 2006).
- Separator trawls: trawls that are horizontally split by a separating panel of netting and terminate in two codends (bags). This design utilises the different behaviour of species during the capture process, some species tend to move upward inside the trawl (whiting, haddock, hake, squid) while others remain on the bottom of the trawl (anglerfish, cod, sole, Nephrops), e.g. (Rihan and McDonnell, 2003; Holst et al., 2009).

- Mesh size increase (codend end mesh size): larger fish can pass through larger meshes. Increasing the mesh size in a net, or section of it can facilitate the escape of smaller fish. A lot of the selection occurs at the codend, increasing the mesh size of the codend can increase the escape of fish from the trawl, e.g. (Graham et al., 2004; Madsen et al., 2008; Enever et al., 2010).
- Modified ground gear: by changing the section of the trawl that is in contact with the seafloor, the selectivity of the trawl can be altered. For example, inserting interspaced discs along the footrope raise it from the seafloor allowing the escape of species that stay close to the bottom, e.g. (Ingolfsson and Jorgensen, 2006).
- Modified bridles and sweeps: the wires that connect the trawl to the hydrodynamic doors that are used to spread open some trawls have an effect to herd some fish species into the mouth of the trawl. Reducing, removing or floating these wires above the seafloor can change the selectivity of the trawl, e.g. (Catchpole et al., 2013).

There are numerous ways in which the selectivity of a trawl can be changed. Further to the modifications described above the catch composition can be altered by changing the speed of the tow of the net, the fishing location, the time day-night or the season.

5.4. Data management

Data risks should not be overlooked (Hentati-Sundberg et al., 2014). Fish stock assessment provides the foundation for scientific advice to decision-makers on sustainable catch levels. A critical feature of stock assessment methodology is its dependence on accurate commercial data, which makes it susceptible to biased reporting (Walters and Maguire, 1996; Cotter et al., 2004; Bousquet et al., 2010). New methods have been developed to reconstruct historical catches and correct for misreporting and underreporting (Zeller et al., 2005, 2007; Rossing et al., 2010; Wielgus et al., 2010).

The reasons for misreporting and underreporting include e.g. IUU fishing (Agnew et al., 2009), discard obligation (Kelleher, 2005; Wielgus et al., 2010) and catches from recreational fisheries (Zeller et al., 2011b). Another potential bias in catch statistics is underreporting or misreporting in highly regulated commercial fisheries (e.g. Roman et al., 2011). Such misreporting can be driven by fishing fleet overcapacity, resulting from restrictive TACs and/or effort regulations (Patterson, 1998; Beare et al., 2005; Dobby et al., 2008) that create economic incentives for non-compliance (Sumaila et al., 2006; Gallic and Cox, 2006; Osterblom et al., 2011).

The findings are supported by theoretical work, suggesting that reinforcing social–ecological feedback between overcapacity, reduced fishing quotas and underreporting of catch quantities are important in preventing recovery in European fish stocks (Osterblom et al., 2011). A vicious circle involving increased misreporting or discarding is also leading to a decline in stock assessment quality. Basing political decisions on uncertain assessments is problematic (Walters and Maguire, 1996; Kraak et al., 2009; Gardmark et al., 2011) and can potentially contribute to a decrease in the credibility and legitimacy of fisheries science (Hentati-Sundberg et al., 2014).

6. CURRENT PRACTICES IN MONITORING DISCARDS AND OTHER FISHERIES ACTIVITIES

KEY FINDINGS

- The implementation, monitoring and control of the landing obligation generates some **new challenges**. In particular, the focus of monitoring and control **shifts from landing to activities at sea**.
- There is much focus on **electronic technologies** (electronic reporting and electronic monitoring systems) which represent a **potentially cost-effective means** to widen observation of activities at sea, and several countries have begin to develop and implement EM systems.

Key practice includes:

- In **Norway** a system of real-time closures operates, supported by strong at-sea surveillance. The regulations have demonstrated success in reducing discards.
- In the **United States**, there is an **increasing focus on electronic technologies** which are in use or being piloted in an expanding range of fisheries. The results of the pilot projects demonstrate some positive uses of electronic technologies but also expose some limitations. In particular, experience from a 7-year programme in which REM was used to monitor a discard ban illustrates the potential effectiveness and cost efficiency of REM.
- Electronic monitoring systems are also being applied and/or developed in **Iceland, Canada, New Zealand, Australia and the Pacific Islands** and **a range of other methods are also applied** in these countries, including area closures and technical regulations.
- In the **EU**, fisheries management measures directed at fisheries discards have so far been limited to technical regulations and 'traditional' MCS controls directed towards a requirement to discard. Permanent adaptations in response to the landing obligation have yet to be developed, but **trials of REM systems have shown considerable promise in some fisheries**.

The implementation, monitoring and control of the landing obligation generates some new challenges. In particular, the focus of monitoring and control shifts from landing to activities at sea leading to potentially higher costs of enforcement as it might require, for successful implementation, full observer coverage or electronic video monitoring to validate a self-reporting system. In this context, much of the focus has been on electronic technologies – i.e. any electronic tool used to support catch monitoring efforts both on shore and at sea, including electronic reporting (e.g., electronic logbooks, tablets, apps) and electronic monitoring (VMS, video cameras and sensors). A key focus of this chapter, therefore, is to review current experience – globally – with respect to electronic monitoring (including reporting), both where this has been applied specifically in the context of discard regulation and also more widely, where useful observations are generated. Additionally, however, and in order for a discard ban to be successful, management authorities need to simultaneously implement complementary measures which will support implementation and encourage compliance with discarding rules. This Chapter also therefore reviews some of the key innovations in current regulatory practice which might inform the future development of discarding regulations under the CFP.

6.1. Third countries

6.1.1. Norway

6.1.1.1. Electronic monitoring

Norway does not implement fully-fledged electronic monitoring systems, although electronic reporting systems have been used in some fisheries since 2005 and since 2011 all Norwegian fishing vessels over 15 meters have been required to report catch and activity data electronically. Under the new regulations the requirements related to content, format and reporting frequency of various reports were specified with the idea was that by combining the information in the required electronic reports it sums up to the information registered in the traditional paper log book.

6.1.1.2. Discard regulation

Generally speaking, it may be observed that the discard ban has been a positive and successful experience in Norway. While the effectiveness of the discard ban cannot be totally evaluated since discard data is not methodically collected, it is recognized that discarding occurs at a significantly lower level than before the ban. (For example, the EU Discarding Commission of 2004 estimated that Norwegian discards to be between 5-10%, slightly higher than those of the Institute of Marine Research of Norway, i.e., 2-8% (MRAG 2007, Kelleher 2005): in either case, a significant reduction.) The discarding and other rules are reinforced by robust monitoring and control procedures. The coastguard is mandated to patrol waters to monitor and control discarding activities, monitor closed areas and conduct at-sea inspections of vessels in Norwegian waters (Hønneland 2009, Lockwood et al. 2010).

6.1.1.2.1. Real-time closures

Real-time closures (RTCs) occur in spatial areas where the number of undersized fish, or level of bycatches, exceeds permitted limits and are then temporarily closed. RTCs are recognised to be an effective tool in situations where unwanted intermixture vary from year to year and/or with respect to time and place. Seen from the fishers' perspective and that of economic efficiency, it is a flexible measure compared with permanent closures, allowing fishing to take place in a controlled and sustainable manner when not in conflict with economic and conservation objectives. The program for closing and opening of areas on a real time basis in the Barents Sea was developed from 1984 onwards to avoid the catching of undersized fish and bycatches of protected species. Similar but less comprehensive programs are now emerging for the North Sea and Skagerrak, in a dialog between EU and Norway.

The closure of the fishing areas is triggered according to various criteria, including the cases when more than 15% of the catch corresponds to below legal size cod, haddock and saithe (ICES, 2011). Furthermore, some closures are related to fish behaviour, namely in the herring purse seine fishery, where day-time closures are enforced if the possibility of seine bursts are predictable due to the presence of large herring shoals during daylight in the area (Johnsen and Eliasen 2011). Area closures can also extend over larger periods of time and be as large as almost half the Barents Sea area, which had to be shut down due to high retention of undersized fish (Graham et al., 2007).

The system of RTCs is controlled by the Directorate of Fisheries and monitored by inspectors in the field (Condie et al. 2014, Johnsen and Eliasen 2011). Coastguard inspectors perform regular inspections on vessels operating in the Barent Sea to determine if juvenile catches in the holds are too high and if so, the area of catch is recorded and a

five mile radius is closed to fishing (Lockwood et al. 2010; Diamond and Beukers-Stewart 2009). Assessment fishing is then conducted by management authorities to determine when the areas are suitable to be re-opened. Quota is set aside at the start of the year to include catch taken by these assessments (European Commission 2011c). The assessments are carried out by IMR researchers using actual contracted fishing vessels to ensure the scenario of fishing is accurately replicated.

Approximately 3000 inspections are made each year by the coastguard which are required to assist in determining areas for RTCs. Scientific inspection vessels employing the use of up-to-date fishing gear are also used to determine sites for RTCs. To increase the efficiency of the operations of the coastguard and the scientific inspection vessels, oceanographic analysis is conducted by IMR to determine where areas would be ideal nursery grounds for juvenile cod (European Commission 2011c). Management authorities are also well experienced in the dynamic nature of the real time closures and can manage a high volume of closures; there are roughly 100 area closures per year (European Commission 2011c).

6.1.1.3. Surveillance at sea

Presence and surveillance at sea by the Norwegian Coast Guard is extensive compared to most coastal states (Gullestad 2015). Presence and inspection at sea are the main tools for preventing and uncovering discarding. Some of the inspection vessels are equipped with a helicopter, and "surprise" filming for evidence followed by boarding has proved effective in uncovering discarding (Gullestad 2015). Norway does neither operate an observer programme collecting scientific data at sea, nor a closed-circuit television (CCTV) programme to monitor potential discarding. However, scientific data, including some data on discards, are collected by the Institute of Marine Research through their Reference fleet.

When discarding is revealed, both the captain of the vessel and the owner may be fined. In extreme cases, if it is revealed that discarding is an integral part of the vessel's 'ordinary' production process, the fishing licence may be withdrawn for a period, and considerably higher fines are issued than for less serious infractions. In serious cases, the entire catch onboard may be considered illegal, and a corresponding value confiscated by the prosecuting authority or by the court, in a separate decision. The Coast Guard, in co-operation with the Public Prosecutor, has developed considerable experience and expertise in collecting evidence in discard cases in a way that will satisfy the Norwegian judicial system, so that convictions in court are frequently successful. As a result, approximately half a dozen captains/companies are fined annually. The fines are around 15 000 to 25 000 NOK (1 750-2 850 Euros) for the captain, and in addition up to 150 000 NOK (17 500 Euros) for the company that owns the vessel (Gullestad 2015).

6.1.1.4. Fishing gear and methods

The area closure system has created incentives for the use of more selective gear, as is the case of the successful Nordmøre grid (Isaksen et al., 1992). The Pandalus shrimp fishery was responsible for catching large amounts of undersized fish which triggered the closure of large areas of the Barents Sea. As a result, affected fishers had a strong incentive to engage in more selective practices and some of them developed the Nordmøre grid, which greatly reduced bycatch, and consequently spread beyond borders and is now mandatory in all Pandalus fisheries of the North Atlantic (Graham et al. 2007).

6.1.1.5. Reference fleet

Norway has for some years used catch reference fleets as a means to supplement MCS efforts. A high-seas reference fleet was established in 2000 and consists of 19 vessels, and in 2005 a similar coastal reference fleet was established along the entire Norwegian coast,

consisting of 20 vessels (IMR 2013). The reference fleets provide the Institute of Marine Research (IMR) with detailed information about their fishing activity and catches on a regular basis. The sampling and data management procedures are similar to the system used on board IMR's research vessels. Data is used for management purposes including stock assessment. The administration and work done by the reference fleets is self-financed by the allocation of a minor part of the Norwegian fish quotas for research purposes. The vessel owner gets 50–60% of the quota value to cover the vessels expenses in catching, producing and selling the fish. The other 40–50% covers the administration and running costs, and payment to the fishermen to take biological samples and data deliveries according to protocol. The reference fleet collects data on catches, discards and other marine information which is used to inform management decisions and overall fleet monitoring. The reference fleet may also be requested to make specific observations and collect urgently needed data, and could also be used to collect environmental and hydrographic data if it does not hamper normal fishing activity.

6.1.1.6. Social and behavioural factors

Allowing fishermen to land everything does not appear to have increased pressure on the fish stocks. On the contrary, combined with a system of real-time area closures the discard ban appears to have generated an incentive for fishermen to install gear modifications and fish more selectively. This, combined with greater scientific knowledge about the status of the stocks, is likely to have contributed to the relatively fast stock recovery rates experienced in the Northeast Arctic. Initially, the economic cost to the fishing industry was relatively high with fishermen experiencing landings comprised of greater proportions of small fish with lower values and lower CPUE. The period for which the fishing sector remained unprofitable lasted for four years. Today, the Norwegian and Barents Sea fisheries are some of the most prosperous in the world (Diamond and Beukers-Stewart, 2011).

As a measure to maximise compliance, ample incentives needed to be provided for vessels to not discard the fish. When the ban was first introduced, fishers were required to land and report all catches even if the catch was illegal of which the catch was the confiscated by the sales associations (Gezelius 2006). This led to a system of reimbursing a percentage of confiscated catch – fishers could apply to the sales associations for 20% of the sale value of the confiscated catch (Gezelius 2008; Diamond and Beukers-Stewart 2009). It should be noted though, that this system only occurs in the whitefish sectors and was removed from the pelagic sales as it was considered to be too lucrative (Gezelius 2006; Gezelius 2008). Given this reimbursement may not cover 100% of total fishing costs, there is still some economic justification and incentive to discard.

6.1.2. United States

6.1.2.1. Electronic monitoring

The use of electronic technologies for fisheries data collection and management, including data collection in relation to discards and bycatches, has been under development for several years. In 2013, the National Marine Fisheries Service (NMFS) published policy guidance on the use of electronic technology for fishery-dependent data collection (NOAA 2013), including a specific directive for NMFS to develop regional electronic monitoring plans, and a discussion draft summarizing electronic monitoring/electronic reporting guidance and best management practices for federally-managed species (NOAA 2013a). The following reviews the technologies that are already in use or are currently being tested.

6.1.2.1.1. Remote electronic monitoring

A remote electronic monitoring system was used over a 7-year period (from 2004 to 2010) in the US shore-based Pacific whiting fishery to support compliance with a landing obligation (a discard ban, similar to the EU landing obligation). REM was compulsory on all fishing vessels from 2004 to 2010; each vessel carried an monitoring system (control centre, up to four CCTV cameras, GPS, winch and hydraulic sensors) that operated continuously while the vessel was at sea. Sensor and image data was collected and analyzed to determine fishing time and location and monitor catch stowage operations to monitor full retention compliance, and REM analysts estimated discard quantities using volume-density estimation methods (McElderry 2014).

Substantial data were collected by the programme and on the programme (information was also recorded on REM data quality and program delivery costs), which has enabled a detailed evaluations of the programme to be developed (McElderry 2014, Lowman et al. 2013, NOAA 2013, 2012). Early monitoring results yielded a clearer understanding of fishing practices, providing a framework for more practical regulations on permissible levels of 'operational discarding'. The programme provided increased transparency which was a contributing factor to a marked decline in at sea discards over the seven year period, and was able to inform new management approaches when the programme came to an end.

A recent analysis of the programme (McElderry 2014) set out a number of lessons learned that would be applicable to the application of REM in Europe:

- REM based monitoring should not be considered a "plug-and-play" alternative to observer programs as each has their own opportunities and challenges.
- The utility of REM for collecting fisheries data relies on a careful design process that integrates the REM technology, the vessel specifications, and specific on board catch handling and REM system duty of care requirements.
- Successful use of REM often depends upon integration with other data collection processes and information sources. Data integration opportunities should be considered in the design process.
- Stakeholder engagement is an essential ingredient to REM program success. This should occur at a variety of levels in order to improve the program, optimize operations, and effect change.
- REM technology will change over time and the program design needs to be flexible to include change, where appropriate.
- Effective REM programs require control measures through governance, regulations, incentives or disincentives.
- REM programs take time to implement and a multi-year time horizon is needed to establish operations and infrastructure, and offset start up costs.
- REM was lower in cost compared to on-board observers, and the incidence of discarding was reduced to a low level; consequently EM was considered a more cost-effective method for this fishery.

Electronic video monitoring systems are not widely used in other fisheries, and are not required in any federally managed fishery although two pilot studies have been conducted on commercial vessels in the Gulf of Mexico and South Atlantic (Pria et al. 2008, Baker 2012). The systems consist of a control box, sensors (e.g., GPS, hydraulic pressure transducer and a winch rotation sensor) and cameras (NOAA 2015). The control box

continuously records sensor data, as well as provides feedback on system operations (Pria et al. 2008). Video images are captured with cameras typically during fishing operations, and may be triggered to go on or off when winches rotate or hydraulic pressure changes. After video imagery is captured, it is viewed to enumerate and identify landed and discarded catch.

In the pilots, comparisons between observer and EM methods of catch identification showed good agreement (>80%) between observer and EM methods, but identification discrepancies were observed for some species. EM was not able to reliably determine catch discarding due to inconsistent catch handling and limited camera views. Overall, study results indicated EM was useful for collecting fishing activity, spatial-temporal data, and assessing catch composition, but further work was needed to reliably determine catch disposition data.

A third study conducted by Tate (2012) and Batty et al. (2014) is still ongoing. The study is evaluating the use of EM in the Gulf of Mexico bandit reel and longline fishery, and preliminary results are similar to those of the earlier pilots. This project demonstrated that EM could be used to reliably document fishing effort and retained catch, but that major changes to camera installation would be required to accurately record discarded fish.

6.1.2.1.2. Electronic Reporting Systems

There are a variety of ways electronic reports are collected from fisheries (NOAA 2015). These include personal computer based software programs, Web-based software, and applications available on tablets and smart phones. Beginning in early 2014, certain vessels in the Gulf of Mexico and South Atlantic were required to submit trip-level logbooks electronically. Electronic logbook reports are required on a weekly basis and may be submitted via the Web or smart phone/tablet applications. Since August 2014, dealers purchasing federally managed species have been required to submit electronic trip tickets using standardised software applications and maintained by the Atlantic Coastal Cooperative Statistics Program (ACCSP). Additionally, a Web-based system is used to report commercial dealer landings and conduct share and allocation transfers for certain reef fisheries. Electronic logbooks are also required in the Gulf of Mexico shrimp fishery to collect fishing effort and location information. Gulf shrimp permit holders are required to participate in the program if selected. Shrimp vessels selected to report have data recording devices with global position system (GPS) units that record a vessel's location every 10 minutes. Data are automatically transmitted to NMFS via a cellular phone connection. Vessel speeds are estimated between data points to determine the vessels fishing activity, which can then be used to calculate shrimp fishing effort and bycatch.

The costs of the programmes are substantial, and are shared with vessel owners. For example, in the shrimp fishery one-time costs to the government for shrimp electronic logbooks (ELBs) were approximately $2 million dollars (2.8 million Euros) and recurring costs are approximately US$313,000 annually (425 772 Euros) (GMFMC 2013c). One-time installation costs for ELB installation were paid for by the government. Reccurring costs to the shrimp fishers for data transmission service fees are approximately US$120,000 (163 233 Euros) annually.

In addition to the mandatory ER programs discussed above there are also several pilot studies underway or recently completed to test the use of logbooks and other ER systems in commercial and recreational fisheries. These include, but are not limited to, a Web-based logbook pilot study of Gulf of Mexico for-hire vessels funded by the Marine Recreational Information Program (MRIP) in 2010-11 (Donaldson et al. 2013), a smart phone/tablet

application (iSnapper) funded by the Marine Fisheries Initiative (MARFIN) grant program to test ER in for-hire and private fisheries (Stunz et al. 2014), and a phone-based reporting system 10 (Digital Deck) to test ER in U.S. Caribbean fisheries (Steinback 2014). In 2013 and 2014, several Gulf of Mexico states implemented or began testing new voluntary or mandatory ER systems for collecting red snapper recreational catch data, and Florida intends to begin a new collection program for recreationally caught reef fish in 2015. North Carolina will also implement a for-hire electronic logbook program beginning in 2015 (NOAA 2015).

6.1.2.1.3. Other technologies

VMS is used in various fisheries. VMS systems have been used by federal fishery managers and law enforcement agencies to enforce spatial-area closures and gear-restricted areas and VMS data have also been used in some instances to assess the impacts of proposed regulations, such as spatial area closures.

The automated information system (AIS) is a tracking system used on ships and by vessel traffic services. AIS is a maritime navigation safety communications system that is currently mandatory for vessels 65 feet or more in length. It is being used by the US Coast Guard to improve national security and maritime safety but is not compatible with VMS as it uses different reporting rates and communication systems (Skirble 2015). However, AIS is being considered as a more cost-effective alternative to VMS that could be used in the future to monitor fishing activity, although this would likely be of limited capability in relation to discards.

6.1.2.2. Discard regulation

A discard ban in the United States' Alaskan groundfish fishery has been operational since 1998. The fishery operates through a system of individual vessel quotas (IVQs) allocates the fishing rights to commercial species while non-target species are protected by fishery specific bycatch limits (Graham et al. 2007). The retention of some vulnerable and commercially important bycatch species is prohibited and, if bycatch exceeds specified levels, the fishery has to be relocated or closed (Graham et al., 2007). The fisheries are monitored through partial or full observer coverage (Graham et al., 2007).

These efforts to reduce bycatch and discards have proven to be successful since they incentivised more selective fishing (Condie et al., 2014). Discard rates of Pacific cod have sharply fallen from 11.7 to 6.8 % between 1997 and 1998, declining and pollock have fallen from 6.8% to 0.4% by 2003 (Graham et al., 2007). Discards of pollock have dropped from 3.7, and to less than 1%, respectively between 1997 and 2003 (Graham et al., 2007). In response to high bycatch of prohibited species, there was a voluntary change from demersal to pelagic trawling, which resulted in bycatch rates falling below 2% (Graham et al., 2007).

An interesting feature is that alongside the discard ban rules, a voluntary hotspot closure programme operates (McIlwain 2015; Gilman et al. 2006). Vessels in the cooperative fleet report real-time catch information to a third-party assessor for analysis. Based on information shared by vessels, if a bycatch rate reaches a designated danger mark, a voluntary closure of the high bycatch area will be declared for all vessels in the specified area for a limited amount of time. The fleet communication programme is recognized to have contributed to the redistribution of demersal longline fishery vessels from areas associated with higher bycatches, resulting in bycatch rates 30% lower than those of vessels which were not associated with the communication programme (Condie et al.,

2014) and 33% lower bycatch mortality rates of Pacific halibut (Gilman et al., 2006; Williams and Chen, 2004).

6.1.3. Iceland

6.1.3.1. Electronic monitoring

Electronic logbooks are used to report vessel name, registration, call code, and fishing gear size and type in addition to the latitude and longitude at start of fishing, catch by weight and species, and the date and harbour for landings. All recorded data are entered into a computer system that links from each port of landing to a central database maintained by the Directorate and paid for through resource fees. This ensures a steady overview of the status of the allowable catch of every vessel and how much has been taken from the fisheries quota.

Processing vessels must electronically submit their logbooks directly to the Directorate of Fisheries. All information on catches, quota share, quota status, and transfer of quota between vessels is immediately available to the public on the Directorate's web site, as mandated by law, thus ensuring transparency (Johnsen and Eliasen 2011). Catch information in the database provides information on individual vessels and summarized data for all Icelandic vessels. Information on individual vessels includes landings, detailed catch reports, transferred quotas, quota status, and how any input of new information can affect a vessel's quota status. The Directorate of Fisheries updates catch data online daily. The database automatically subtracts the catch from a vessel's quotas. These real-time catch figures allow for the Directorate to act quickly if vessels have exceeded their quota.

6.1.3.2. Discard regulation

Icelandic fisheries are based on an ITQ system. Discards are banned fishers are obliged to land all catch, with the exception of live young haddock and cod caught by handline. The Minister of Fisheries and Agriculture sets the TAC for each species based on scientific advice and individual registered vessels are allocated a share of TAC of certain species according to each vessel's quota (Johnsen and Eliasen 2011). Each catch quota is fully transferable and divisible so that vessel owners can transfer an entire quota or a portion of a quota to another vessel. To ease the transferability of catch quotas, each quota is calculated in "cod equivalents" (a weight measurement based on the value of a species in proportion to the value of gutted cod, where gutted cod has a value of one). The cod equivalent system is designed to increase flexibility for vessel owners and decrease discards which are banned in Icelandic fisheries. Vessel owners can catch all other species and deduct their catches from their cod quotas using the cod equivalents (Christensen et al. 2009).

The Icelandic Directorate of Fisheries has established a strict monitoring program to ensure compliance with regulations, specifically adherence to species' TACs. Iceland's monitoring and enforcement regime includes port control, weighing of all catches, and mandatory landing of all catches (Johnsen and Eliasen 2011). Inspectors from the Directorate of Fisheries monitor the landing of the catch and publish the information, together with quota use (Johnsen and Eliasen 2011). In case fishers catch above their quota, they still have an incentive to land all the fish caught. They can either be covered by quota from the following year (up to 5% quota of the coming year) (Sanchirico et al., 2006; Hutton et al., 2010), purchase additional quota (in case of larger excesses and non-target catch) (Johnsen and Eliasen, 2011), or land a small bycatch percentage without using quota (Johnsen and Eliasen, 2011). The value of over quota and non-target catch is channelled for fisheries research (MFA 2015), after 20% of the total value is subtracted to cover fishers' landing costs (Sanchirico et al., 2006; Hutton et al., 2010).

There is no minimum landing size in Icelandic regulations. To prevent catching small size fish, mesh size regulations are enforced (ICES, 2014). Additionally, the Directorate of Fisheries discourages the capture of juvenile fish by applying real-time closures to fishing grounds from which large quantities of undersized fish are caught (MFA, 2015). Fishing is prohibited for two weeks in such areas, and if there are several consecutive quick closures, the Minister of Fisheries can enforce area closures for longer periods and force the fleet to move to other fishing areas (ICES, 2014).

The efforts made and the management strategies chosen by Icelandic authorities to reduce discards have proven successful since discarding of the main commercial species has declined and remains low. Discard rates of cod are below 2.2%, of haddock below 5%, and for saithe and golden redfish discards are negligible (ICES, 2014). ICES (2014) argue that the country's low discard rates are a result of the flexibility embedded in its ITQ system. However, some issues still persist. Misreporting in landings might be happening due to the TAC system. In an unpublished report by the Icelandic Directorate of Fisheries, in which export information from fish processing plants is compared to landings weight, indicates mismatching information in landing statistics in the order of single digit percentages (ICES 2014). Additionally, about 10,000 t of over quota and small size catch is landed annually under the permitted 5% quota overages (MRAG, 2007). The effectiveness of the area closures is still unclear. It is argued that juveniles might not be protected by short-term closures but by successive ones instead (ICES, 2011). Nevertheless, in the last 3 decades, Icelandic authorities closed temporarily about 2000 fishing areas, usually by banning bottom trawling and longlining (MFA 2015).

6.1.4. Canada

6.1.4.1. Electronic monitoring

Electronic monitoring systems are already more than a decade in use in Canada complementing observer schemes and enforcement activities. The technology is well tested in practice and the technical reliability has been proven (IMCSN 2013). EM programs have successfully monitored fishing location, catch handling, bycatch, discards, enumeration, and protected–species interactions among other criteria. The primary piece of equipment is a metal, tamper-proof, control center that houses the digital data logger and video computer circuitry. The control center is typically mounted in the vessel wheel- house. Recorded video and sensor data are stored on a removable hard drive that can be swapped out when the vessel is serviced so the fishing-activity data can be reviewed on shore. Traditionally, analog cameras were standard, but digital cameras are now increasingly used for their flexibility and high-definition output. All cameras are configured and situated to reduce the effects of glare, water spray, or low light levels on image quality.

6.1.4.2. Discard regulation

Canada deploys a range of bycatch reduction measures (including gear requirements, closed areas, quota exchanges and the setting of minimum landing sizes) although a discard ban exists only in relation to groundfish species in the Scotia Shelf multispecies groundfish fishery, where the discarding of the main target rockfish species is banned. When fishers reach their quota, they must either cease fishing or buy additional quota within specified limits (Grafton et al. 2005). In other fisheries, different measures are applied to reduce incentives to discard. For example, when fishers catch up to 37.5% of halibut and 15% of hake over quota, they can still legally land the catch without buying additional quota, reducing the incentive to discard (Condie et al. 2014). The value of the excess catches is confiscated and the catch counted against the following year's quota, removing the alternative incentive to target over-quota catch that can be legally landed

(Condie et al. 2014). The discard measures are supported by robust monitoring and control mechanisms, including an on-board observer programme.

The regulations have had a measurable impact. Fishers started to target species with bigger quotas and avoided areas where species with limited quotas were more abundant (Condie et al., 2014), resulting in 50% reduction in some rockfish species' catches (Branch et al., 2008). Bycatch limits were also successful in incentivising more selective fishing, as discard rates of spiny dogfish decreased by 5% between 1997 and 2004 (Condie et al., 2014), and the annual bycatch of halibut by 15% (Grafton et al., 2005).

6.1.5. New Zealand

6.1.5.1. Electronic monitoring

Remote electronic monitoring has not been utilised to support discarding rules, although has been used in pilot programmes to monitor protected species interactions. The pilot indicated the "tremendous potential" of REM for monitoring PS catch occurrences, providing routine monitoring for mitigation practices (McElderry 2011) but also exposed some limitations. For example, not all fishing events could be recorded (overall image recording was complete for 83% of fishing events; usability for specific monitoring objectives varied from 0% for one objective to 73–97% for the remaining objectives). The project demonstrated the need to prioritise monitoring objectives to enable better configuration of the monitoring system, and also highlighted the value of industry involvement in project design and potentially significant cost savings of electronic monitoring over human observer programmes (McElderry 2011).

6.1.5.2. Discard regulation

New Zealand fisheries operate under a quota management system that encompasses both ITQs and annual catch entitlements, which are a leasable form of ITQ that can be traded independently (MRAG 2007). A total ban on discards applies, with exceptions for species with high survival rates and undersized fish (Villasante et al. 2015). Compliance with discard regulations is incentivised by permitting over-quota and bycatch species to be landed. When doing so, fishers must either buy additional quota or pay a "deemed value", i.e., a penalty corresponding to the market value and weight of catch subtracted to catch profits. The deemed value increases with the magnitude of the excess in order to discourage increasing overruns of quota.

The impact of the discard ban cannot be accurately assessed because there are no comprehensive data on discards in New Zealand. Nevertheless, some studies indicate that discarding continues (but on a lesser scale), principally because fishers wish to avoid deemed values (Mace et al. 2014). Mace et al. (2014) indicate that increasing amounts of fish are being discarded illegally for being undersized, or because fishers do not possess enough quota to cover bycatch. This arises from decreasing incentives to comply with regulations largely because of a trend towards (cheaper) annual catch entitlements rather than (more expensive) ITQs, which results in reduced fishers' sense of ownership due to loss of property rights that discourage compliance with discard and bycatch regulations.

6.1.6. Other countries

It is worth noting briefly developments in the Australia and in some Pacific island countries with respect to the application and development of EM. In Australia, EM has been applied on a trial basis to support a number of other MCS tools in various fisheries for a number of years. The Australian Fisheries Management Authority (AFMA) considers that EM shows great potential in being able to prove fishing in closures from an evidentiary perspective

(AFMA 2015, IMCSN 2013). When boats are detected inside closures, for example, VMS and the GPS logger within the EM unit can be corroborated to demonstrate that the boat was inside the closure. Sensors on the EM system which detect fishing activity (usually hydraulic pressure and rotation sensors) indicate that the fishing gear is being used, and the CCTV footage shows the fishing activity occurring. Compliance with reporting requirements can be checked by comparing EM and logbook data, and adherence to bycatch mitigation arrangements can also be verified using EM footage. The Australian Fisheries Management Authority (AFMA) has also observed that having EM onboard encourages fishermen to become more accurate in filling out their logbooks.

Within the Pacific island countries, a number of countries have started to trial EM systems, while a wider number have started to implement electronic reporting tools as part of a regional effort to develop EM (Williams 2015, Hosken et al. 2014). Regional workshops assessing the experiences to date have concluded that the main impediments to implementing EM and ER are not technical but rather political and legal (Western and Central Pacific Fisheries Commission 2014). Key impediments include (i) the work involved in reviewing and changing policy and legislation to best support ER/M, (ii) concerns on data security, (iii) concerns on costs for resources and equipment, (iii) the delays in establishing regional data standards, (iv) simple lack of commitment to move towards implementing ER (e.g. this includes moving from "trial" to "implementation"), (v) the lack of policy and agreement on E-Reporting data sharing (at regional, sub-regional and bilateral levels). It is recognized that collaboration amongst the regional agencies and national fisheries offices is fundamental to its success (Williams 2015). For example, regional agencies will need to ensure that different monitoring systems are compatible, with transparent integration where necessary, while ensuring data confidentiality and security are maintained. Overall, it is recognized in the Pacific that over the longer term, ER and EM have the potential to provide significant gains in cost-saving and efficiency but that the countries are currently some way from having established the planning, resources and infrastructure required to deploy the technologies fully (Williams 2015).

Finally, mention could also be made of regulatory approaches towards discards (including minimum landing size obligations) in the Faroe Islands. The Faroe Islands banned discards in 1994 and at the same time implemented an ITQ system. However, by 1996, the ITQ system was abandoned, not only due to high administrative costs and effort to impose such measures, but also because illegal landings and discards were thought to continue (Jákupsstovu et al. 2007). The ITQ system was substituted by an effort regulation system (Løkkegard et al. 2007) alongside specific restrictions in the 200 m depth contour area around the island, called "the ring" (Johnsen and Eliasen 2011). During the spawning season, some areas inside the ring are closed to fishing, and the great majority of trawlers are forbidden to fish inside the area (Jakupsstovu et al. 2007).

The Fisheries Inspection can also close the area when big hauls of juvenile fish are reported, although the "small-fish regulations" allow fishermen to bring a certain share of fish below the minimum landing size (MLS) per haul (e.g., 30% of cod sized under 55 cm per haul; Johnsen and Eliasen, 2011). Reporting big hauls of juvenile fish is strictly mandatory, and fishers are obliged to leave the fishing ground if 4% or more of the total trip catch of cod is below 40 cm (Gezelius, 2008).

To avoid catching undersized fish outside the ring, trawlers have to comply with regulations that specify the use of large minimum mesh sizes and sorting grids (Løkkegard et al., 2007). The management system in the Faroe Islands is largely based in effort regulations coupled with area closures. Johnsen and Eliasen (2011) point out the importance of

capacity control for the fishing-day system, as greater capture capacity corresponds to greater effort per fishing day. Monitoring is also fundamental. In fact, in the Faroe Islands, vessels over 15 tonnes are obliged to have monitoring systems (VMS) installed, while smaller ones are monitored by landing tickets (Gezelius, 2008). Discarding in the Faroese fisheries targeting cod, saithe and haddock is estimated to be low (ICES, 2011), but no comprehensive discard data is available to analyse the efficacy of the ban. Although it is difficult to know if this management system creates incentives for more selective fishing, it is evident that it did not improved the status of haddock stocks (currently depleted), nor the status of cod and saithe stocks, which according to ICES (2011) advice should see a reduction of over 30% in effort to result in sustainable exploitation.

6.2. Member States

The trials of fully-documented fisheries (FDF) and remote electronic monitoring (REM) that have been carried out in European fisheries have been developed at Member State level. As a result, there are some differences among the trials: FDF trials have been conducted either together with the prohibition of discarding all cod, including cod under the minimum landing size (Scottish Government, 2011; Marine Management Organisation, 2014; Needle et al., 2015), or without (Danish and Dutch trials, where all cod is accounted on the quota but discarding of undersize cod is still allowed) (van Helmond et al., 2015). This section briefly reviews some of the recent experience in some of the Member States with respect to regulatory responses to the landing obligation. This section also includes a brief review of experience in the Mediterranean, although this region has been subject to comprehensive analysis elsewhere (Bellido et al., 2014).

6.2.1. Denmark

Denmark was the first country in Europe to promote the use of FDF through REM (CCTV camera systems), with pilot schemes first introduced in 2008. The Danish Government's objectives were intended to ensure better management, rewarding good practices and relying less on detailed and prescriptive technical rules (Regeringen, 2007). Since the first trial, participation has been incentivised by an additional quota, but the conditions for this and the number of participating vessels have changed over time.

A fixed set of requirements and rules for participation was fully established in February 2010, in collaboration with the Danish Fishermen Association (Dalskov et al., 2011) and include requirements to report additional information in logbooks, beyond the usual requirements. This includes, for each individual fishing operation, the recording of date, time and position of gear shooting, time and position of gear hauling, total catch in weight (usually visually estimated by the skipper), weight of retained part of the catch by species, cod discard weight, and total discard weight for other species. According to the protocol, fishers must collect cod discards in standardized baskets and hold them in front of the cameras for a few seconds before discarding. This procedure was not always well complied with at the beginning, but has become increasingly applied by the crew over time. Landings and discards have to be uploaded sequentially in two consecutive e-log transmissions. Discard information is then reported separately in logbooks as a negative landing value. The Danish AgriFish Agency reviews video footage from 10% of the hauls carried out by each vessel. The protocol of selection of hauls to be reviewed has evolved over time and is at present semi- random, including systematically a review of at least one haul within the last five hauls of the trip (when high-grading is more suspected to occur).

The trials generated a number of positive results, and were considered to demonstrate that REM showed great potential as a cost-effective and wide-covering control and documentation tool for obtaining accurate reporting of discards in logbooks (Ulrich et al. 2015). According to Ulrich et al. (2015) the results could be considered as a positive and successful demonstration of the concept, having (i) reduced discards without additional technical rules, (ii) improved compliance to registering all catches in logbooks, and (iii) enhanced

controllability of the TAC management system. This supports the use of logbooks as a potentially reliable source of information on discard weight for FDF vessels. The control agency has full video access to all fishing operations, and while not all hauls can be examined in detail, there is nevertheless the possibility to carry out more targeted controls if necessary (which in turn is likely to create a deterrent effect on logbook misreporting, as control can occur any time after the trip has been completed).

On the other hand, Ulrich et al. (2015) also considered that some adjustments would be needed to ensure full effectiveness. In particular, more emphasis was required on validation of the accuracy of the data collected, and various limitations needed to be accommodated, for example viewers acknowledged that if the camera vision is reduced because of mist or dirt, the identification of species in the basket can be difficult and some might be omitted or wrongly allocated. Additionally, counting discards against the quota maintains an incentive to underreporting if not properly controlled. It is therefore of utmost importance to maintain the accuracy of the discards estimation protocol through regular control of weight estimates, both with fishers and with viewers.

6.2.2. Scottish Catch Quota Monitoring Scheme

The Scottish Government has been trialling fully documented fisheries, mainly in the North Sea demersal fleet, since 2009 with the aim of developing appropriate CCTV technology to monitor absolute catches and reduce cod mortality. The trial was extended in 2013 to a "Land All You Catch" trial, designed specifically to respond to the landing obligation by including a discard ban within the FDF trial (IMCSN 2013).

The process involved fitting as many as seven cameras on each vessel along with two control units, while the scheme rules were also strengthened to include haul-by-haul logbook recording. The main installation of the equipment is carried out by engineers from the marine compliance unit, and government scientific staff also assist with the location of cameras for evaluating discards, calibration of images using checkpoints and positioning and calibration of sensors. The cameras were placed so as to be able to record the entire fish catching and handling process, up to the point of gutting and sorting, and then also the sorting and processing belt, where the fish could be counted and measured in video and converted to weight for comparison against entries in the electronic logbook. Marine Scotland Science is granted access to all REM data collected from Scottish vessels.

The programme has generated significant amounts of data, and has proved attractive to the fleets concerned (while the list of vessels involved has not remained constant, the scheme remains attractive to skippers - 27 vessels in 2014 - and has always been over-subscribed (Needle et al. 2015). A recent analysis of the programme concluded that, while further development work is certainly needed, REM provides a rich source of fisheries information for science as well as for compliance and management but that care should be be taken to ensure that science monitoring and analysis resources do not become overwhelmed (Needle et al. 2015).

6.2.3. English South West Beam Trawl fishery

A trial was undertaken in 2013 with 9 vessels from the Southwest Beam Trawl fishery. Each vessel was fitted with REM devices (CCTV) and was required to operate under a discard ban for at least 2 catch quota (CQ) stocks. Fishing effort was monitored for compliance with the requirement to retain and land all catches of CQ species from a 5% audit of REM data and CCTV footage. Among the aims of the trial were to explore the implications of the landing obligation in this mixed demersal beam trawl fishery, including an assessment of the efficacy of the REM system.

The REM system was able to monitor catch activities in detail, and to estimate the extent to which different segments of the fleet would be affected by the landing obligation. For example, while discards were generally very low, significantly higher levels of discards were observed in the inshore grounds, pointing to the need for improved selectivity or avoidance behaviour. From this, the UK Marine Management Organisation was able to estimate the additional fish room capacity which would be required for the low value plaice that might otherwise be discarded. The trial also demonstrated that the use of Remote Electronic Monitoring (REM) to corroborate self-reported discard data is highly effective, allowing for a high resolution of spatial and temporal trends across a large proportion of the overall beam trawl effort (Marine Management Organisation 2015).

Mediterranean

We finish this section with a brief look at the Mediterranean case. Here the most important driver of discarding has been identified as the low economic value of part of the catch and the absence of legal restrictions on landings. The discards include the species of the low or no commercial value as well as damaged and/or smaller individuals of commercial species (Tsagarakis et al., 2014).

TACs and quotas are not applied in the Mediterranean Sea except for bluefin tuna; thus, no over-quota discards are observed in contrast to the Atlantic (Tsagarakis et al., 2014). As for legal minimum landing sizes, low compliance has been observed. The landing of undersized fish has been observed from bottom trawls, swordfish longlines, and small-scale fisheries (Tsagarakis et al., 2014), and these fish are sold onto the human consumption market. Therefore, there is already a market for undersized fish and persistent non-compliance with legal landing sizes, due to a lack of adequate enforcement that enables fishers to benefit from this market.

Improving selectivity has been identified as a prerequisite for the mitigation of discards but also for rebuilding Mediterranean fish stocks, and some potential gear solutions have been developed (Tsagarakis et al., 2014). However, without improved monitoring of the destination of catches, there is considerable risk that, under the Landing Obligation, more fish under the Minimum Conservation Reference Size could be landed to the human consumption market. In the absence of quotas and adequate monitoring of landings, the incentive for fishers to improve selectivity will likely remain low. There is recognised risk that undersized fish could be targeted by fishers for the human consumption market (Tsagarakis et al., 2014).

Although, as with gear selectivity, the incentive to avoid areas with high concentrations of small fish maybe low but there have been an increasing number of spatial regulation established in the Mediterranean, with currently more than 90 Marine Protected Areas in place (Abdulla et al., 2008). In certain of these MPAs, one of the scopes of their establishment has been the reduction in bycatches, mainly concerning vulnerable and charismatic species (Abdulla et al., 2008), whereas the protection of nursery areas is also considered (García-Charton et al., 2008). Temporal closures for specific fishing gears also exist and they usually aim to protect juvenile fish and their recruitment. However, although MPAs in bycatch hotspots and subsequent restrictions to fishing may reduce catches of small fish, their establishment does not necessarily mean management effectiveness (Abdulla et al., 2008) and needs to be followed by strong surveillance (Tsagarakis et al., 2014).

Discards are characterised by extremely high species diversity (more than 100 species in a bottom otter trawl and of these more than 60 discarded) with a high percentage of non-commercial catch (commercial portion of catch may range from 30-80%) and high variability

in total discard rate due to seasonality (Bellido et al., 2014). Unreported removals and discards represented important portions of total removals in the Mediterranean (Coll et al., 2014). In the Mediterranean, discard ratios from bottom trawlers show high differences among areas and operations, varying from 20% to 65% (Tsagarakis et al., 2014). A study combining data collected via the data collection framework indicates that there is a high difference in discard levels between the Mediterranean Sea and other regions in the EU and overall the variation in discard ratios for a number of commonly- discarded species is often greater between regions than between fisheries (Uhlmann et al., 2013). In the case of percentage of discards by fleet, gillnets (25-30%) and artisanal gears (45%) show important percentages of discards in the Balearic Islands and Andalusia discards from the artisanal fishery in the Gulf of Cadiz may have experienced an increase from the 1990s to 2010 (Coll et al., 2014).

The landing obligation of regulated species in the EU Mediterranean is raising some concerns about its effective implementation (Bellido et al., 2014). The EU CFP should caution about the contextualization of discard management according to the local/regional characteristics of each SSF; coordination and participation between/with stakeholders; and caution about the ecological cost of landing discards. The high logistical, surveillance, monitoring and ecological costs could produce a negative outcome despite the objective pursued, the willingness of the fishing industry to reduce discards and the profitable use of the resource by its proposed end users. This has led some commentators to raise a concern that this may lead to the measure proving unviable and ineffective in the Mediterranean Sea (García-Rivera et al., 2015).

7. SOCIAL AND BEHAVIOURAL IMPACTS

KEY FINDINGS

- **Social and behavioural impacts are often under-estimated** in fisheries management, and frequently inadequately addressed
- It is anticipated the **new discard rules will influence the decisions made by fishers** about **where**, **when** and **how to fish** and that they will be motivated to avoid catching low value fish.
- The **motivation to change selectivity** is based on three assumptions: (1) there is **an economic advantage** to avoid small and juvenile fish; (2) fishers have the **ability to change selectivity**; and (3) there is **effective enforcement and control**.
- Regarding (1), the **relatively low value of fish for non-human consumption markets** means it is unlikely that there will be incentive for fishers to target more of the fish currently discarded, meaning in turn that there will be **an economic advantage to avoid small and juvenile fish**.
- Regarding (2), **fishers in general do have the ability to change selectivity**. Trials in European fisheries are generating positive results.
- Regarding (3), **instrumental incentives including economic gains and deterrence are crucial for the behaviour of fishers**. Fishers' acceptance of regulations is influenced by whether the implementation effects are considered fair, whether the imposed regulations are perceived as meaningful and whether there is compatibility between the regulation and the traditional fishing patterns and practices.
- There is a risk that the **measures will stimulate new black market trade**, given that catches could reach higher prices on human consumption black markets than non-human consumption markets.
- It is also recognised that **the landing obligation may facilitate illegal trade** because it will be usual to transport undersized specimens in the hold (whereas previously, such fish had to be discarded and could not be brought to land with risk of detection at sea).

Social and behavioural impacts are often under-estimated in fisheries management, and frequently inadequately addressed. In short, without adequate mechanisms and approaches to make the deal more attractive to fishermen, it is always going to be a struggle to achieve the management objectives sought. In any particular fishery, with respect to any particular regulatory control, there is likely to be a range of factors affecting fisher behaviour.

7.1. Impact of the landing obligation

With respect to the new discard rules, the change in management system will influence the decisions made by fishers about where, when and how to fish. The cost of catching unwanted fish will become internalised within fishing businesses. Fishers will be motivated to avoid catching low value fish, these will be deducted from their quota allocation for little or no profit, and to avoid those species with the most restricted quotas, catching these could result in a curtailment of the fishing season. So, based on these principles, fishers will be motivated to catch species for which they have quota and the most valuable specimens of those species. To achieve this, it is anticipated that fishers will change the location, timing and fishing gears used, to modify the selectivity of the fishing operation and the composition of their catches.

Historical fishing business investment decisions will have been based on where, when and how fishing was most profitable under the previous management system. Similarly, decisions on investments in quota will have been based on the expected benefits for businesses under the previous management system. The impacts of having insufficient quota, under the new system will potentially be much greater on fishing businesses (a cessation of fishing), and the value of quota will now include the benefits of being able to continue fishing for all species and not simply reflect the value of the fish associated with a specific species.

In recognition of the potential difficulties that fishing businesses may face when making the transition to the new management system, the new policy – as has been noted – includes a number of exemptions and tools designed to assist in its successful implementation (inter-species flexibility derogation, etc.). These provisions were agreed to provide some safeguards for the fishing industry. These tools and exemptions will also influence the motivations of fishers to alter their catch patterns. The interspecies and year-to-year flexibility will reduce the risk of a premature end to fishing activities and consequent impact on fishing businesses, but it may also reduce the motivation to alter catch compositions and avoid unwanted catches. When these tools are applied it will reduce the need to match exactly the catch composition with the original quota allocations. It is possible that the fishers will prefer to use these tools rather than change, or make further changes, to their fishing practices.

Similarly, where exemption is awarded on the basis of high survival, the motivation to improve the selectivity of fishing operations could be diminished. The Scientific, Technical and Economic Committee for Fisheries (STECF) considered that permitting exemptions based on high survival would limit incentives to improve exploitation patterns (STECF, 2013). It was believed that this would likely result in retention of the status quo, i.e. no change in exploitation pattern pre and post introduction of the landings obligation, which would undermine the broader objectives of minimising unwanted waste and elimination of discards. STECF therefore considered that the trigger point to permit exemptions based on high survival should be of sufficient magnitude to provide strong incentives to change fishing tactics and technical characteristics of fishing gears to improve selectivity.

7.2. Motivation to change selectivity

Nonetheless, due to the limitations and restrictions on the levels of banking and borrowing, interspecies flexibility, *de minimis* and survival exemptions, there is still anticipated to be substantial advantage for fishing businesses to change the selectivity of their fishing operations to avoid catching previously discarded catches. Changing the selectivity patterns of fishers is seen as one of the fundamental outcomes of the reformed CFP. This expected increased incentive and motivation to change selectivity so that fishers avoid previously discarded catches is based on **three assumptions**:

1) There is an economic advantage to avoid small and juvenile fish
2) Fishers have the ability to change selectivity
3) There is effective enforcement and control

Each of these assumptions will be considered in turn.

1) There is an economic advantage to avoid small and juvenile fish

The following section is largely based on the only known study to have been conducted in Europe on the potential uses and value of fish discards by Mangi and Catchpole (2014). The report concluded that the relatively low value of fish for non-human consumption markets is unlikely to create an incentive for fishers to target more of the fish currently discarded with the implementation of the landing obligation.

The study explored the implications of introducing a discards ban by assessing the practical and economic issues surrounding whether discards not destined for human consumption can be used by commercial outlets in the UK. The analyses of English discard data showed potential quantities of discards that would be available to commercial outlets when a ban is implemented.

A list of opportunities for discard use in the UK was compiled including two associations that represent the rendering industry (rendering is any process that converts waste animal tissue into stable, value-added materials): UKRA (UK Renderer's Association) and FABRA (Foodchain and Biomass Renewables Association). Several of these companies provided detailed information on the suitability of each outlet for discard fish. Those that had were able to use fish discards for non-human consumption uses fell into **six main categories**:

1. Reduction to fishmeal and fish oil;
2. Ensiling (liquefied fish);
3. Composting;
4. Rendering;
5. Anaerobic digestion with energy recovery;
6. Freezing prior to use as bait for commercial fishing.

The main outlets that expressed interest in using discards indicated that they would use the discards as raw materials to process into animal, pet and aqua feed; compost and organic fertilizer; frozen bait; and other products, such as renewable energy generation. All company managers interviewed indicated that they had capacity to process substantially more material in their current plants.

Some outlets, such as the fishmeal plants, buy material from the fishing industry, while others, like those involved in composting and rendering, require fishers to pay a fee to dispose of the material. Based on current information, unwanted fish can be sold to fishmeal plants for 65-170 Euros per tonne. This compares with approximately 500 Euros per tonne for the lowest value species and grades sold on the human consumption market. Therefore, there is a significant price differential between the human consumption and non-human consumption markets.

Most respondents from non-human consumption outlets felt that directing the otherwise unwanted material to fishmeal, fish oil, animal feed, pet feed and organic fertilizer would act as a disincentive to catch unwanted fish. This is because fish by-product processing companies are unable to compete on the price paid for the fish that enters the human food chain. None of the commercial outlets provided a figure for the revenue they would generate by processing the material, but stated confidently that it would be possible to make a profit from the otherwise discarded fish.

The economic consequences of the landing obligation will be influenced also by any additional costs imposed on the fishers for handling previously discarded material. For example, the crew may spend more time sorting the catch, to separate what will be landed for the human food chain from that for the non-human consumption. This may affect the fishing operation, potentially reducing overall productivity, it may even necessitate employing more crew (Condie et al., 2013). In some cases, fish holds may be filled more rapidly due to the requirement to land all fish, leading to an earlier return to port. This, combined with the need to purchase extra boxes, ice and increased landing fees, means that fishers, even with securing top prices from fishmeal plants, may still make a loss when landing previously discarded material.
So, at the present time, there is no evidence to indicate that fishers will target undersized fish for non-human consumption markets, the value of this material is simply too low. Other uses for the material may develop in time, and these may increase the demand and

value of this material, however, the price differential between the discards and fish for the human food chain is so large it would seem unlikely that fishers would find economic advantage in targeting small fish for the non-human consumption market. It is much more likely that fishers will be motivated to avoid this material by adopting more selective gears or discarding the material illegally.

Moreover, any new uses for discards developed would need to be compliant with the legal framework with the use of discarded fish. The main regulatory framework associated with the use of discards not intended for human consumption is the EU regulations that control the use, sale and disposal of high- and low-risk animal by-products (ABP). Fish and shellfish automatically become an ABP when the irreversible decision is made that they are not intended for human consumption. EC Regulation 1069/2009 (EU 2009) and its corresponding implementing EU Regulation 142/2011 (EU 2011) form the key European regulations related to fish discards. Wild-caught fish not intended for human consumption typically fall into Category 3 ABP, provided they do not show signs of disease communicable to humans or animals, in which case they would be Category 2 ABP. Category 3 is the lowest risk category and has the greatest number of potential uses. All outlets using previously discarded fish would need to be EU-approved facilities dedicated to processing ABP.

2) Fishers have the ability to change selectivity

As has already been noted, fishers in general have the ability to change selectivity. This can be achieved in particular through spatio-temporal adaptations (see 5.3.1) or technical adaptations (see 5.3.2). The extent to which such adaptations can improve selectivity depends of course on various factors, including the technical success of the adaptation itself and conditions in the fishery. However, various fishing gear and method adaptations that have been developed and piloted in a number of fisheries in response to the landing obligation illustrate the potential to improve selectivity, at least in some fisheries. Two such examples are given below.

Box 7: **North East Coast Net Grid Trials**

Trials were carried out in the Nephrops fishery off the North East coast of England aiming to reduce bycatches of cod in the fishery. By making adaptations to the trawl, catches of cod were significantly reduced to less than 5% of catch while still retaining previous levels of Nephrops. The changes significantly reduced discards (as well as landings of other species of fish) providing good evidence of the feasible practical changes industry can make when operating under the landing obligation.

Source: Marine Management Organisation (2015a)

Box 8: **Size Composition and Selectivity of Haddock Trials**

In ICES area VIIb-k there has been high discard levels of haddock in recent years and local fishermen were keen to reverse this trend. Participants in this trial used trawl configurations that reduced haddock catches across all size ranges and took other avoidance measures (for example reducing fishing effort at times at night when catches are at the highest levels). The results suggest that trawl modifications can reduce fishing mortality of juvenile and mature haddock whilst maintaining profitable catch of other quota species – that increased selectivity is possible by the industry to adapt to the introduction of the landing obligation.

Source: Marine Management Organisation (2015b)

3) There is effective enforcement and control

Whether or not there is effective control and enforcement depends on a range of factors, and includes of course the methodologies, procedures and resources applied by the enforcing authorities. However, social and behavioural responses are also a key element of compliance success. The following main factors that influence compliance in fisheries regulations have been identified by Nielsen and Mathiesen (2003) as:

- Economic gains to be obtained from non-compliance
- Deterrence and sanctions
- Compatibility between regulations and fishing practices
- Efficacy of imposed regulations
- Norms (behaviour of other fishers), and moral
- Perception of being part of the decision-making

The main findings of the research supported the view, that instrumental incentives including economic gains and deterrence are crucial for the behaviour of fishers. Rule compliance is often analysed and understood from a monetary perspective (Nielsen and Mathiesen, 2003), and assumes that fishers act as rational agents. This is the instrumental perspective, which is based on the assumption that the individual fisher primarily responds to the immediate economic benefits of compliance or non-compliance. However, other studies indicate that explaining compliance behaviour in fisheries is more complex.

The normative approach supplements the instrumental approach to further analyse and explain the incentives among fishers for noncompliance behaviour (Nielsen and Mathiesen, 2003). Here norms are defined as the typical actions; attitudes and the expectations among fishers concerning the behaviour and attitude of peers. Increasing enforcement activities can reduce or even prevent non-compliant behaviour among fishers, but there are limits to the amount of resources that can be used.

Fishers are often creative in finding ways to avoid getting caught during illegal fishing (Nielsen and Mathiesen, 2003). The lack of compliance in some fisheries despite increased enforcement activities has highlighted the importance of legitimacy of fisheries management for fishers (Nielsen and Mathiesen, 2003). In general, the better the economic performance of the fishery, the higher the gains from illegal fishing need to be before fishers violate the regulations. The profit to be obtained from allocated quotas has substantial impact on compliance (Nielsen and Mathiesen, 2003). In the context of the reformed Common Fisheries Policy, the incentive for non-compliance will be highest where species have restricted quotas but are difficult to avoid catching.

Fishers' acceptance of regulations is influenced by whether the implementation effects are considered fair, whether the imposed regulations are perceived as meaningful, and whether there is compatibility between the regulation and the traditional fishing patterns and practices (Nielsen and Mathiesen, 2003). Fisher's responses to the new CFP reforms policy will influenced by the level of consistency between different fishing sectors and between Member States. It will also be influenced by how much change will be required in their fishing operations and business models.

The incentive for compliance is closely related to the fishers accepting biological meaningfulness in complying with the regulation (Nielsen and Mathiesen, 2003). Fishers regularly report that they found it morally wrong to discard fish that is already dead that could otherwise be landed to the market. This will no longer be a legal requirement under the new regulation. There is also general support for the avoidance of the capture of juvenile fish, which are viewed by fishers as the future reproductive contributors to the fish stock and future catches, however, there remain fisheries in which the catch of juvenile fish

is substantial. Fishers are unlikely to see the purpose of having to land fish, which are not wanted by the fishers, but are believed would survive if returned to the sea.

Given the limitations of the resources for fisheries control and enforcement in the EU, it will be important to ensure the support from the fishers to the regulation to create a higher degree of voluntary compliance behaviour among fishers. The abolition of the requirement to discard marketable fish will be welcomed by fishers, as well as the general aim to improve selectivity to avoid juvenile fish. Using the framework of fishers compliance developed by Nielsen and Mathiesen (2003) it can be inferred that the **compliance** with the new regulations **will be influenced** by:

1. The scale and effectiveness of control and enforcement (at-sea and onshore)
2. The perceived consistency in control measures across sectors and Member States
3. The scale of the difference between the vessel catch and the vessel quota composition
4. The potential to change the vessel catch to match quota composition using gear technology
5. The potential to change the vessel catch to match available quota composition using spatial and temporal distributions
6. The cost to fishing businesses in matching the catch with the quota composition
7. The accuracy of stock assessments and scientific catch advice
8. The credibility and legitimacy of fisheries science by fishers
9. The effective use of exemptions and quota flexibility provisions
10. The cost associated with landing fish for non-human consumption uses
11. The perceived level of survival of unwanted fish that must be landed
12. The overall perceived ecological and conservation benefits

The influence of these factors will vary by region, by country, by fishing sector and by individual fishing business. There is a multitude of factors, only the first of these factors listed is linked only with the instrumental approach. Participants at a session on the Landing Obligation at the 2014 ICES Annual Science Conference considered that although having limits on total catches could be scientifically supported, the objective of minimising waste and ecosystem impact, by utilising all of the fish caught could not be fully supported by scientific evidence. Instead, the requirement to land all catches was thought to be mostly driven by societal and ethical concern. The absence of clearly demonstrated ecological benefits of bringing all catches to shore was believed could undermine the perceived legitimacy of the regulation and the willingness to comply from the industry (Catchpole et al., 2014). Critical to the successful implementation of the new CFP will be effectively communicating the aims of the reforms to the fishers in the context of conserving stocks and delivering sustainable fishing opportunities.

7.3. Black market trade

There is some concern that the introduction of the landing obligation for juvenile fish will stimulate black market trade. The specific concern is that since the landing obligation will result in increasing number of juvenile fish being landed, these fish may find their way to human consumption black markets rather than the intended markets for non-human consumption. From a practical perspective, it is recognised that the landing obligation may facilitate illegal trade because it will be usual to transport undersized specimens in the hold (whereas previously, such fish had to be discarded and could not be brought to land with risk of detection at sea); i.e. landing, storage and transportation of juveniles will be legal and this can simplify commercialisation via the black market.

The risks of black market supply may be further enhanced if measures designed to support the landing obligation are not properly or effectively deployed. According to a report examining the impact of the landing obligation in the Mediterranean, the apparent lack of incentives to land unwanted catches and the still unclear penalties for failure to meet this requirement in the Mediterranean could encourage the illegal sale of fish below the minimum legal size (Bellido et al. 2014). Other factors to take into account will include (physical and financial) access to suitable facilities for landing undersized fish, monitoring and enforcement technologies and effort and the impact of measures to reduce unwanted catch in the first place.

Informal consultations with fishers (who acknowledged the existence of black market trade) did not indicate an inevitable increase in the trade, although this is not in itself necessarily a reliable indicator (and in any case, the true amount of catches that go into the black market is very difficult to estimate). Data from fishers' interviews indicated that considerable amounts of fish were used for self-consumption by the fishers and their families (treated here as subsistence fishing) or for family businesses (i.e., commercial ventures). According to fishers, this was a common practice in the whole area.

In other European fisheries, the risks might be assumed to be less. As has been seen, there is already considerable economic movement directed towards creating new markets for non-human consumption fish, and due to the nature of the fishing sectors for pelagic, industrial and many demersal fisheries (fishing vessel sizes, landing sites, etc.) the MCS challenges – at sea and at landing sites – are more manageable (although not of course insignificant).

8. ANALYSIS AND RECOMMENDATIONS: ADAPTING THE REGULATORY FRAMEWORK

The landing obligation is one of the most significant changes there has been in the history of the development of the CFP. The measure is significant in its own right, since it represents a fundamental change in what happens to fish that are caught. The estimates reviewed and presented in the first part of this study for example indicate the level and variability of impact in different fisheries – overall discard rates (based on all regulated species and including over-quota (large fish) and under minimum landing size discards (uMLS) varying between 1% in gears such as pots and traps, dredges and longlines and 60%-70% for beam and otter trawlers.

But **the measure has wider significance in that its implementation and enforcement calls for a broader review of how to manage and control fishing activities**. In particular, the landing obligation provides an opportunity for a decisive move away from technical measures based on prescriptive rules to a radically more flexible and adaptable approach to achieving greater selectivity, focused at regional, fishery or even individual vessel level. The expectation is that the landing requirement combined with the restriction to non-human consumption purposes will encourage fishers to internalise the costs of catching unwanted fish and motivate them to avoid unwanted catch, for example by altering their fishing practices. However, in order to realise this, sufficient flexibility must be introduced to allow fishers to find their own solutions to reducing unwanted catches.

Meeting the landing obligation will also require changes to the current Control Regulation. In particular, key MCS activities must be carried out at sea. Any new controls must avoid making the industry less efficient, and must balance the need for effective control with the conservation risks of the fishery and existing control and enforcement budgets. Again, a more flexible and adaptable approach may be required, focused at regional, fishery or even individual vessel level.

The reviews in earlier Chapters indicate the range of approaches, technologies and measures that might be applied to meet the new challenges. This Chapter will begin by briefly reviewing the interim approach to technical and control adaptation being developed at the European level and will then review the potential for longer-term adaptation.

8.1. Current adaptations

Following the adoption of the new CFP basic Regulation, the European Commission recognized that certain provisions within the existing technical regulations would require amendment or removal so as to make the landing obligation operational. The Commission therefore tabled a proposal, known as the "Omnibus Regulation", focussed on removing immediate contradictions between existing EU fisheries regulations and the requirements contained in the landing obligation (European Commission 2013). The Regulation was adopted in May 2015.[4]

[4] Regulation (EU) 2015/812 of the European Parliament and of the Council of 20 May 2015 amending Council Regulations (EC) No 850/98, (EC) No 2187/2005, (EC) No 1967/2006, (EC) No 1098/2007, (EC) No 254/2002, (EC) No 2347/2002 and (EC) No 1224/2009, and Regulations (EU) No 1379/2013 and (EU) No 1380/2013 of the European Parliament and of the Council, as regards the landing obligation, and repealing Council Regulation (EC) No 1434/98, *OJ L 133, 29.5.2015, p. 1–20.*

The Regulation is intended to be a temporary "sticking plaster", to remove critical legal and practical impediments to implementation on a transitional basis while a new framework is developed. Thus, it is recognized that more comprehensive modifications will be required and the new regulation anticipates more extensive changes through the preparation of a new technical measures framework and the further development of regionalised multiannual and discard plans. It is anticipated that the new generation of technical measures will be completed so as to enter into force in 2017 (European Parliament 2014).

The changes addressed in the Omnibus Regulation are structured around two main aspects: fisheries technical measures and control regulations. Regarding technical measures, the Regulation amends three major regulations on technical measures (general measures for the protection of juveniles, technical measures in the Baltic Sea, and the Mediterranean Regulation), as well as three regulations on management of specific stocks (Baltic cod, Irish Sea cod and deep-sea stocks), which also contain technical measures.[5] The key changes involve replacing the provisions which forbid keeping on board and landing of fish below the 'Minimum Landing Size' and introducing the 'Minimum Conservation Reference Size' (below which fish must be landed and counted against quotas, but not used for human consumption). Other provisions concern the catch composition rules, which set limits for the various species making up the catch, with those components of the catch that are outside the given percentages having to be discarded. The Regulation requires that all unintended catches of species subject to the landing obligation over the permitted catch composition limits must be landed and counted against quotas. Finally, the Regulation addresses multiple provisions which provide bycatch limits, and require fishermen to land fish caught in excess of these limits in specific areas, at specific times and for specific gear types.

As regards the control rules, the proposal contains a series of modifications to Council Regulation (EC) 1224/2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy. The modifications address various matters including fishing authorisations for fisheries concerned by the landing obligation; recording of data on all catches; the margin of tolerance in estimates recorded in logbooks and transshipment declarations for catches below 50 kg; rules for utilisation of remote electronic monitoring of the landing obligation at sea; separate stowage of catches and control of marketing of catches below minimum conservation reference sizes; conditions for the use of control observers for the monitoring of the landing obligation definition of the violation of the landing obligation as a serious infringement, to which a penalty point system would apply.

The Omnibus Regulation proposal had a somewhat arduous legislative journey. The initial proposal was heavily criticized by the Economic and Social Council, which considered the proposal was "unnecessarily complicated and will generate an undue and disproportionate amount of additional work for fishing operators" (European Economic and Social Council,

[5] The Regulations concerned are: Council Regulation (EC) No 850/98 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms; Council Regulation (EC) No 2187/2005 for the conservation of fishery resources through technical measures in the Baltic Sea, the Belts and the Sound; Council Regulation (EC) No 1967/2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea; Council Regulation (EC) No 1098/2007 establishing a multiannual plan for the cod stocks in the Baltic Sea and the fisheries exploiting those stocks; Council Regulation (EC) No 254/2002 establishing measures to be applicable in 2002 for the recovery of the stocks of cod in the Irish Sea (ICES division VIIa); Council Regulation (EC) No 2347/2002 establishing specific access requirements and associated conditions applicable to fishing for deep-sea stocks. In addition, one regulation no longer relevant under the landing obligation will be repealed: Council Regulation (EC) No 1434/98 specifying conditions under which herring may be landed for industrial purposes other than direct human consumption.

2014). It also recommended introduction of more pragmatic rules that gave fishing operators time to adapt during a transitional period, without facing heavy penalties. The Parliament was also critical of initial proposals, and worked with the Council on a series of amendments through the co-decision procedure. A provisional political agreement between the Parliament and the Council was only reached in January 2015, however, and approved by the Parliament in April 2015 (European Parliament 2015, 2015a). The key changes introduced in the political agreement included:

- An obligation for the European Commission to draft an annual report on implementation of the requirement to land unwanted catches;
- introduction of a two-year delay before sanctions for failing to comply with the landing obligation take effect;
- requirement to stow undersized fish separately by species was removed (and for small fishermen, the obligation to record the catches in a fishing logbook was limited to catches of a species in excess of 50 kg);
- introduction of a mechanism to prevent the development of a parallel market for non-marketable catches; and
- the requirements on remote electronic monitoring were removed.

8.2. Enforcing the landing obligation

8.2.1. Remote electronic monitoring

There is no doubt that REM shows great potential in being applied to the EU landing obligation. Commenting on the trials that have so far taken place, one recent study (Ulrich et al. 2015) observes:

> "*the impression of these trials is positive [...] The judicious combination of CQM with full catch documentation where the burden of proof relies on the industry is a promising driver of change. Such a combination can create a decisive shift from a top-down control and command to a bottom-up results-based management system providing better monitoring, more accurate management and less waste. In the context of the incoming landing obligation in Europe, we observed from, for example, the UK trials that REM was even more suitable as a control tool when no discards are allowed. It is more difficult to monitor and control discards that need to be quantified and reported, rather than controlling that no discards take place…*"

In theory, such a scheme could supplement and even potentially replace expensive control and monitoring programmes; and when associated with a catch quota management (CQM) system, incentivize positive changes in fishing patterns in a results-based management approach. Mangi et al. (2013) stated that fishers would potentially prefer using other methods such as reference fleets or self- sampling, although studies in the Scottish and Danish trials have indicated a high degree of satisfaction from the fishers voluntarily involved (Scottish Government, 2012; Kindt-Larsen et al., 2012). Obviously, in such a voluntary trial it is difficult to disentangle incentives arising from the quota uplift from those arising from the FDF, and it might be the case that the voluntary vessels are those already most likely to comply and keenest to collaborate with scientists. It is thus difficult to infer how FDF would work if it would become compulsory for all vessels, without a quota premium. Nevertheless, experiences in Canada and USA demonstrated that larger discard reductions had actually been achieved after that FDF became mandatory compared with the initial years when the system was voluntary (McElderry, 2014), because the system became more strictly enforced and included all vessels, also the less cooperative ones (Ulrich et al., 2015).

8.2.1.1. Technical development

While the trials to date have mostly been positive, there is a need for the technology and its technical application to be further developed. Some this is already underway, for example automatic image recognition software is being developed to detect bycatch (Kindt-Larsen et al., 2012) and infer catch composition and length distribution from video footages (Marine Management Organisation, 2013). The current challenge, however, is to consider the feasibility of the system when discarding of several species must be monitored closely. Mixed-fisheries REM trials have been in place for some time in the UK and are now also starting in Denmark, but the results have so far shown the need for further development.

8.2.1.2. Governance

Legislation and governance rules will need to be developed to support REM. It is important to clarify the distribution of responsibilities between the scientific and control institutions to ensure adequate quality proofing and use of the data (including, for example, storage and access to data, legal obligation to delete videos, choice of hauls to be monitored, estimation methods, coupling of FDF data with e-log information, etc.). Also, the daily follow-up and feedback process with the participating vessels must be carefully planned. Also, the role and use of REM data in enforcement processes would need to be clarified, and standard operating procedures developed concerning its collection, safeguarding and interpretation.

8.2.1.3. Financing

REM is proving to be an adequate tool, being considerably more cost-effective than observers if good coverage is required (Kindt-Larsen et al., 2012; Dinsdale, 2013), especially after some years when the initial installation costs have been covered (McElderry, 2014). Nevertheless, despite the availability of newer and cheaper systems, the use of REM systems can be expensive so the number of systems in use, and fleet segments covered, would need to be carefully considered and based on the risks involved. The capital cost of purchasing and running the REM system would need to be met by governments, and may be partly funded through the EMFF.

Recommendation 1 (Remote electronic monitoring trials)

Remote electronic monitoring (REM) is demonstrating sufficient potential to be pursued more extensively. In the short-term, **further trials** should be developed and implemented and analysis made of outstanding technical and governance issues. These should continue to be industry-led and reward based. Proposals at the regional level should be developed for other reward-based schemes. Funding in support of these initiatives should be made available through the EMFF.

Recommendation 2 (Remote electronic monitoring Regulation)

Without displacing the option to develop specific remote electronic monitoring plans at the regional or fishery level, the **European Commission should develop a proposal** for a **Regulation** on a governance and legal framework for REM. The Regulation should clarify the distribution of responsibilities between the scientific and control institutions to ensure adequate quality proofing and use of the data (including, for example, storage and access to data, legal obligation to delete videos, choice of hauls to be monitored, estimation methods, coupling of FDF data with e-log information, etc.) and the role and use of REM data in enforcement processes.

8.2.2. Reference fleet (catch composition comparisons)

Where implemented, the use of catch comparisons based on reference fleets has generated a number of benefits, for science, management and control. Moreover, it is relatively inexpensive to implement and tends to be supported by industry. Such an approach would need careful development and negotiation in order to determine and reach agreement regarding common understandings on definitions, parameters and a harmonised management approach. There are also regulatory and legislative implications, since agreement is required on the enforcement and legal implications of comparisons to a reference fleet in individual cases. In particular, the circumstantial evidential nature of an individual comparison is unlikely to be of significant weight as evidence in criminal proceedings. Many of these issues would need to be worked out at European level, although schemes for specific fisheries could be developed at the regional level.

Recommendation 3 (Reference fleet)

Using **reference fleet** (catch composition comparisons) could supplement remote electronic monitory systems, as well as provide additional data for scientific assessment and management decision-making. European level rules would need to be developed concerning matters such as harmonised management approaches and enforcement and legal implications of comparisons in individual cases, but specific fishery schemes could be developed at the regional level.

8.2.3. Data needs

A short to medium term strategy is needed to permit the full use of control and monitoring tools applicable to the enforcement of the landing obligation, taking into account the development and compilation of data necessary for their implementation, capacity building for industry and administrations in the use of new technologies and the development of the technical infrastructure.

ECFA (2014) has indicated several data needs that need to be developed, including:

- Discard atlas (time, area, gear, mesh size) based on ERS reports and scientific knowledge and fully documented fishing trips by observers;
- Reference fleet and catch profiles allowing the modelling of catches, catch rates and related discards;
- General information on the market, mean prices, importations, exports;
- Improved risk analysis based on cross-checking of information available through ERS and REM systems (such as MARSURV3, CCTV, etc.) to determine the likelihood of discarding behaviour.

According to ECFA, the combination of the different avenues will provide an integrated maritime fisheries operation picture facilitating comprehensive remote sensing and monitoring of the fishing activities, including the obligation to land all catches.

At the same time, the need for continual improvement in data for assessing stocks, preparing scientific advice and making management decisions must not be over-looked. The need to collect independent scientific data for assessment and management off-shore and on-shore cannot be completely achieved by means of CCTV data alone, for example. If the quality of the data on catches after the implementation of the landing obligation deteriorates, then the quality of the stock assessments with be affected and the confidence

in the quota advice will be reduced. In this context, the separation of data collection and application for scientific and enforcement purposes needs to be recognized, and there is a need to look at the EU data collection requirement in combination with the compliance monitoring to identify where and how they might complement one another, whilst maintaining their primary functions.

Recommendation 4 (Data needs)

Data needs in support of the landing obligation need to be fully assessed. A specific short to medium term strategy is needed to permit the full use of control and monitoring tools applicable to the enforcement of the landing obligation, taking into account the development and compilation of data necessary for their implementation, capacity building for industry and administrations in the use of new technologies and the development of the technical infrastructure. At the same time, the need to collect independent scientific data for assessment and management must not be overlooked. There is a need to look at the EU data collection requirement in combination with the compliance monitoring to identify where and how they might complement one another, whilst maintaining their primary functions.

8.3. Accompanying measures

In the absence of perfect fishing gears and methods, and of universal monitoring, non-target fish will continue to be caught and some discarding will continue to occur. Complementary management measures are necessary to create strong enough incentives to encourage landing of catch or more selective fishing practices (Condie et al., 2014). Some such accompanying measures are already built into the landing obligation, while others may be contemplated: the reviews in previous Chapters indicate the range of measures available. Experiences from other jurisdictions, however, show that selecting the right measures is not a simple process. Different measures will be needed for different fisheries, dependent upon the species that are targeted, the non-target species that associate with target species, the distribution of activities, the gears and methods in use and the scale and type of enforcement that is available.

The difficulties in selecting appropriate measures underline the need for industry to be closely involved, since they are best placed to know what works and what does not (and can exchange experience), to innovate and develop new approaches (including initiating pilot projects) and to encourage participants to make a positive contribution to the task of increasing selectivity. Regarding the latter, attention should be given to developing proposals for establishing a system of rewards for vessels that are successful in increasing selectivity (for example, based on models such as the Scottish Conservation Credit Scheme).

Recommendation 5 (Accompanying measures)

Industry needs to play a leading role in developing and trialling new technical and management **measures to accompany enforcement efforts**, and this needs to be facilitated though co-management approaches. Industry schemes to reward vessels that are successful in increasing selectivity should be developed.

8.3.1. Gear selectivity

Gear selectivity remains a central method to reduce unwanted catches and discards. Modifications to certain types of gear, the use of specific devices, or modified practices may all have the common goal of avoiding unwanted catch whilst maintaining or even increasing commercial catch rates. It is important to appreciate that while technical regulations can be a key tool in ensuring selectivity, they can also potentially be a constraint to adjusting selectivity. Unless technical regulations are aligned – with respect to every fishery, and with respect to each component of that fishery – with the most technical favourable gears and methods, optimal selectivity cannot be obtained. Even at the level of the vessel, different technical adaptations may be permissible provided that the result is increased selectivity.

Recommendation 6 (Gear selectivity)

The development and implementation of technical measures needs to accommodate a culture shift, based on a flexible framework designed to ensure better management, rewarding good practices and relying less on detailed and prescriptive technical rules. Fishing gear and method adaptations enhancing the **gear selectivity** should be developed within the regional framework, in close cooperation with industry. Thus, while basic or default requirements can be set at European level, there should be the option to override these at regional and specific fishery level.

8.3.2. Spatio-temporal closures

The analysis in previous Chapters highlights a number of systems in which selectivity can be promoted through spatial management measures such as temporary area closures (e.g. to protect spawning grounds or young fish) and move-on rules. Regulations could be adapted to support these. For example, in Norway it is prohibited to fish 'illegal' fish, as distinct from a prohibition that merely limits the landing of such fish. This prohibition constitutes an obligation for fishers to change fishing ground when the fishing operations contravene the regulations, for example whenever bycatch limits or the permitted intermixture of undersized fish have been exceeded, the fishing operation on the fishing ground in question must cease and operations must move to an area where, to the best of the fisher's knowledge, it is probable that the catch composition is within the limits of the relevant regulations. At the same time, regional planning and regional schemes could be developed which determine the practical modalities of the scheme and create information sharing platforms that would enable move-on decisions to be made and communicated quickly.

Recommendation 7 (Spatio-temporal closures)

Wider use should be used of **spatio-temporal closures** and a technical measure. Whilst preserving the principle that such measures are better developed at the regional level, there is scope to develop a Europe-wide regulation setting out basic procedural and data-sharing requirements which could determine the practical modalities of the scheme and create information sharing platforms that would enable move-on decisions to be made and communicated quickly. At the same time, regional planning and regional schemes could be developed which determine the practical modalities of when to change the fishing ground (move-on) when the fishing operation begins to contravene the regulations, for example whenever bycatch limits or the permitted intermixture of undersized fish have been exceeded.

8.3.3. Quota and discarding flexibilities

The exemptions permitting quota and discarding flexibilities in Article 15 of the CFP basic Regulation should be used whenever appropriate. This would enable implementation of the landing obligation to be respond directly and flexibly to the particular realities of a fishery and to reduce the pressures on the fishing sector in meeting the landing obligation (thereby supporting compliance). In the short-term, some research is required to support the development and implementation of these flexibilities. For example, research on different species for different types of fisheries and on-board processing is needed in order to objectively determine the survival rate. It is widely known that fish survival depends on a multitude of factors, including: fishing gear, fish speed, tow time, water temperature, types of sea floor, processing, exposure to air, fish condition and body length. Research should also look specifically at these factors so that they can be taken into account when improvements are made to techniques and procedures on board. There is a wealth of practical knowledge on board vessels about the survival of unwanted by-catch. In advance of any research the sector can start pilot projects aimed at increasing the survival rates.

Recommendation 8 (Quota and discarding flexibilities)

In the medium to long-term, strategies and proposals should be developed to utilise the **quota and discarding flexibilities** in Article 15 of the CFP. In the short-term, the focus should be on further research and on developing pilot projects (e.g. pilot projects aimed at increasing the survival rates).

8.3.4. Utilisation of landed bycatch

The question of what happens to the **unwanted catches** is one of the most challenging issues of the landing obligation. While there are already some existing markets, new markets will also need to be developed. While there are potential new uses, potential new markets and potential for existing market expansion for the newly landed fish (and evidence of commercial and investment interest in these opportunities) there are some challenges for commercial development. For example, the onward infrastructure and logistics to handle this material onshore may not exist in every location or might be ineffectively or inefficiently set up towards using these fish. There may need to be adaptations both in port and in business organisation. Most significantly, however, the commercial / investment environment is difficult. Currently, it is difficult to estimate both the level of supply of these fish (and the location of that supply) and the demand (since some of the markets are new). Moreover, since the overriding objective of the new discard rules is to **reduce unwanted catches** as far as possible, and since it is anticipated that unwanted catches will be reduced – for example through enhancements in fishing gear

selectivity and changing fishing patterns and behaviour – the supply of this fish has the potential to decrease over time.

In the short-term, the approach needs to be made to work. This requires close cooperation between industry and the public sector to minimise uncertainties that act as a constraint to investment. Governments and sector leaders need to encourage the necessary parties, individuals and their own members to initiate collaborative pilot projects relating to logistics and marketing opportunities, including supporting feasibility studies and pilot projects where there is a need. Financial support (including through the EMFF) should be provided to such schemes. For new approaches that might be developed, consideration will need to be given to whether there is a need to adapt the technical regulations to remove a barrier to the activity concerned. (For example, the potential for on-board grinding is being examined in the Netherlands, which would require revision of European legislation).

In the longer-term, the efficacy of the marketing rules remain to be seen. This implies the need for effective evaluation and close scrutiny to be given to the impacts in the longer-term. The option to switch to other utilisation methods should be kept open. Other models might include that utilised in Norway whereby a percentage of the sale value of the confiscated catch is paid by sales associations. In evaluating this aspect of the policy, account also needs to be taken on consumers and prices (since under the landing obligation, fish for which there is demand in human consumption markets is not entitled to be sold in that market). The possibility should also exist in future evaluations, for incentive-based systems to be developed at the regional level and for different schemes to be developed in different regions, or even within the same region but for different fisheries/products – this would enable successful markets to continue, but provide alternatives where the measure was not working.

Recommendation 9 (Utilisation of landed bycatch)

In the short-term, close cooperation between industry and the public sector is needed to minimise uncertainties that act as a constraint to investment in developing new businesses to **deal with the new landings of fish**. Governments and sector leaders need to encourage the necessary parties to initiate collaborative pilot projects relating to logistics and marketing opportunities, including supporting feasibility studies and pilot projects where there is a need. Financial support (including through the EMFF) should be provided to such schemes.

Recommendation 10 (Utilisation of landed bycatch)

The long-term efficacy of the **marketing rules** needs to be kept under close scrutiny, so as to ensure that full, effective and targeted support is provided for businesses built around the new markets for previously discarded fish. The possibility should also exist in future evaluations, for incentive-based systems to be developed at the regional level and for different schemes to be developed in different regions, or even within the same region but for different fisheries/products – this would enable successful markets to continue, but provide alternatives where the measure was not working.

8.4. Adapting the regulatory approach

In bringing these measures together, consideration needs to be given to the overall process for adapting, developing and maintaining the regulatory approach. The landing obligation – and some of the wider contexts of the CFP reform – introduce some fundamental shifts in the management and control approach. At this stage, it is unclear how some of these shifts

will develop and also how some of the details of new management, control and regulatory approaches will "play out". The landing obligation therefore needs to be viewed with a longer-term objective, with industry and regulators being given the time to develop, analyse and test proposals and approaches, and the impacts of landing and discarding practices to be evaluated within different regions and fisheries. The priority should be focussed on effective implementation, protected to some extent from the pressure of political urgency. In this context, the changes to the Omnibus Regulation – concerning annual reports from the European Commission, introduction of the two-year delay before sanctions for failing to comply with the landing obligation take effect and the extra time given to develop remote electronic monitoring systems – are to be welcomed.

As several of the previous recommendations demonstrate, many of the shifts that the new rules imply (need for accurate and flexible technical adaptations at the fishery level, results-based and incentive-based compliance mechanisms) point towards increased emphasis on regional and sub-regional implementation, decision-making and adaptation. More authority needs to be given to regional decision-making, closely involving industry, through more cohesive co-management approaches. The use of co-management in discard mitigation proceedings provides an effective platform for: (a) knowledge exchange that can help shape the requirements of discard reduction methods to fit specific fisheries and discard problems; (b) higher acceptability, thus easier implementation of discard reduction methods if they are decided in co-operation with the involved fishers (or other stakeholder); and (c) improved legitimacy of the regulations and specific methods among the fishers and thereby higher compliance. Industry will benefit from the development and introduction of tailored fisheries management measures which have been designed to address the specific challenges of each regional fishery. Industry can access scientifically justified exemptions to the landing obligation once agreed using the regionalisation process. These exemptions could relate to high survivability or *de minimis* rules. This will benefit industry by allowing them to operate more efficiently under the new rules (Defra 2015).

Given the role regionalization plays in any case within the new CFP basic Regulation (and more so, if regionalized co-management is developed) the process for adopting regional approaches, measures and plans needs to be more robust. The consultation process needs to be more effectively executed, and all relevant stakeholders need to be given a realistic opportunity to input. In the longer-term, more extensive regional co-management needs to be developed. This needs to be set out in a specific Regulation, dealing with the distribution and delegation of roles, responsibilities and decision-making authority and the oversight mechanism for the European Commission.

Recommendation 11 (Adapting the regulatory approach)

Guidelines (and, if necessary, **regulatory requirements** or inter-institutional agreements) need to be introduced on the consultation process and requirements for regional discard plans.

Recommendation 12 (Adapting the regulatory approach)

In the longer-term, more extensive regional co-management needs to be developed. This needs to be set out in a **specific Regulation**, dealing with the distribution and delegation of roles, responsibilities and decision-making authority and the oversight mechanism for the European Commission.

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ANNEXES

ANNEX 1 – LIST OF QUOTA SPECIES USED IN THE REPORT

Species Code	Scientific Name	Common name
ANF	*Lophiidae*	Anglerfishes
ARU	*Argentina silus*	Greater Argentine
BFT	*Thunnus thynnus*	Atlantic Bluefin Tuna
BLI	*Molva dypterygia*	Blue Ling
BLL	*Scophthalmus rhombus*	Brill
BOC	*Capros aper*	Boarfish
BSF	*Aphanopus carbo*	Black Scabbardfish
DAB	*Limanda limanda*	Dab
COD	*Gadus morhua*	Atlantic Cod
FOX	*Phycis spp*	Forkbeards
GHL	*Reinhardtius hippoglossoides*	Greenland halibut
HAD	*Melanogrammus aeglefinus*	Haddock
HER	*Clupea harengus*	Atlantic Herring
HKE	*Merluccius merluccius*	European Hake
HOM	*Trachurus trachurus*	Atlantic Horse Mackerel
JAX	*Trachurus spp*	Jack And Horse Mackerels
LEM	*Microstomus kitt*	Lemon Sole
LEZ	*Lepidorhombus spp*	Megrims
LIN	*Molva molva*	Ling
MAC	*Scomber scombrus*	Atlantic Mackerel
MEG	*Lepidorhombus whiffiagonis*	Megrim
NEP	*Nephrops norvegicus*	Norway Lobster
NOP	*Trisopterus esmarkii*	Norway Pout
PLE	*Pleuronectes platessa*	European Plaice
POK	*Pollachius virens*	Saithe
POL	*Pollachius pollachius*	Pollack
PRA	*Pandalus borealis*	Northern Prawn
REB	*Sebastes mentella*	Beaked Redfish
RED	*Sebastes spp*	Atlantic Redfishes
REG	*Sebastes marinus*	Golden Redfish
RNG	*Coryphaenoides rupestris*	Roundnose Grenadier
SAL	*Salmo salar*	Atlantic Salmon
SAN	*Ammodytes spp*	Sandeels
SOL	*Solea solea*	Common Sole
SPR	*Sprattus sprattus*	European Sprat
SRX		Skates and rays
SHK		Sharks
SWO	*Xiphias gladius*	Swordfish
TUR	*Psetta maxima*	Turbot
USK	*Brosme brosme*	Tusk
WHB	*Micromesistius poutassou*	Blue Whiting
WHG	*Merlangius merlangus*	Whiting

ANNEX 2 – OVERALL LANDINGS, DISCARDS AND DISCARD RATES PER COUNTRY AND GEAR

Landings (t) and discards (t) per country, fishery and year. Table sorted in descending order on the average catch 2010-2012 within each country.

Country	Fisheries	2010			2011			2012			Average 2010-2012			
		Landings	Discards	%DR	Landings	Discards	%DR	Landings	Discards	%DR	Landings	Discards	Catch	%DR
Belgium	BEAM_TRAWLS	12,782	2,786	18%	14,410	3,771	21%	15,158	13,599	47%	14,117	6,719	20,835	29%
	OTTER_TRAWLS	1,551	1,131	42%	1,867	6,158	77%	2,628	4,481	63%	2,015	3,923	5,939	61%
	NETTERS	133	39	23%	111	9	8%	80	3	4%	108	17	125	11%
	DREDGE	13	-	NA	8	-	NA	13	-	NA	11	-	11	NA
	LONGLINES	1	-	NA	-	-	NA	1	-	NA	1	-	1	NA
Germany	OTTER_TRAWLS	41,425	17,442	30%	34,039	29,929	47%	24,230	3,338	12%	33,231	16,903	50,134	30%
	BEAM_TRAWLS	2,208	7,315	77%	1,918	3,320	63%	1,960	6,729	77%	2,029	5,788	7,817	73%
	NETTERS	6,457	84	1%	4,753	85	2%	6,028	71	1%	5,746	80	5,826	1%
	SEINES	285	0	NA	438	0	NA	213	0	NA	312	0	312	NA
	LONGLINES	33	-	0%	27	1	4%	14	-	0%	25	0	25	1%
	POTS&TRAPS	52	-	NA	7	-	NA	7	-	NA	22	-	22	NA
Denmark	OTTER_TRAWLS	296,698	18,344	6%	257,833	15,973	6%	143,994	29,079	17%	232,842	21,132	253,974	9%
	NETTERS	10,169	3,759	27%	10,173	415	4%	10,014	465	4%	10,119	1,546	11,665	12%
	BEAM_TRAWLS	1,247	272	18%	1,485	590	28%	1,546	381	20%	1,426	414	1,840	22%
	SEINES	549	98	15%	1,140	67	6%	724	64	8%	804	76	881	10%
	LONGLINES	906	17	2%	846	11	1%	823	5	1%	858	11	869	1%
	POTS&TRAPS	138	-	0%	140	1	1%	86	1	1%	121	1	122	1%
	DREDGE	34	1	3%	5	-	NA	-	-	NA	13	0	13	3%
Spain	OTTER_TRAWLS	-	-	-	-	-	-	23,124	22,344	49%	7,708	7,448	15,156	16%
	LONGLINES	-	-	-	-	-	-	28,209	19	0%	9,403	6	9,409	0%
	NETTERS	-	-	-	-	-	-	3,541	179	5%	1,180	60	1,240	2%
	DREDGE	-	-	-	-	-	-	23	-	NA	8	-	8	NA
	POTS&TRAPS	-	-	-	-	-	-	15	2	12%	5	1	6	4%
	BEAM_TRAWLS	-	-	-	-	-	-	7	-	NA	2	-	2	NA
Estonia	POTS&TRAPS	9,109	-	NA	8,572	5	0%	6,728	-	NA	8,136	2	8,138	0%
	OTTER_TRAWLS	526	55	9%	622	113	15%	408	98	19%	519	89	607	15%
	NETTERS	-	-	-	-	-	-	25	-	NA	8	-	8	NA
Finland	POTS&TRAPS	2,329	7	0%	1,933	4	0%	-	-	NA	1,421	4	1,424	0%
	NETTERS	76	4	5%	81	6	7%	-	-	NA	52	3	56	6%
France	OTTER_TRAWLS	58,165	43,942	43%	82,511	27,870	25%	74,710	37,386	33%	71,795	36,399	108,195	34%
	NETTERS	15,924	5,188	25%	21,871	1,247	5%	22,877	1,378	6%	20,224	2,604	22,828	12%
	LONGLINES	2,236	-	NA	2,641	-	NA	4,195	-	NA	3,024	-	3,024	NA
	BEAM_TRAWLS	599	109	15%	658	170	21%	640	110	15%	632	130	762	17%
	SEINES	284	-	NA	285	-	NA	332	-	NA	300	-	300	NA
	POTS&TRAPS	70	-	NA	106	-	NA	98	-	NA	91	-	91	NA
	DREDGE	86	-	NA	38	-	NA	27	-	NA	50	-	50	NA
Ireland	OTTER_TRAWLS	27,729	7,011	20%	30,913	6,001	16%	32,163	20,758	39%	30,268	11,257	41,525	25%
	BEAM_TRAWLS	1,967	377	16%	1,986	526	21%	2,466	1,450	37%	2,140	784	2,924	25%
	NETTERS	1,925	59	3%	1,938	47	2%	2,327	36	2%	2,063	47	2,111	2%
	LONGLINES	137	-	NA	109	-	NA	146	-	NA	131	-	131	NA
	POTS&TRAPS	48	-	NA	54	-	NA	33	-	NA	45	-	45	NA
Lithuania	OTTER_TRAWLS	3,694	232	6%	4,997	110	2%	2,661	117	4%	3,784	153	3,937	4%
	NETTERS	485	139	22%	307	-	NA	189	10	5%	327	50	377	14%
	LONGLINES	22	-	NA	17	-	NA	-	-	NA	13	-	13	NA
Latvia	OTTER_TRAWLS	2,532	325	11%	5,454	445	8%	2,806	454	14%	3,597	408	4,005	11%
	NETTERS	2,454	241	9%	1,778	87	5%	1,291	113	8%	1,841	147	1,988	7%
	Total	505,078	108,977	18%	496,071	96,961	16%	416,560	142,670	26%	472,570	116,203	588,772	20%

Country	Fisheries	2010			2011			2012			Average 2010-2012			
		Landings	Discards	%DR	Landings	Discards	%DR	Landings	Discards	%DR	Landings	Discards	Catch	%DR
Netherlands	BEAM_TRAWLS	40,583	55,431	58%	39,364	67,504	63%	41,030	53,268	56%	40,326	58,734	99,060	59%
	OTTER_TRAWLS	8,951	39,149	81%	9,122	61,696	87%	11,225	15,084	57%	9,766	38,643	48,409	75%
	NETTERS	295	200	40%	251	12	5%	305	216	41%	284	143	426	29%
	SEINES	75	-	NA	-	-	NA	41	-	NA	39	-	39	NA
	DREDGE	5	-	NA	-	-	NA	-	-	NA	2	-	2	NA
	LONGLINES	7	-	NA	-	-	NA	-	-	NA	2	-	2	NA
Poland	OTTER_TRAWLS	7,899	656	8%	8,528	1,072	11%	11,741	1,550	12%	9,389	1,093	10,482	10%
	NETTERS	3,705	272	7%	3,562	209	6%	4,708	283	6%	3,992	255	4,246	6%
	POTS&TRAPS	1,404	-	NA	1,751	-	NA	2,016	-	NA	1,724	-	1,724	NA
	LONGLINES	1,421	175	11%	1,144	45	4%	763	27	3%	1,109	82	1,192	6%
	SEINES	6	-	NA	50	-	NA	-	-	NA	19	-	19	NA
Portugal	OTTER_TRAWLS	7,515	1,904	20%	5,834	1,446	20%	9,508	6,442	40%	7,619	3,264	10,883	27%
	LONGLINES	2,294	-	NA	2,337	-	NA	2,151	2	0%	2,261	1	2,261	0%
	NETTERS	1,825	-	NA	1,586	-	NA	1,597	53	3%	1,669	18	1,687	3%
	POTS&TRAPS	81	-	NA	103	-	NA	112	3	3%	99	1	100	3%
Sweden	OTTER_TRAWLS	62,785	3,387	5%	61,506	4,797	7%	33,267	5,900	15%	52,519	4,695	57,214	9%
	NETTERS	3,770	166	4%	3,171	355	10%	3,220	100	3%	3,387	207	3,594	6%
	LONGLINES	795	62	7%	807	24	3%	791	17	2%	798	34	832	4%
	POTS&TRAPS	192	7	4%	132	2	1%	203	-	NA	176	3	179	3%
	SEINES	6	-	NA	18	-	NA	40	-	NA	21	-	21	NA
UK	OTTER_TRAWLS	153,517	33,074	18%	145,569	27,413	16%	143,062	33,167	19%	147,383	31,218	178,601	17%
	BEAM_TRAWLS	14,547	3,465	19%	14,259	1,569	10%	15,386	1,699	10%	14,731	2,244	16,975	13%
	NETTERS	4,335	104	2%	4,988	154	3%	5,263	185	3%	4,862	148	5,010	3%
	LONGLINES	4,610	-	NA	5,152	-	NA	5,207	-	NA	4,990	-	4,990	NA
	POTS&TRAPS	665	-	NA	579	-	NA	599	-	NA	614	-	614	NA
	DREDGE	216	-	0%	256	-	0%	209	-	0%	227	-	227	0%
	SEINES	5	-	NA	-	-	NA	119	-	NA	41	-	41	NA
Total		321,509	138,052	30%	310,069	166,298	35%	292,563	117,996	29%	308,047	140,782	448,829	31%

Landings (t) and discards (t) per country, fishery and year, in the Mediterranean Sea. Table sorted in descending order on the average catch 2010-2012 within each country

Country	Fisheries	2010			2011			2012			Average 2010-2012			
		Landings	Discards	%DR	Landings	Discards	%DR	Landings	Discards	%DR	Landings	Discards	Catch	%DR
Cyprus	LONGLINES	NA	NA	NA	2	-	NA	NA	NA	NA	2	-	2	NA
	NETTERS	NA	NA	NA	3	-	NA	NA	NA	NA	3	-	3	NA
	OTTER_TRAWLS	NA	NA	NA	3	-	NA	NA	NA	NA	3	-	3	NA
Spain	OTTER_TRAWLS	4,850	310	6%	NA	NA	NA	NA	NA	NA	4,850	310	5,160	6%
	LONGLINES	548	1	0%	NA	NA	NA	NA	NA	NA	548	1	549	0%
	NETTERS	303	-	0%	NA	NA	NA	NA	NA	NA	303	-	303	0%
France	OTTER_TRAWLS	1,723	-	NA	145	NA	NA	NA	NA	NA	934	-	934	NA
	NETTERS	887	NA	NA	747	NA	NA	NA	NA	NA	817	NA	817	NA
	LONGLINES	NA	NA	NA	14	NA	NA	NA	NA	NA	14	NA	14	NA
	POTS&TRAPS	NA	NA	NA	38	NA	NA	NA	NA	NA	38	NA	38	NA
Italy	OTTER_TRAWLS	9,824	516	5%	8,718	3,009	26%	NA	NA	NA	9,271	1,763	11,034	15%
	NETTERS	2,139	44	2%	2,328	240	9%	NA	NA	NA	2,234	142	2,376	6%
	LONGLINES	1,034	NA	NA	1,098	NA	NA	NA	NA	NA	1,066	NA	1,066	NA
	BEAM_TRAWLS	665	NA	NA	426	4	1%	NA	NA	NA	546	4	550	1%
Malta	LONGLINES	11	NA	NA	11	NA	NA	NA	NA	NA	11	NA	11	NA
	OTTER_TRAWLS	3	-	NA	18	-	NA	NA	NA	NA	11	-	11	NA
	NETTERS	2	NA	NA	5	NA	NA	NA	NA	NA	4	NA	4	NA
Slovenia	NETTERS	18	-	NA	26	2	7%	NA	NA	NA	22	1	23	7%
	OTTER_TRAWLS	4	-	NA	4	-	0%	NA	NA	NA	4	-	4	0%
Total		**22,011**	**871**	**4%**	**13,586**	**3,255**	**19%**	**-**	**-**	**-**	**20,679**	**2,221**	**22,900**	**10%**

Proportion of the total landings in each port, in some European countries (source: EAFPA, 2005) in 2003 and estimates on proportion of undersize discards per port. *The landings from UK are from 2013.

Country	Number of ports	Port names	Proportion of the total landings	Indicative estimations of discards under mininum landing size per port (t)
Belgium	3	Zeebrugge	68%	>1000
		Oostende	31%	
		Nieuwpoort	1%	50 - 100
Denmark	9	Skagen	24%	500 - 1000
		Esbjerg	22%	
		Thyboron	17%	
		Elvrige Eavne	14%	100 - 500
		Hanstholm	9%	
		Hirtshals	7%	
		Bornholm	2%	50 -100
		Greni		
		Hvide Sande		
France	44	Boulogne/Mer	16%	>1000
		Le Guilvinec	8%	500 - 1000
		Lorient	7%	
		Granville	6%	
		Concarneau	5%	
		Saint Guenole	5%	100 - 500
		Erouy	4%	
		Saint Quay Portrieux		
		La Turballe		
		Cherbourg	3%	
		Port En Bessin		
		Saint Jean De Luz		
		Loctudy		
		Séte		

Country	Number of ports	Port names	Proportion of the total landings	Indicative estimations of discards under mininum landing size per port (t)
France (continued)		Saint Gilles		
		Les Sables D'Olonne	2%	
		Fecamp		
		Roscoff		
		Ole Ron		
		Dieppe		
		Douarnenez	1%	
		Le Croisic		
		Port La Nouvelle		
		Copemart		
		Grau Du Roi		
		La Rochelle		
		Arcachon		
		Noirmoutier	1%	50 -100
		Grandcamp		
		Ile D Yeu		
		Proguaport		
		Loguivy		
		Brest		
		Port De Bouc	<1%	<50
		Saint Malo		
		Ouiberon		
		Dunkerque		
		Agde		
		Audierne		
		Port Vendres		
		Royan		

Country	Number of ports	Port names	Proportion of the total landings	Indicative estimations of discards under mininum landing size per port (t)
France (continued)		Cancale		
		Lesconil		
		Grand-Fort-Philippe		
United Kingdom	51	Peterhead	28%	>1000
		Others	13%	
		Lerwick	12%	
		Fraserburgh	6%	
		Brixham	1- 3%	100 - 500
		Scrabster		
		Plymouth		
		Newlyn		
		Ardglass		
		Kinlochbervie		
		Douglas		
		Kirkcudbright		
		Kilkeel		
		Ullapool		
		Mallaig		
		Holyhead		
		Leigh-on-Sea		
		Scalloway and Isles		
		Portavogie		
		Milford Haven		
		Shoreham	1%	50 -100
		Bridlington		
		North Shields		
		Newhaven		

Country	Number of ports	Port names	Proportion of the total landings	Indicative estimations of discards under mininum landing size per port (t)
United Kingdom (continued)		Kings Lynn		
		Ilfracombe		
		Saundersfoot		
		Boston		
		Lochinver		
		Whitstable		
		Campbeltown		
		Troon		
		Teignmouth		
		Cullivoe	<1%	<50
		Whitehaven		
		Grimsby		
		Oban		
		Eastbourne		
		Stromness		
		Portsmouth		
		Weymouth		
		Scarborough		
		Port St Mary		
		Salcombe		
		Fishguard		
		Blyth		
		Peel		
		Whitby		
		Stornoway		
		Wells		
		Warrenpoint		

Country	Number of ports	Port names	Proportion of the total landings	Indicative estimations of discards under mininum landing size per port (t)
Ireland	39	Killybegs	46%	>1000
		Rossavea I	7%	500 - 1000
		Other Ports	6%	
		Cobh	5%	
		Dunmore East	4%	
		Wicklow	4%	100 - 500
		Rathmullan	3%	
		Dingle		
		Castletownbere		
		Howth		
		Pena		
		Greendastle	2%	
		Union Hall	1%	
		Downings		
		Kilmore Quay		
		Kinsale		
		Battimore		
		Schull	1%	50 -100
		Malin Head		
		Clogherhead		
		Moviller		
		Crosshaveri		
		Durmnnori/St. Helens		
		Burtonport	<1%	<50
		Valehtia		
		Pailycotion		
		Skerries		
		Helvick		

Country	Number of ports	Port names	Proportion of the total landings	Indicative estimations of discards under mininum landing size per port (t)
Ireland (continued)		Arklow		
		Parma Gee		
		Gast Egregory		
		Dunlaogha Ire.		
		Courtown		
		Garrigaholt		
		Werford		
		Athills		
		Carna		
		Aran Islands		
		Bantry		
Netherlands	13	Yerseke	34%	>1000
		Urk	19%	
		Harlingen	9%	
		Ijrnuiden		
		Lauwersoog	7%	500-1000
		Den Helder	5%	
		Goedereede		
		Vlissingen		
		Den Oever	3%	100 - 500
		Scheveningen	3%	
		Breskens	2%	
		Colijnsplaat	1%	
		Zoutkamp	0%	<50

ANNEX 3 – LIST OF EUROPEAN PORTS WITHOUT LANDINGS INFORMATION

Country	Port Name			
Spain (149)	Algeciras	Zierbana	Bueu	Elantxobe
	Ayamonte	Zumaia	Burela	Fuenterrabia
	Barbate	Candelaria	Camarifias	Guetaria
	Bonanza	Nostra Sra de la Consolacion	Cambados	Lekeitio
	Cadiz	Nostra Sra de la Neives	Camelle	Mortico
	Cartaya-Guadarranque	Puerto de la Cruz	Cangas de Morrazo	Mundaka
	Conil de la Frontera	San Miguel de Tajao	Caririo	Ondarroa
	El Puerto de Santa Maria	Santa Crus de Tenerife	Carnota	Orio
	Huelva	Tazacorte	Carreiro y Aguano	Pasajes de San Juan
	Isla Cristina	Agaete	Carril	Pasajes de San Pedro
	La Linea de la Concepcion	Alajero La Gomera	Cay6n	Santurce
	Lepe	Alcala Guia de Isora	Cedeira	Santurzi
	Punta Umbria	Arico	Cee	Santa Eugenia de Riberia
	Sanlucar de Barrameda	Arona	Celeiro _ Vivero	Comillas
	Tarifa	Arrecife	Corcubion	Laredo
	Aviles	Castillo del Romeral	Corme	San Vicente de la Barquer
	Banugues	Corralejo	El Pindo	Santander
	Candas	Garachico	Ferrol	Santoria
	Casariego	Gran Tarajal	Finisterre	Suances
	Cudillero	Isla de los Vinos	Foz	Verde Palmeira
	Figueras	Isla de la Graciosa	Isla de Arousa	A Coruna
	Gijon	La Laguna	La Guardia	Arcade Soutomaior
	La Caridad	La Oliva-Fuerteventura	Lage	Ares
	Lastres	La Restinga Isla	Laxe	Baiona
	Llanes	Las Palmas de ran Canaria	Lira Carnota	Barallobre
	Luanco	Mogan	Lourizan	Boiro
	Luarca	Morro Jable	Malpica	Pontedeume
	Ortigueira	Playa de Arguineguin	Marin	Pontevedra
	Oviriana	Puerto del Rosario	Mera Oleiros	Porto de Bares Barquero
	Puerto de Vega	San Andre	Mifio	Portonovo
	Ribadesella	San Nicolas de Tolentino	Moaria	Portosin
	San Juan de la Arena	Santa Cruz de la Palma	Mugardos	Puebla de Caramifial
	Tapia de Casariegp	Tacoronte	Muros	Puerto del Son
	Tazones	Valle Gran Rey La Gomera	Muxia	RaxO
	Arminza	Yaiza	Noya	Redondela
	Bermeo	Castro Urdiales	Ogreve	Rianxo
	Ceirvana	Colindres	Ribadeo	Sangenjo
	Sada			
Portugal (34)	Aveiro	Sines	Nazare	Tavira
	Figueira da Foz	Viana do Castelo	Peniche	Vila Real de Santo Antonio
	Lagos	Sao Mateus	Cascais	Ponta Delgada
	Olhao	Praia da Vitoria	Matosinhos	Canical
	Portimao	Praia da Graciosa	Povao	Faial
	Quarteira	Velas	Sesimbra	Lajes do Pico
	Sagres	Madelena	Setubal	Vila do Porto
	Sta Luzia	Ribeiras	Corvo	Vila do Porto
	Santa Maria	Funchal		

Source: EAFPA, 2005

ANNEX 4 – QUESTIONNAIRE

To provide a reliable and up-to-date review of the impact of the landing obligation on the production, landing and potential markets for previously discarded fish, a questionnaire was developed for scientists and policy officials dealing with implementation of the new CFP. The questionnaire was designed to elicit the respondents' views on the implications of the landing obligation and the control of fisheries across EU Member States, and the potential adjustments that might be needed. The questionnaire included open – and closed-ended questions to gather specific information about the landing obligation in each MS (Appendix A).

The questions focused on gathering details from each Member State on

- State of infrastructure at each key port where the unwanted catches would be landed. Respondents were asked to indicate the status of infrastructure for storage, handling, sorting and grading, logistics, security etc. that is needed or available to handle unwanted catches landed for non-human consumption market in the various ports in their country.

- Potential uses for unwanted catches. Respondents were asked to state utilisation opportunities that are available to use unwanted catches, and for each opportunity to provide the species used, whether the utilisation opportunity was already developed or yet to be developed and any comments including whether there are potential barriers in using discards.

A list of policy officials and scientists dealing with the new CFP in the various Member States was compiled from past projects and contacts held by the Project Team. The list had names and email addresses of scientists from 15 Member States and policy officials from 7 Member States. Every person on the list was contacted to take part. In total, replies from 8 Member States were received. Some of these had filled in the questionnaire while others just sent an email message providing the status of analyses related to the landing obligation in their country. The responses are summarised below under each of the questions for each MS.

Date:.....

Q1. Your details

Your name:	Organisation:
Position:	Country:

Q2. Have you made an estimate of the quantity of unwanted catches for non human consumption that are expected to be generated by your fishermen?

If **yes**, what quantity of unwanted catches are you expecting to have to deal with and where might they be landed?

Main ports where landings may take place *(please list as many ports as possible)*	Fisheries targeted	Estimated quantity of unwanted catches for non-human consumption that would be landed (Kg)
1.		
2.		
3.		
4.		

What were the challenges in making that estimate?
If **no**, how and when are you planning to examine this issue?

Q3. What infrastructure (e.g. for storage, handling, sorting and grading, logistics, security etc) is needed/available to handle unwanted catches landed for non-human consumption market? (*Please list by port where possible)*

Q4. What opportunities are available to utilise unwanted catches?

Utilisation opportunity (e.g. fish meal)	Species used	Status (*already developed or yet to be developed*)	Remarks (*include potential barriers in using discards)*

Q5. For each utilisation opportunity please answer the following questions.

Issue	Question	Utilisation opportunity 1 (e.g. fish meal)	Utilisation opportunity 2 (....	Utilisation opportunity 3 (....	Utilisation opportunity 4 (....
Location	Where are the main plants located?				
Capacity of unwanted catches	What volume of unwanted catches (raw material) could they process (e.g. tonnes per day)?				
Raw material requirements	What quality of unwanted catches are they happy to use? (e.g. fresh, frozen)				
Cost	Do they have transport or would they require the unwanted catches to be delivered?				
	Roughly, how much would they pay for the unwanted catches? (£/tonne)				

Income	Would processing unwanted catches be profitable?				
Limitations and uncertainties	What would limit businesses in utilising unwanted catches?				
	What is needed to overcome these limitations?				

Q6: Please briefly discuss the principal measures in place to regulate, monitor and enforce the landing obligation in your country?

Q7. Please feel free to provide any other comments

Thank you for your cooperation.

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