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The EU landing obligation and European small-scale fisheries: what are the odds for success?

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Research highlights:

- A landing obligation was recently put in place as part of the EU Common Fisheries Policy.
- By 2019, the obligation will cover all EU fishing sectors, including small-scale fisheries (SSF).
- The odds for success of a landing obligation in SSF are likely to be small at this point.
- More negative social, economic and ecological impacts than benefits are anticipated.
- Research on the applicability of the obligation and development of appropriate measures for SSF are needed.
Abstract

A landing obligation was formally implemented in the European Union (EU) for the first time, as part of the recent reform of the EU Common Fisheries Policy (CFP). Given the reasonable success of the landing obligation in some countries such as the Faroe Islands, Iceland and Norway, this policy is seen as a viable approach to tackle the long-recognized discarding problem in EU waters. However, there has been some debate on whether there is sufficient evidence to support the feasibility of such a measure in the EU-CFP. The EU landing obligation will implicitly include all small-scale fisheries (SSF) provided the species captured are subject to catch limits or minimum sizes (in the case of the Mediterranean). SSF were included irrespective of the fact that the discarding problem in the EU has been historically associated with medium-to-large-scale fleets (in particular largely mixed species trawl fisheries). Additionally, past experiences with a discard ban policy are still limited to specific countries and/or specific fisheries. This paper examined the appropriateness and feasibility of the recently implemented EU landing obligation in SSF. The effects in the long-term are unpredictable, but available evidence suggests that in the short to medium-term a landing obligation is likely to bring more negative social, economic and ecological impacts than benefits.

Keywords: Discard ban, Common Fisheries Policy, Europe, bycatch reduction, small-scale fisheries
1 Introduction

Discards, which represent the fraction of fish and other aquatic organisms that have been caught by a fishing gear and are returned to the water, alive or dead, have long been regarded as one of the key issues in commercial fishing worldwide [1, 2]. They represent production and yield forgone, resulting in a waste of resources and consequently future economic losses to fisheries [2-4], as well as population, community and ecosystem level impacts [5, 6]. In European waters, discards represent a significant component of fishing related mortality in many important fish stocks, and the high levels of discards have been considered one of the main shortcomings of the Common Fisheries Policy (CFP) [7, 8]. According to Kelleher [2], around 19% (1.3 million tons) of the global discarding is reported for FAO area 27, which includes much of the European Union’s (EU) Economic Exclusive Zone (EEZ). Part of this is because many EU fisheries, particularly trawl fisheries, are still amongst those with highest discard rates in the world [2]. Enever and others, for example, estimated that between 2003 and 2006 Nephrops trawlers and other otter trawlers contributed to 33% and 24% of the total discards in the North Sea, respectively [9].

Despite the importance of discards in Europe, overall information on discard rates is still limited. In some areas, such as the Mediterranean, studies on discards are poor and cover only a small proportion of the total fishing activity [2, 10]. However, some progress has been made following the implementation of the EU Data Collection Regulation (Commission Regulation (EC) No 1639/2001 [11]; and more recently, the Data Collection Framework (DCF), Council Regulation (EC) No 199/2008 [12]).

Understanding the reasons for and factors affecting discarding is an important step towards the management of the discards issue [1]. Under the existing legal framework in the EU,
there are a vast number of inter-connected reasons contributing to the practice of discarding [1, 2, 13]. Many are regulatory in nature, imposed by the increasing number of legal constraints such as the type of licensing and the existence of quota systems or minimum landing sizes (MLS) (leading to discarding of over-quota or undersized fish). However, a vast number of discarding practices are discretionary, i.e., voluntarily conducted to maximize profitability. Examples include: highgrading, the practice of discarding low value species or sizes to maximize the value of catch; slippage, similar to highgrading but distinguished by mass discarding of fish from purse seines prior to being hauled onboard, occurring in certain pelagic fisheries; or discarding of fish in poor condition. Highgrading and slippage are significantly related to economic and market condition; the use of unselective gear or the existence of vessel constraints in terms of freezing capacity or onboard storage space may also be important reasons to explain highgrading [14]. Slippage can also in many cases be related to legal constraints (e.g., quota limits or fish size restrictions) [15].

Several efforts have been made over the past few decades by the European Commission (EC) to address the discards issue. These included, for example, a number of research initiatives to improve selectivity and reduce discards [e.g., 16-19], as well as implementation of specific regulatory measures to mitigate bycatch. In terms of research, there was significant funding to find policy and technical solutions to reduce discards [5, 20]. According to Fischler [21], from the mid-90s to the mid-2000s the EU funded more than 400 projects at a cost of c. €8 million per year; these included programs to control and/or monitor discards, to evaluate the impact of bycatch/discards on the ecosystems, and to develop mitigation measures to reduce bycatch and discards. At the same time, a number of management measures — such as minimum mesh sizes and closed areas to protect juveniles (e.g., “the Norway pout box”) — were also tested and put
into force in some fisheries [20]. Despite all these efforts, the proportion of fish that is discarded has remained significantly high in many EU areas, both at the fishery and/or species level [e.g., 10, 22, 23].

Acknowledging the growing public opinion against discarding practices, the reduction of discards was assumed as one of the key priorities to be addressed in the CFP reform [7, 13]. In this regard, the EC published a proposal in 2011 that, amongst other measures aims at reducing discards, and foresees a gradually implemented landing obligation\(^1\) for the commercially important EU stocks [7]. If effectively implemented, it is expected that such an obligation will encourage fishers to use more selective fishing gears and practices in the long term, working as a driver to reduce the bycatch of unwanted catch in the first place [7, 24]. Additionally, it is expected to also improve the reliability of stock assessments by reducing the uncertainty associated with unaccounted fishing mortality due to discards [1, 2]. The landing obligation was formally implemented in 2015, and at this stage includes only small and large pelagics, fisheries for reduction purposes, and fisheries for salmon and cod in the Baltic Sea (Fig. 1). By 2019, it is planned to be in force in all EU waters, covering all fisheries that capture commercial species covered by the obligation [25], regardless of the fishery segment, i.e., small-scale fisheries (SSF) or large-scale fisheries.

\[\text{FIGURE 1 ABOUT HERE}\]

There has been some debate on whether there is sufficient evidence to support the feasibility of the landing obligation in the EU-CFP. Currently, this policy will implicitly include

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\(^{1}\) The EU landing obligation has also been termed the *EU discard ban* in the scientific literature and EU official documents. Both terms are used in this paper.
all types of fisheries provided the species captured are subject to catch limits (or minimum sizes in the case of the Mediterranean). This was done irrespective of the fact that the discarding problem in the EU has been historically associated with medium to large-scale fleets, and mostly with particular fisheries (e.g., mixed species trawl fisheries) [2, 10, 22]. It was also based on a model that is in place in very particular fisheries or management systems (e.g., Iceland, New Zealand, or Norway), and with very different features from the EU, particularly in terms of the complexity of the fisheries sector and management systems (Appendix A). In a management system with extensive mixed fisheries such as the EU, a landing obligation could be particularly challenging for the viability of these fisheries, due to the high potential for ‘choke’ species (species with the lowest quota in a mixed-fishery, which restrict the fishing opportunities for other quota species) [26].

The EU has one of the largest and most heterogeneous fishing fleets of the world, with a total of 85,744 registered fishing vessels as of January 2015 [27]. From these, SSF fleets are by far the most important fishing segment in terms of numbers of vessels and fishers employed. Assuming the definition proposed by the Scientific, Technical and Economic Committee for Fisheries (STECF) for statistical purposes [28], SSF are defined here as fisheries with vessels under 12 metres in length using static or passive gears. SSF account for almost 80% of the EU fleet by number (67,235 active vessels), the majority of which operate in the Mediterranean [27]. SSF also play a vital role in the EU coastal regions by: creating/maintaining jobs in rural coastal communities with low employment opportunities; maintaining the social structure and economic health of coastal communities; as well as contributing to the supply of high quality fresh fishery products to the EU market [29, 30]. Despite their importance, most SSF have generally been subject to little attention by the scientific community and managers, compared to the industrial
fishing sector [31, 32]. One of the main constraints has been the absence of a formally agreed
definition of SSF, which has resulted in a lack of biological, economic and social knowledge and
other types of indicators, essential to develop adequate and targeted management strategies [30, 33]. In order to address this problem, the reformed CFP includes a number of measures to
support SSF, namely the potential exemption from transferable fishing concessions schemes, and
additional operational programs for the development and increased sustainability of the SSF
segment [33, 34]. However, some of the measures, such as the recently implemented EU landing
obligation, are likely to pose additional challenges to this often marginalized fishing sector [35].

A fully enforced landing obligation imposed on SSF is likely, at least in the short term, to
have considerable social, economic and ecological implications [4], particularly in some regions
such as southern Europe [e.g., 4, 31, 36]. This paper examined the appropriateness and feasibility
of the recently implemented EU landing obligation in SSF. It also considers the trade-offs of the
social, economic and ecological impacts as applied to the SSF sector, to determine the costs and
benefits the sector is likely to experience.

2 The implementation of the EU landing obligation in small-scale fisheries: factors to
consider

2.1 Available evidence on the feasibility of the EU landing obligation

Discard bans are a relatively recent approach to addressing the discards problem, and so
far limited to only a few countries (e.g., Faroe Islands, Iceland, Norway, New Zealand), or
specific fisheries (e.g., US Alaskan and Canada’s British Columbian groundfish trawl fisheries)
[31, 37]. As argued by Condie and others [37], finding the right accompanying measures to
support a discard ban, and ultimately incentivize more selective fishing, is not a simple process. It depends on a number of factors such as the regulatory framework (e.g., enforcement measures in place), fishers’ beliefs and attitudes towards the regulation itself, characteristics of the fishery (e.g., catch composition, bycatch and discard rates), socio-economic aspects, bycatch mitigation measures, among others [37]. This is particularly true for a complex scenario such as the EU, with multiple Member States, management systems, and types of fisheries, fishing practices, and fish consumption habits. For example, although most stocks across all EU waters and fishing grounds (and for EU vessels operating in non-EU waters) are regulated via the CFP, the Member States are responsible for designing their own quota management system and may impose further regulations in the territorial waters under their jurisdiction, which adds an extra layer of complexity to the EU regulatory framework (see Appendix A for further information).

In many cases where a discard ban has been implemented there is evidence of a decrease in discard rates and an increase in more selective practices [37, 38]. However, the circumstances in which the bans were implemented were different from the EU in a number of aspects. First, the regulatory frameworks surrounding many of the bans were much less complex; it concerned just particular fisheries (e.g., US Alaskan and British Columbian groundfish trawl fisheries), or single and comparatively less complex management systems such as those of Iceland, Norway or New Zealand (Appendix A). Second, compared to the EU, countries like Iceland or Norway can be assumed to have much less extensive mixed fisheries [39], making it much easier to effectively introduce bycatch reduction measures such as optimal mesh sizes, minimizing the need to discard in the first place and avoiding the risk of ‘choke’ species. Thirdly, most were cases with relatively strong enforcement and monitoring systems in place and where compliance
with regulations was already assumed to be high [39], in contrast to the historical weak
enforcement and non-compliance in many EU fisheries [4, 40-42].

Since the EC proposal for a discard ban in 2011 [7], a number of studies for European
waters were published on the pros and cons and potential impacts of this policy overall [e.g., 4,
13, 43], and on the impacts of the ban and the feasibility of implementing it in particular
fisheries, species or regions [e.g., 26, 37, 44, 45]. However, for SSF in particular, specific studies
exploring the feasibility and potential outcomes of the discard ban are very limited, even though
it will likely be different across regions, fisheries, and métiers\(^2\) [31, 36]. To the best of our
knowledge only two studies (both published after the adoption of the EU landing obligation)
have explored the potential feasibility of a discard ban in SSF in EU waters: a report to the
European Parliament exploring the consequences and challenges of the EU discard ban in the
Mediterranean overall (i.e., across all fishing sectors, including SSF, which represent about 80%
of the entire EU Mediterranean fishing fleet [36]); and more recently, another report to the
European Parliament providing a comprehensive overview of the discards problem in SSF across
EU waters, highlighting the main challenges associated with implementing a discard ban in this
sector [31]. Both studies emphasised the current gaps in terms of dedicated research on the
discards problem (e.g., mitigation measures, discarding practices, discards rates and
composition), in order to explore the feasibility, and evaluate potential impacts of a discard ban
[4, 31]. The limited evidence with regard to the feasibility and outcomes of such a measure
across European waters, particularly for SSF, is a potential constraint to the successful
implementation of the landing obligation.

\(^2\) EC definition of métier: “a group of fishing operations targeting a similar (assemblage of) species, using
similar gear, during the same period of the year and/or within the same area and which are characterized by a
similar exploitation pattern.” (source: 2008/949/EC)
2.2 Bycatch and discards of unwanted catch in SSF

The bycatch and discards problem has generally been associated with medium or large-scale fisheries, trawling in particular, rather than the small-scale fishing sector [2, 31]. This is probably because discard rates in SSF are generally lower than for most of the industrial fisheries [2, 6, 31]. Globally, Kelleher [2] reported a weighted discard rate of 3.7% for SSF (2005 estimates). For European waters in particular, discards rates have been found to be highly variable and dependent on a number of factors such as the métier, market influence, fishing practices, but in general with discard rates of less than 10-15% for most fishing gears [10, 46, 47]. Possible explanatory factors for overall lower discards rates in the SSF are the use of more selective fishing gears (e.g., traps and pots), higher utilization rates of the bycatch (e.g., personal consumption or for bait) [10, 46], and also, potentially, a lower compliance of SSF with regulations that traditionally imply discarding (e.g., minimum landing sizes, catch limits).

SSF in the Mediterranean, for example, are in general characterized by moderate to low discarding rates [10]. Traps and pots mainly targeting cephalopods and shrimps are amongst the most selective gears, with little discards, and the same stands for demersal longlines (0–9%). For trammel-nets and gillnets, several studies reported discards ratios lower than 15% [10]. However, in certain fisheries two fishing gears have higher discard rates: gillnet fisheries for hake in the Ionian Sea (29.5%) [48]; and trammel-nets fisheries for prawns in Izmir Bay [49], and for common spiny lobster (*Palinurus elephas*) in Tunisia and Spain [50], where discards may exceed 40% of the total catch (by weight).

It is, however, important to note that despite the available data suggesting overall lower discards rates in SSF, data on discards and bycatch for this sector is still very limited [31, 48]. According to Villasante and others [31], research on SSF represent less than 10% of the available
research published in peer review journals on discards in Europe, and most of the data is from southern European waters [e.g., 10, 47, 48, 51]. The available information suggests that, for some areas, specific SSF such as static bottom nets (i.e., trammel and gillnets) can have relatively high discard rates [10, 51, 52]. It is thus also possible that the problem of bycatch in SSF is higher than generally assumed based on the limited available information [52, 53].

2.3 Exemption of species with high discard survival rates from the EU landing obligation

A landing obligation only makes sense in a scenario where the majority of discarded fish would die. For species with known high post-release survival rates, mandatory landing of unwanted catch would represent unnecessary fishing mortality levels, potential negative impacts on these stocks, and limited benefits to the fishing industry itself [4]. To address this, the reformed EU-CFP anticipates that species with proven scientific evidence of high post-release survival rates may be exempted from the discard ban [article 15.4 b); 25]. According to the Scientific, Technical and Economic Committee for Fisheries (STECF), managers should be responsible to decide what rates constitute a “high survival” [54].

The information currently available on post-release survival is limited to only a few commercially important species (e.g., Norway lobster, Atlantic cod) and also to a few fishing gears (mostly trawls, purse seine, and longline) [54]. For SSF, the available information is particularly scarce; for most species/fishing gears/locations combinations there are still no post-release survival estimates available. Of the 28 species that are expected to be covered by the EU landing obligation, and are considered to be targeted or to represent important bycatch in the SSF (Appendix B and C), post-release survival information specific to small-scale fishing gears is only available for five species (or groups): Atlantic cod (Gadus morhua), common sea-bream
(Pagrus pagrus), salmon (Salmo salar), skates and rays (Elasmobranchii), and turbot Psetta maxima. There is some additional information available on survival rates — either for fishing gears other than SSF, or for SSF but from other related species in other parts of the world (e.g., species from the same genus) — that could probably provide a general idea of potential survival rates of this group of species.

The effects of the different phases of the fishing process on captured and discarded species is also quite complex, with post-release survival rates highly dependent on species ability to withstand the exposure to a number of different stressors. These include physical stressors associated to fishing gears and operations (e.g., fishing depth, soaking times), as well as environmental factors (depth, type of bottom, water temperature), and handling practices, in particular time waiting on deck before being discarded, among others [55-58]. For example, in a review of 130 studies related to the fishing mortality associated with gillnets and traps, Uhlmann and Broadhurst [3] found that although gillnets presented generally higher discard mortality rates, these were dependent on a range of factors such as species-specific traits, environmental conditions, and catch mechanisms: in some specific cases, discard related mortalities could be as low as 0%. Due to the limited information for most of the combinations of species, fishing gears, and locations, a landing obligation will likely include SSF with potentially high post-release survival rates of some bycatch species.

2.4 Potential socioeconomic impacts

An EU landing obligation will inevitably result in an increased logistical and economic burden to fishers [4, 31]. It will mean, for example: more time spent handling and sorting on board, as well as processing at ports, of specimens that previously were discarded (e.g., fish below the minimum landing sizes); increased take up of storage capacity by less valuable
species; and, need for investments in improving storage capacity (e.g., extra storage compartments, extra ice) [31, 36, 59, 60].

The added logistical burden, increased labour, potential investment in storage capacity, may be particularly challenging to SSF, due to the inherent characteristics of this sector. First, SSF are generally characterized by smaller vessels, with limited storage capacity. Increasing storage capacity could also be challenging and potentially affect the navigability and safety of the fishing vessels [31]. Second, SSF generally have smaller workforces (crew per vessel) and less technological capacity. Finally, they are generally characterized by low economic revenue [61-63], which means that any change of the status quo in fishing practices may render the activity economically unsustainable. The results of the recent study by Villasante and others [31], which included a survey of different key stakeholders with regard the potential impacts of the discard ban in SSF, concluded that the landing obligation would bring considerable direct and indirect economic losses to this sector. For example, in the case of Galician (NW Spain) SSF, the annual direct and indirect economic losses were estimated between €30-40 and 50 million respectively. In terms of employment, the discard ban could result in a direct and indirect loss of 7,000 jobs in the SSF sector, for that region.

The current regulations anticipate economic incentives to support investments in more selective fishing gear or equipment to facilitate handling, landing and storage of unwanted catches, as well as exemptions from the discard ban for fisheries with known technical and handling difficulties to deal with discards. However, the lack of scientific and empirical information could prevent SSF from being included in the de minimis\(^3\) exemptions. Additionally,

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\(^3\) According to Articles 15.4 and 15.5 of the reformed CFP (REGULATION (EU) No 1380/2013), de minimis exceptions to the landing obligation can be applicable to unwanted catch that is unavoidable even when applying best practices to avoid bycatch (provided that discards do not exceed 5% of the total catch to which the ban applies, and that catches are fully documented).
it is still unclear how small-scale fishers will be eligible or have access to these incentives, and if it will be sufficient to compensate for the potential economic losses associated with the discard ban. In the end, an absence of visible economic benefits (e.g., potential decrease in profitability due to increased labour and storage of less valuable fish) will likely discourage small-scale fishers from complying with the discard ban, unless there is strict control of fishing activities (explored in detail below) and economic incentives are provided [8, 23, 31].

The reformed CFP [25] stresses that the destination of landings of fish under the minimum conservation reference size should exclude sale for human consumption. This provision implies that even though factories to process the fish for other purposes are available, landed discards will become a “special waste”, requiring high costs for disposal. Moreover, expected increases in landings of previously discarded organisms might produce additional environmental impacts on land [36, 60]; in southern Europe this is already an important issue to take into consideration, given that many SSF landing sites are close to or within tourist spots. Finally, it should be considered that fisheries products are a highly perishable food commodity, which generally requires proper handling and preservation to increase their shelf life, particularly during summer. Many fish species spoil quickly because temperature is too high, especially in the Mediterranean. At present, well-defined logistics and management of discards once they are landed is not known to exist. Most markets and first landing sites are also still not prepared to receive and process discards. Moreover, in some regions such as the Mediterranean, SSF have a large number of different landing sites, many of these in remote areas (e.g., small islands). In these cases, the cost of transporting discards to processing units could be as high as or higher than the value of the catch itself. Most of the points above suggest there is a
high probability that the EU landing obligation will render SSF economically unsustainable, at least in the short to medium-term.

2.5 Potential ecological effects

The potential wider ecological effects associated to changes in the discarding patterns have been one of the concerns related to the implementation of the EU landing obligation [e.g., 4, 43, 44, 60, 64]. At the ecosystem level, fisheries discards and offal represent an important source of food for a number of marine species, including demersal fish and invertebrates, and other opportunistic scavengers such as sharks, marine mammals and seabirds [e.g., 4, 44, 65, 66, 67]. In the North Sea English Norway lobster (*Nephrops norvegicus*) fishery, for example, Catchpole and others [68] estimated that energy available from discards could provide up to 21% of the annual energy requirements of the identified benthic scavengers. Also in the North Sea, fisheries discards were found to comprise an essential part of the diet of many seabird species such as great skuas (*Stercorarius skua*), northern fulmar (*Fulmarus glacialis*) and several species of gulls (*Larus* spp.) [67, 69]. In the Patagonian squid fishery, discarded squid remains represented 20-40% (by volume) of the diet of three demersal fish species [65]. In Moreton bay, Australia, Blaber and Wassenberg [70] found that three piscivorous seabird species were primarily dependent on food from fisheries discards.

The long-term ecological effects of a fully enforced discard ban are unpredictable. In the short-term, the discard ban will likely result in an increase of fishing mortality for species subject to total allowable catch (TAC) due to potential quota adjustments (to accommodate the fraction that was previously discarded) [4, 43]. It will also mean a drop in the energy available in the marine ecosystems and will inevitably affect the equilibrium of the existing species interactions
(e.g., competition for food, trophic relations) [4, 43, 44, 64]. On the other hand, reducing
discards may decrease the risk of seabird bycatch (as fewer birds are expected to be attracted to
fishing vessels) [44]. For SSF in particular, the anticipated short and long-term effects of a
discard ban are likely much smaller than large-scale fisheries (given the generally lower bycatch
and discard rates). Nonetheless, underlying causes for discarding and potential ecological
implications of a change in discarding rates should be further monitored and studied before a
landing obligation is implemented [4, 43, 44].

2.6 Enforcement of the EU landing obligation in the SSF

Any fisheries management measures will only be successful if fishers’ compliance is high
[71, 72]. But fishers’ compliance will be directly affected by a number of factors, such as
whether the regulation is understood and perceived as legitimate by fishers, fisher’s own beliefs
and values, their involvement in the decision making process, as well as the existence of robust
and effective enforcement measures [8, 39, 60, 71, 73, 74]. For the discard ban in particular,
evidence from other regions/specific fisheries (e.g., US Alaskan and Canada’s British Columbian
groundfish trawl fisheries) shows that effective compliance (i.e., to ensure discarding and
misreporting of catches do not take place), can only be achieved with strong enforcement and
monitoring measures [1, 24, 37].

Unlike certain schemes in the US, such as the Alaskan pollock fishery which have 100%
observer coverage [75], the observer coverage in the EU fleet is relatively small. Even in the
most extensive of observer programmes [22] operating in the large demersal fleets of the North
Sea only ~20% of the catch of cod was monitored by observers in 2010 (Fernandes pers comm.,
University of Aberdeen). Furthermore, working under the EU DCF, these observers have a
scientific role, i.e., to estimate the discarded proportion of the catch, not to enforce any regulation. So even if the existing observer scheme was to have an enforcement role, the coverage in the large-scale fleets would still be small and coverage in the SSF almost nonexistent.

At this point, enforcement and proper monitoring of an EU discard ban in SSF is likely to present serious challenges, with no obvious solutions in the foreseeable future. On the one hand, current enforcement is already considered to be a widespread problem in the EU fisheries [41, 42], particularly in southern Europe [36, 76] where most of the SSF fleet is located. On the other hand, unlike other regulations that may be enforced at the landing sites (e.g., landings restrictions of particular species), discard bans require additional at-sea monitoring measures. Given the number and characteristics of the existing EU SSF, the implementation of currently available at sea monitoring tools such as onboard observers, vessel monitoring systems (VMS) or CCTV cameras would not be logistically and economically viable in this sector [4, 59, 77], especially in the context of the current economic crisis that the EU is facing [13]. Without a major new investment on observer programmes and other viable monitoring resources, the likelihood of compliance with a discard ban in SSF is very low.

It should be noted however that complete compliance might not be socially optimal. Results from the FP6 project COBECOS (Costs and Benefits of Control Strategies) indicate that the optimal level of compliance for each fisher is obtained when the marginal cost of violating equals the marginal benefit of violating [78]. This usually occurs at enforcement levels that are well below 100%. Although full compliance is usually set as the target for enforcement management, the high costs needed to achieve full compliance usually render such policies impractical. Imposing higher sanctions when violations are detected would be a much more cost-
effective strategy, as higher fines do not bring about additional costs to the enforcement agency [78].

2.7 Black markets for undersized fish

In some areas, especially in southern European countries, the consumption and illegal marketing of undersized fish of particular species for human consumption is a common practice. For particular species, given the cultural value of some traditional dishes, the demand for undersized specimens can be even higher than for legally sized fish, which, combined with a relatively weak enforcement system, has created an incentive for non-compliance [23, 76]. One such example is horse mackerel (Trachurus trachurus) in Portugal, in which fish below the MLS of 15 cm usually cost more than those of the legal size [77]. Other examples are undersized cuttlefish (Sepia officinalis), squid (e.g., Loligo spp.), or European hake (Merluccius merluccius), considered local delicacies and highly sought-after in southern Europe (e.g., Portugal, Italy, Spain, or southern France) [79].

Illegal marketing of undersized fish was fought very hard in the EU through specific Regulations (e.g., Council Regulation (EC) No. 1967/2006), which have fixed a zero tolerance scheme on the presence of undersized organisms in the whole supply chain, from the boat to the retailer, and also involving the processing and marketing of fishery products. However, black markets for undersized fish are still known to exist, and the EU landing obligation may potentially undermine the efforts made so far to combat illegal sales for undersized fish.

In fact, according to Millán and others [36], one potential negative outcome of the recently implemented EU landing obligation will be an increase in non-reporting and illegal marketing of undersized fish, particularly in the SSF. First, because small-scale fishers are likely
to get better prices for undersized fish in the black market (for direct human consumption), than
for reduction purposes. Second, because with the landing obligation the onboard retention and
transport of juveniles will be legal. This may facilitate the process of illegal commercialization,
as fishers will only have to avoid landing at control points. In some areas, such as the
Mediterranean, SSF have numerous landing sites (more than a thousand in countries such as
Greece), which will render controlling illegal commercialization of juveniles almost impossible
[36].

3 Foreseeable challenges and shortcomings of a potential exemption of the SSF sector
from the EU landing obligation

The potential socioeconomic and ecological consequences, as well as the odds for success
of an EU discard ban in SSF, should be considered before such a measure is fully implemented
in this sector. However, a potential provisional exemption of SSF from the discard ban would
also bring some challenges and constraints. The first and probably most important would be how
to determine the cut-off point defining what part of the EU fishing fleet qualifies as SSF. The
current definition proposed by STECF is based on a combination of vessel size and type of gear.
However, both scientists and policy makers agree that the definition of SSF should be based on
several attributes [33, 80], making this a very complex issue, which has been subject to extensive
debate. Several approaches have been put forward in recent years [80], but there is still no
consensus on a formal multi-criteria definition [29, 33, 80]. Part of the problem is related to the
great cultural heterogeneity in EU coastal communities dependent on fisheries and the different
interpretations across Member States on what defines a SSF [80]. In this regard a regional
approach might be appropriate given that this is another new feature of the reformed CFP, although this still requires Member States within a region to agree on joint recommendations.

As for shortcomings, excluding SSF from the newly implemented landing obligation could result in the continuity, or possibly an increase, in highgrading. Highgrading has been one of the main causes for discarding in European fisheries [13], and is generally triggered either by both legal (e.g., quota systems, particularly when focusing on landings) and logistical (e.g., limited storage) constraints [14, 39, 81]. Lastly, an exemption of the SSF sector from the landing obligation might be perceived as unfair by the other components of the EU fishing fleet (i.e., the medium and large-scale fisheries), if such a measure is not adequately supported and debated beforehand with all the relevant stakeholders.

4 Conclusions and Recommendations

The main goal of the EU discard ban is to eliminate discards, and in the long term to reduce bycatch by promoting more selective fishing [25]. However, discard bans are a relatively novel approach to address the discards problem, and still only used in a relatively small number of countries or particular fisheries [37]. Furthermore, past evidence shows that banning discards only works if supported by considerable data collection on the fishery (discarding rates, reasons for discarding, etc.) and integrated with incentives for compliance and additional measures to address and mitigate bycatch in the first place [20, 37]. The current approach flies in the face of recognised systems of effective management that are more bottom-up, participatory and results-based [e.g., 82, 83].

The present analysis shows that, for the EU small-scale fisheries in particular, there is still very limited evidence to support the feasibility and appropriateness of a landing obligation. The
effects in the long-term are unpredictable, but available evidence suggests that a landing obligation in SSF will potentially create more negative social, economic and ecological impacts than benefits. SSF are already considered an economically fragile sector due to their low capitalization [29, 31]. Any changes to the status quo, without clear economic trade-offs can lead to considerable economic losses in the short-term and compromise the sustainability of the sector [31]. It also reveals that a landing obligation in SSF could also pose additional challenges that need to be addressed before such as a measure is considered: these include increased labour for handling and sorting on board, as well as processing at ports, and lack of infrastructures to address the expected increase in landed fish. With the current lack of clear incentives to ensure compliance, as well as the difficulty to effectively enforce a discard ban in the SSF sector, past evidence also suggests the inclusion of a discard ban in this sector would be unlikely to result in a decrease of discarding rates. On the contrary, it will probably result in increased misreporting and non-compliance, compromising the long-term objectives of this management measure.

Based on the above, the odds of the success of a discard ban in small-scale fishing in southern Europe are likely very small at this point. Before such a measure is fully implemented in SSF, further evidence should be made available on the benefits of its application in this sector, and effective enforcement and monitoring tools developed – as well as additional supporting measures (e.g., transferable fishing quotas). This includes optimizing the structure of social incentives and testing the implementation of such a measure via bottom-up management tools already available for many SSF. The lack of a clear definition of SSF — probably the major challenge associated with a potential provisional exemption of SSF from the discard ban — could be provisionally addressed by adopting the current STECF\(^4\) definition for statistical fishing carried out by “all vessels under 12 meters using static gears.”
purposes [28], at least until managers, fishing industry, and scientists agree on a more formal and holistic definition.

In the meantime, EU managers could also improve management within the CFP by focusing on other actions aimed at addressing the underlying causes of discarding, some already anticipated in the CFP reform [25]. These include: (1) conducting more research on and promoting the utilization of more selective fishing gears; (2) increasing fisheries observer programmes; (3) increasing research on the species affected by the discard ban, to ensure that all have adequate stock assessments, and effective understanding of spawning areas and seasons, bycatch rates (e.g., of juvenile component), discards mortality rates and underlying factors; (4) promoting best practices to reduce bycatch and reduce discard mortality while avoiding damage to sensitive marine species and habitats; (5) conducting pilot studies on the ecological and socio-economic feasibility of a possible discard ban in different types of métiers that would fall within the SSF umbrella; (6) increasing transparency in the regulatory framework; and finally (7) promoting fishers’ awareness and participation in the decision-making and implementation of these and other regulations [e.g., 4, 20, 32]. As noted by McClanahan and others [32], the use of transitional management strategies is less disruptive to social systems, more likely to build social consensus, and promote more adequate tools for each situation, rather than extreme actions such as a discard ban.

Acknowledgements

The research leading to this paper was funded by “EcoFishMan – Ecosystem-based Responsive Fisheries Management in Europe”, Project co-financed by the European Commission within the Seventh Framework Programme (FP7–265401).
5 References


[66] Olaso I, Velasco F, Pérez N. Importance of discarded blue whiting (Micromesistius poutassou) in the diet of lesser spotted dogfish (Scyliorhinus canicula) in the Cantabrian Sea.


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Figure Captions

Fig. 1. Diagram of the gradual implementation of the EU landings obligation by geographical area and fishery (source: REGULATION (EU) No 1380/2013). NWW, ‘North Western waters’; SWW, ‘South Western waters’.
Figure 1. Diagram of implementation of the EU landing obligation
Click here to download high resolution image

<table>
<thead>
<tr>
<th>Year</th>
<th>Baltic Sea</th>
<th>Black Sea</th>
<th>Mediterranean</th>
<th>North Sea</th>
<th>NWW</th>
<th>SWW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>Small and large Pelagic and industrial fisheries: (fisheries for mackerel, herring, horse mackerel, blue whiting, boarfish, anchovy, argentine, sardine, sprat, bluefin tuna, swordfish, albacore tuna, bigeye tuna, blue and white marlin, capelin, sandeel and Norwegian pout)</td>
<td>Salmon and fisheries for species that define fisheries (i.e., cod)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
<td>Demersal fisheries for species that define fisheries:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>North sea: fisheries for cod, haddock, whiting, saithe, Norway lobster, common sole and plaice, hake, Northern prawn</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>North Western waters: fisheries for cod, haddock, whiting, saithe, Norway lobster, common sole and plaice, hake</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>South Western waters: Fisheries for Norway lobster, common sole and plaice, hake</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Other fisheries for species subject to catch limits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>all remaining species subject to catch limits</td>
<td>Demersal fisheries for species that define fisheries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td></td>
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<td></td>
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<tr>
<td>2019</td>
<td></td>
<td></td>
<td>all remaining species subject to catch limits or subject to minimum landing sizes (Mediterranean)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix A

Supplementary Table 1. Fisheries related indicators for the European Union, Iceland and Norway. 2013 data.

<table>
<thead>
<tr>
<th></th>
<th>European Union</th>
<th>Iceland</th>
<th>Norway</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EEZ (km²)</strong></td>
<td>c. 25,000,000</td>
<td>751,345</td>
<td>2,385,178</td>
</tr>
<tr>
<td><strong>Registered vessels (n):</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>86,524</td>
<td>1,696</td>
<td>6,126</td>
</tr>
<tr>
<td>Small-scale fisheries (% of total)</td>
<td>67,767 (78.3%)</td>
<td>1,205 (71%)</td>
<td>3,345 (55%)</td>
</tr>
<tr>
<td><strong>Fishers (n) [4-6]</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>151,383 ²</td>
<td>4,000 ⁴</td>
<td>11,611</td>
</tr>
<tr>
<td>As main occupation</td>
<td>120,315 ³</td>
<td>3,800</td>
<td>9,559</td>
</tr>
<tr>
<td><strong>Catches: [7-9]</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of species</td>
<td>521</td>
<td>32</td>
<td>38</td>
</tr>
<tr>
<td>Total catch (tonnes)</td>
<td>4,806,707</td>
<td>1,366,832</td>
<td>2,089,970</td>
</tr>
</tbody>
</table>

Fisheries management system

Fisheries Management in the EU is rather complex; All fishing fleets and most stocks across all EU waters and fishing grounds (and for EU vessels operating in non-EU waters) are regulated via the Common Fisheries Policy (CFP), however, Member States may impose further regulations in the territorial waters under their jurisdiction, provided those measures are compatible with the objectives of the CFP, and at least as strict as the measures under EU Law [10].

In all EU waters except the Mediterranean (where days at sea are used instead to control fishing pressure on stocks) the most important fish stocks are subject to EU defined fishing quotas (depending on jurisdictions) and specific fisheries, a combination of additional technical measures and input and output controls are also in place. Shared stocks are subject to International agreements with other countries (e.g., Norway, Faroes Islands, EU).

Fisheries management in Norway and Iceland are the responsibility of a single authority: the Directorate of Fisheries in Norway, and the Icelandic Ministry of Fisheries of Agriculture. All the relevant species are subject to catch limits. Shared stocks are subject to International agreements with other countries (e.g., Norway, Faroes Islands, EU).

Iceland was one of the first countries in Europe to adopt a system of Individual Transferable Quotas (ITQ). Additional technical measure and input (e.g., closed seasons and areas) are also in place. In both Norwegian and Icelandic fisheries, the control and monitoring systems are considered amongst the most sophisticated in the world. A ban on discards is in place in Norway since 1983, and in Iceland since 1989 [11-14].
<table>
<thead>
<tr>
<th>European Union</th>
<th>Iceland</th>
<th>Norway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian Federation).</td>
<td>Icelandic EEZ (ICES areas Va) and International waters of Vb, Norwegian sea (IIa) and South-east Greenland (IVb).</td>
<td>Norwegian Sea, the Barents Sea and the North Sea.</td>
</tr>
</tbody>
</table>

**Main fishing areas**

- The EU fleet operates across almost all ICES areas in FAO 27, most of the Mediterranean and Black Sea (FAO 37), SW Indian ocean (FAO 51), Eastern Central (FAO 34), and SW Atlantic (FAO 41).
- Icelandic EEZ (ICES areas Va) and International waters of Vb, Norwegian sea (IIa) and South-east Greenland (IVb).
- Norwegian Sea, the Barents Sea and the North Sea.

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**Notes:**

1. query criteria: EU, all vessels under 12 meters in length using static or passive gears; Iceland, Undecked and decked vessels under 10 GT;
2. 2012 data;
3. in terms of full time equivalents (FTE);
4. includes both fishing and aquaculture sectors;
5. number reported at species level (all fishing areas) on official catches, based on national statistics.

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**References:**


Fishery group, year and area obligation starts, relevance for the small-scale fishing sector (SSF), and available information on discards survival rates for each of the species covered by the EU landings obligation.

<table>
<thead>
<tr>
<th>Landings Obligation Fishery group (article 15; REGULATION (EU) No 1380/2013)</th>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small pelagic fisheries</td>
<td>Greater silver smelt</td>
<td><em>Argentina silus</em></td>
</tr>
<tr>
<td>Small pelagic fisheries</td>
<td>Boarfish</td>
<td><em>Capros aper</em></td>
</tr>
<tr>
<td>Small pelagic fisheries</td>
<td>Herring</td>
<td><em>Clupea harengus</em></td>
</tr>
<tr>
<td>Small pelagic fisheries</td>
<td>Anchovy</td>
<td><em>Engraulis encrasicolus</em></td>
</tr>
<tr>
<td>Small pelagic fisheries</td>
<td>Blue whiting</td>
<td><em>Micromesistius poutassou</em></td>
</tr>
<tr>
<td>Small pelagic fisheries</td>
<td>Sardine</td>
<td><em>Sardina pilchardus</em></td>
</tr>
<tr>
<td>Small pelagic fisheries</td>
<td>Mackerel</td>
<td><em>Scomber scombrus</em></td>
</tr>
<tr>
<td>Small pelagic fisheries</td>
<td>Sprat</td>
<td><em>Sprattus sprattus</em></td>
</tr>
<tr>
<td>Small pelagic fisheries</td>
<td>Horse mackerel</td>
<td><em>Trachurus spp.</em></td>
</tr>
<tr>
<td>Industrial fisheries</td>
<td>Sandeel</td>
<td><em>Ammodytes marinus</em></td>
</tr>
<tr>
<td>Industrial fisheries</td>
<td>Capelin</td>
<td><em>Mallotus villosus</em></td>
</tr>
<tr>
<td>Industrial fisheries</td>
<td>Norway pout</td>
<td><em>Trisopterus esmarkii</em></td>
</tr>
<tr>
<td>Large pelagic fisheries</td>
<td>Blue marlin</td>
<td><em>Makaira nigricans</em></td>
</tr>
<tr>
<td>Large pelagic fisheries</td>
<td>White marlin</td>
<td><em>Tetrapturus albidus</em></td>
</tr>
<tr>
<td>Large pelagic fisheries</td>
<td>Albacore</td>
<td><em>Thunnus alalunga</em></td>
</tr>
<tr>
<td>Large pelagic fisheries</td>
<td>Bigeye tuna</td>
<td><em>Thunnus obesus</em></td>
</tr>
<tr>
<td>Large pelagic fisheries</td>
<td>Bluefin tuna</td>
<td><em>Thunnus thynnus</em></td>
</tr>
<tr>
<td>Large pelagic fisheries</td>
<td>Yellowfin tuna</td>
<td><em>Thunnus albacares</em></td>
</tr>
<tr>
<td>Large pelagic fisheries</td>
<td>Swordfish</td>
<td><em>Xiphias gladius</em></td>
</tr>
<tr>
<td>Demersal fisheries - species which define fisheries</td>
<td>Atlantic Cod</td>
<td><em>Gadus morhua</em></td>
</tr>
</tbody>
</table>

Notes: DSR, Discards survival rate; Geographical areas: BS, Baltic sea; BlS, Black Sea; M, Mediterranean. Fishing gears generally associated to Small-scale fishing (SSF) are bold highlighted. Small-scale fishing definition as per the current used EU definition: "all vessels under 12 metres using static gears."
Discards survival rates (DSR) by species, fishing gear and location,

notes: DSR, Discards survival rates; Small-scale fishing as per the current Scientific, Technical not for commercial SSF; 3 (Species and SSF) - data on discards survival is available for the sp

<table>
<thead>
<tr>
<th>Common name</th>
<th>Species included in landings obligation</th>
<th>Type of data on DSR</th>
<th>Fishing gear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglerfish</td>
<td><em>Lophius</em> spp.</td>
<td>0 - No data</td>
<td>-</td>
</tr>
<tr>
<td>Annular sea-bream</td>
<td><em>Diplodus annularis</em></td>
<td>2 - Species (but not SSF)</td>
<td>Recreational hook and line (boat)</td>
</tr>
<tr>
<td>Atlantic cod</td>
<td><em>Gadus morhua</em></td>
<td>3 - Species and SSF</td>
<td>Hand line</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Longline</td>
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<td></td>
<td></td>
<td></td>
<td>Longline</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Otter trawl</td>
</tr>
<tr>
<td>Atlantic halibut</td>
<td><em>Hippoglossus hippoclossus</em></td>
<td>2 - Species (but not SSF)</td>
<td>Longline</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Longline</td>
</tr>
<tr>
<td>Common pandora</td>
<td><em>Pagellus erythrinus</em></td>
<td>2 - Species (but not SSF)</td>
<td>Bottom trawl</td>
</tr>
<tr>
<td>Common sea-bream</td>
<td><em>Pagrus pagrus</em></td>
<td>3 - Species and SSF</td>
<td>Hook and line</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hook and line</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hook and line</td>
</tr>
<tr>
<td>Common sole</td>
<td><em>Solea</em> spp.</td>
<td>2 - Species (but not SSF)</td>
<td>Otter trawl</td>
</tr>
<tr>
<td>Crawfish (spiny lobster)</td>
<td>Palinuridae</td>
<td>1 - SSF (not species)</td>
<td>Traps</td>
</tr>
</tbody>
</table>

potential survival rate: low: < 40%; medium: 40 - 70%; high: > 70%