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Contribution to the Themed Section: *'Balanced harvest and the ecosystem approach to fisheries'*

Food for Thought

Discard ban and balanced harvest: a contradiction?

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Discard bans have been proposed as part of management policies aimed at balanced harvest (BH). Nationwide discard bans exist in several countries, including Chile, the European Union, Norway, and New Zealand. We analysed experiences from these countries to determine whether or not discard bans are in contradiction with BH, based on six aspects: policy objectives, species/sizes applicability, accompanying technical measures, at-sea monitoring and control, and possible impacts. When discard bans are fully implemented, fishing operations change to more selective fishing, typically targeting bigger individuals of main commercial species. This is consistent with the primary objective of many discard policies, i.e. to reduce unwanted catch. In contrast, proponents of BH argue that broader catch diversity, a product of a widespread harvest strategy, should be sought to avoid major impacts on the ecosystem. Our analysis demonstrates that the scope of discard bans is often limited to main commercial species, although usually they can be extended to include more ecosystem components. Some of the policies examined also prohibit the use of unwanted catches for human consumption, thus limiting their effective use. However, the implementation of discard bans requires high levels of at-sea monitoring and effective control, and/or strong incentives to fish more selectively, neither of which applied in most cases examined. We conclude that if discard bans were set differently, they could contribute to fishery management policies aiming at BH. Their goals should be in line with BH, i.e. to reach a wider global harvest pattern, or at least be established within management regimes that promote high compliance. Finally, the extent to which a discard ban contributes to achieve BH depends also on the relative importance of the ecosystem benthic and megafauna components.

Keywords: full catch retention, global harvest pattern, policy goals, selective fishing.

Introduction

Recent studies reviewing fisheries selectivity in an ecosystem context have concluded that intense and highly selective fishing has a strong impact on ecosystem structure, stability, resilience, and productivity (e.g. Zhou *et al.*, 2010; Rochet *et al.*, 2011). Balanced harvest (BH), a strategy that distributes fishing pressure across the widest possible range of trophic levels, sizes, and species, in proportion to their natural productivity (reducing fishing pressure where it is excessive), has been proposed to counter this effect (Garcia *et al.*, 2012). This involves the harvest of some ecosystem components that are not (yet) fully utilized by society. Such catch is currently likely to be discarded, particularly in the developed world, while in view of food security, all catches (commercial and non-commercial) should be landed and utilized. In this context, full catch retention policies (also known as discard bans) have been proposed as part of management policies aimed at BH (Garcia *et al.*, 2011, 2015). This implies that markets and the processing sector will need to adapt to accommodate a wider range of catch components, and even be incentivized to do so, for example, by (i) enhancing industrial processing for animal feed or human consumption; (ii) changing status from non-target to target species or sizes; and (iii) consuming less-utilized species (Garcia *et al.*, 2012).

In the past, the practice of discarding part of the catch at sea has largely been unregulated in most fishery jurisdictions (Heath *et al.*, 2014). However, the landing obligation of the recently reformed Common Fisheries Policy (CFP) of the European Union (EU) is a prominent example of a recent trend in fisheries management to limit discarding, reflecting successful public opinion campaigns that see it as a waste of resources (Borges, 2015). The objectives of

discard bans are usually (i) to contribute to the sustainability of fisheries through the improved implementation of catch limits and (ii) to reduce unwanted catch. The latter objective recognizes that not all catch can be utilized (due to stock sustainability, markets, societal values, etc.) and should therefore not be caught in the first place. On the other hand, proponents of BH argue that broader catch diversity, stemming from a widespread harvest strategy, is needed to reach BH.

BH and discard bans appear to be in conflict with each other, since the former promotes a proportionate approach to fisheries removals in relation to ecosystem components, while the latter, by prohibiting discards from occurring, eventually limits removals in a way that is unlikely to be in proportion to ecosystem components. BH is an *a priori* fisheries management strategy, i.e. trying to plan the catch to be caught, while discard bans are an *a posteriori* fisheries policy tool, dealing with the catch that has already been caught, although also aiming at indirectly changing fishing practices. In other words, BH is primarily about fishing mortality, not what ultimately happens to the catch. But in a BH perspective, it is important to know the impact of discarding vs. not discarding the catch back into the sea (and, instead, landing it). Does discarding (or not discarding) part of the catch make the ecosystem more unbalanced? Will discard bans be associated with increased market acceptance of otherwise discarded species and sizes, or will they instead lead to increased selectivity and hence counter BH?

This paper discusses the relationship between discard bans and BH based on a brief summary of selected examples of discard bans around the world. The main issues of the discard policy examples chosen were assessed generally as well as in the specific context of BH by answering six questions: (i) what are the goals of the discard ban?, (ii) what is it illegal to discard (species, sizes) and when and by whom (season/time/fishery)?, (iii) were there any technical measures (compulsory or not) introduced together with the ban?, (iv) was the ban associated with (increased) compulsory at-sea monitoring?, (v) what are the sanctions for violating the ban, and is there any (at-sea) control?, and finally (vi) is there an analysis of the impacts of the ban and what are the results?

Examples of nationwide discard bans

The discard ban examples described in this section, summarized in Table 1, were selected to reflect a diverse set of fisheries in terms of species, gears, and sizes, but also of management strategies and social realities around the world. Only cases of nationwide discard bans were chosen. This excludes cases of discard bans that are specific to fisheries or regions (such as the case in Canada and the United States).

Chile

The general aim of the Chilean discard ban is to increase the biomasses of target and non-target stocks (Table 1). The specific objectives are to reduce discards of target and non-target species, as well as the incidental catch of birds, mammals, and turtles (Ministerio de Economía, Fomento y Turismo, 2013a).

The term discard was first introduced in Chilean legislation with the Fisheries Law amendment of 2001, which also introduced an individual transferable quota (ITQ) system. Before 2001, Chile had a "race for fish", i.e. boats would fish as much as possible until the total allowable catch (TAC) was reached and the fishery closed. The 2001 law prohibited discards, with no distinction between species and sizes, and established strong sanctions to offenders, such as deductions of 30% of their ITQs (Ministerio de Economía, Fomento y Turismo, 2011). These heavy sanctions made fishers uncooperative and discards became a taboo subject, unknown in their magnitude to the fishing authorities, while the practice of discarding continued as normal. In recognition of these issues, the 2012 revision of the Fisheries Law introduced fisheries exceptions to the discard ban, conditional on a minimum 2-year monitoring programme to quantify and identify the causes of discards, and to develop and implement mitigation plans. Further exemptions may apply as long as the following requirements are met: (i) monitoring programmes are completed and discard mitigation plans are established, (ii) sufficient technical background has been collected according to the protocols established by the monitoring programmes, (iii) the monitoring programme continues to run, (iv) a global catch quota, which accounts for discards, has been set for the target species, (v) target and non-target species are subjected to a mitigation plan, and (vi) discarding does not affect the conservation of the target species. Finally, there are restrictions on the use of previously discarded catches for human consumption, such as under minimum landing sizes (MLS), but these may be lifted within the remits of the mitigation plans.

Additional technical measures have not (yet) been implemented with the discard ban, except that from July 2014 onwards, the trawls used by the demersal fleet targeting crustaceans (shrimps, prawns, etc.) were standardized and regulated through the establishment of mandatory features such as dimensions, buoyancy, and bycatch excluder systems, among others (Ministerio de Economía, Fomento y Turismo, 2013b). The objectives of these changes were to minimize (i) the capture of small or immature specimens of the target species, (ii) the capture of bycatch, and (iii) seabed impacts.

Law compliance will be monitored by electronic monitoring systems (EMS) in all vessels of the industrial fleet as soon as an EMS regulation is enacted, while artisanal boats longer than 15 m will be required to carry EMS 3 years after the EMS regulation is enacted. Observer programmes, carried out since 1990, are extended with the new Fisheries Law, but will continue with the sole objective of collecting biological and fisheries data to be used in scientific advice for management, without any jurisdiction in compliance.

The impact of the Chilean discard ban is not known as it is yet to be fully implemented. At present, there is a huge interest from the fishing industry in these non-sanction monitoring programmes, as they perceive the resulting transparency of their fishing operations as an opportunity to change fishing regulations and match fishing opportunities with their real catches. At the same time, Chilean society is increasingly concerned about the profitability and environmental impacts of fishing activities, and open to sustainability certifications. It remains to be seen if, despite the proposed changes in law and surveillance, the discard ban will be fully implemented as Chilean fleets are large and extremely diverse in terms of gears, operations, and target species. In any case, it is expected that the increase in at-sea monitoring will change fishing practices, which will probably result in a change in fishing patterns and a reduction in unwanted catch.

European Union

The European Union introduced a landing obligation from 1 January 2015, foreseen in the recently revised EU Common Fisheries Policy (European Union, 2013). The sole objective of the landing obligation is to reduce unwanted catch (Table 1); it is not explicitly aimed at contributing to stock sustainability as is true with similar legislation in other countries. Before 2015, it was

Table 1. Summary of the nationwide discard bans examined by each of the six research questions considered.

	What are the goals of the discard ban?	What is illegal to discard?	Were there any technical measures introduced together with the ban?	Was the ban associated with (increased) compulsory at-sea monitoring?	What are the sanctions for violating the ban, and is there any (at-sea) control?	Is there an analysis of the impacts of the ban and what are the results?
Chile	Specific objective: reducing discards of target and non-target species, and incidental catches of turtles, seabirds, and marine mammals General objective: increase stocks biomass and sustainable fisheries	At present everything Exemptions will be allowed in the future under some conditions and specified in mitigation plans Some species will be mandatory to discard	No Very recently standardization of trawl gears in the demersal shrimp fleet Future discard reduction measures specified in mitigation plans	Yes Electronic monitoring systems (EMS) in all vessels: - industrial fleet as soon as an EMS regulation is enacted (expected date second half of 2015) - artisanal boats longer than 15 m 3 years after the EMS regulation is enacted	Fines for vessel owners and skippers related to the species and amounts discarded	No Likely changes: - improvements in selectivity (where possible) - codes of conduct (e.g. specifying moving on provisions) - development of new products and markets - major changes in fishing strategies and fishers behaviour
European Union	Specific objective: reduce unwanted catch General objective: sustainable fisheries	Atlantic waters: TAC-regulated species Mediterranean Sea: MLS species Applies in European waters and to European fishing vessels in other waters Exemptions: - species for which fishing is prohibited, - species that have high survival rates after being discarded, - catches falling under *de minimis* exemption	No Future discard reduction measures specified in discard plans	No	2015–2016—No sanctions 2017—serious infringement under Regulation (EC) No. 1224/2009: fines, fishing licences suspended and possibly revoked No specific additional surveillance and control required	- Heath *et al.* (2014)possible negative impacts on macrofauna and benthos communities, no benefits to commercial stocksLikely changes: - improvements in selectivity (where possible) - major changes in fishing strategies and fishers behaviour
Norway	Higher fisheries profitability based on improved exploitation patterns (i.e. more species and size selective fisheries)	Dead or dying fish of species mentioned in regulation (generally fish with commercial value) Potentially other marine organisms (plants, invertebrates, birds, mammals) through additional regulation	Yes A range of associated measures were implemented including - Real-time closures - Sorting grids - Bycatch allocations in mixed fisheries	No	Fines, temporary withdrawal of fishing licences, confiscation of catch High at-sea enforcement regime	Gullestad *et al.* (2015) Indication of: - increase size and species selective fishing that contributed to rebuilding main commercial species

Continued

Table 1. *Continued*

	What are the goals of the discard ban?	What is illegal to discard?	Were there any technical measures introduced together with the ban?	Was the ban associated with (increased) compulsory at-sea monitoring?	What are the sanctions for violating the ban, and is there any (at-sea) control?	Is there an analysis of the impacts of the ban and what are the results?
New Zealand	General objective of increasing biomass of commercial stocks	Species under ITQ system: - catch over MLS - all catch for species without MLS Exemptions: high survival species listed under schedule 6 of the Fisheries Act	No	No	Fines, temporary withdrawal of fishing licences and possibly ITQs Modest at-sea enforcement regime: - limited surveillance and monitoring by fisheries inspectors - limited number of observers	MRAG (2007) Indication of: - more discards above MLS - possibly small increase in selectivity - stocks biomass increased

MLS, minimum landings size; ITQ, individual transferable quota.

legal, and in some circumstances compulsory, to discard part of the catch at sea in European waters (Borges, 2015).

The landing obligation is only applicable to TAC-regulated species in the Atlantic and to species that have a MLS in the Mediterranean Sea, caught in European waters or by European fishing vessels. It is implemented progressively by species and fisheries, starting with pelagic fisheries and fisheries in the Baltic Sea in 2015, and to be completed by 2019 (European Union, 2013). The landing obligation also includes three specific exemptions: species for which fishing is prohibited, species that have high survival rates after being discarded, and catches which fall under the *de minimis* exemption. The *de minimis* exemption is applicable under two conditions: if there is scientific evidence that increases in selectivity are very difficult to achieve, or to avoid disproportionate costs of handling unwanted catches, but only where the bycatch of the gear in question does not represent more than a certain percentage of the catch. Details on the implementation of the discard ban are established in discard plans. Catches below minimum conservation reference sizes (MCRS, comparable, but not equivalent, to the previously known MLS) have limited use and cannot be sold for human consumption to avoid creating markets for undersized fish. TACs are adjusted to account for the previously discarded part of the catch, although the details of this adjustment are not clear (European Union, 2016).

No new technical measures are foreseen to specifically accompany the implementation of the EU landing obligation. There are also no specific additional requirements for its monitoring and control, except for an obligation to document the catches, details of which are again to be specified in multiannual plans. Failing to comply with the landing obligation is categorized as a serious infringement under Regulation (EC) No. 1224/2009 (European Commission, 2009), but there will be a 2-year delay before sanctions take effect, i.e. from 1 January 2017 (European Union, 2015).

Since the EU landing obligation is quite recent and has yet to be fully implemented, there are few data available to assess its effect on the fisheries and species it applies to. However, considering that many commercial stocks are moderately to highly discarded (ICES, 2015), if the landing obligation is fully implemented, i.e. is monitored at-sea at significantly high levels, it is likely that fishing operations will change to maximize the use of the space on board and quota available for high price species and sizes. The landing obligation could therefore represent the biggest push for more selective fishing in the history of the EU Common Fisheries Policy. There will probably be a significant change in fleet diversity, and thus in the global harvest pattern of EU fishing fleets, as many fishers are considering swapping fishing gears for more selective ones. Furthermore, this is likely to affect the ecosystem megafauna and seabed communities. Heath *et al.* (2014) showed that landing the entire catch of TAC-regulated species, while fishing as usual in the North Sea, has conservation penalties for seabirds, marine mammals, and seabed fauna, with no benefit to fish stocks.

Norway

The discard ban in Norway is an element within a set of measures that were deployed in support of the objectives of enhancing the exploitation pattern of commercial fish stocks and reducing unwanted catches (Gullestad *et al.*, 2014, 2015; Table 1). Norway first introduced a discard prohibition for cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) in 1987, with the specific purpose of reducing discard of legally sized individuals of a strong year class of the Northeast Arctic cod (Gullestad *et al.*, 2015). The ban was

later extended to cover other commercial species. A general discard ban was introduced as part of a new basic Marine Resource Act (MRA) in 2009. The overall goal of the MRA is to ensure sustainable and economically profitable management of wild living marine resources, while contributing to coastal employment and settlement (Norwegian Government, 2008; Gullestad *et al.*, 2014). The MRA requires that all catches of commercial species, with some exceptions, are landed and can be sold through ordinary market outlets (Norwegian Government, 2008). Echinoderms and nearly all species of molluscs and crustaceans may, however, be discarded (Fisheries Directorate, 2015a). Other taxonomic groups such as sponges, jellyfish, seaweed, birds, and mammals may also be discarded, although the MRA authorizes the Ministry to extend the discard ban to such groups (Norwegian Government, 2008).

The Norwegian TAC system was strengthened through the introduction of individual vessel quotas for the coastal fleet in the late 1980s (Gullestad *et al.*, 2014, 2015). In 1983, a system for mandatory real-time area closures (RTC) was introduced (Reithe and Aschan, 2004). The RTC system involves the continuous monitoring of fishing grounds by trained inspectors on board chartered vessels; areas are closed when inspectors register that catches of juvenile fish exceed a certain limit. Furthermore, fishers are obliged to move fishing grounds if they observe excessive juvenile bycatch in a haul. The RTC system is combined with compulsory gear selectivity measures (e.g. type and minimum dimension of mesh sizes) as well as sorting grids that became mandatory in 1997 in demersal trawl fisheries for gadoid species (Isaksen, 2000).

Control at sea is conducted by the Norwegian coastguard, which currently conducts around 2000 vessel inspections per year at sea (Gullestad *et al.*, 2015). Monitoring at sea by way of observers or through other means is not mandatory, but observers are placed on board a limited number of vessels to collect high-quality and fine-scale fisheries data. However, it remains difficult to control and monitor the discard ban at sea due to the large size of the sea area to be controlled and associated high cost (Gezelius, 2006). Several high-risk areas for discard ban violations have been identified for the year 2015: slipping and highgrading in pelagic fisheries, the discarding of juvenile cod and haddock in the Barents Sea, and the discarding of individual gadoid fish and flatfish below the MLS in the North Sea (Fisheries Directorate, 2015b). Nevertheless, in 2000, discards in Norwegian waters amounted to just 2–8% of total catches (Anon, 2004).

Cod and haddock discards below the minimum legal catch size declined after the introduction of the discard ban in Norwegian waters. However, evidence suggests this occurred in response to the area closures, rather than the discard ban. The effect of the Norwegian discard ban in incentivising more selective fishing is difficult to quantify due to ineffective monitoring and a lack of data (Condie *et al.*, 2014). Nevertheless, there was a general increase in selectivity due to the combination of all the management measures.

The difficulty of controlling the discard ban, and the resulting low chance of detecting violations, makes its implementation in practice highly dependent on cooperation and general acceptance by fishers (Gezelius, 2006, 2008; Johnsen and Eliasen, 2011). Nevertheless, Gullestad *et al.* (2015) contend that it is "beyond reasonable doubt" that Norwegian discard management measures and improved exploitation patterns have contributed to the rebuilding of cod and haddock stock in the Barents Sea, as well as leading to substantial increases in annual yields. However, at present, not all commercial stocks are exploited sustainably and a few are even overexploited (ICES, 2015).

New Zealand

In 1986, New Zealand introduced an ITQ system to ensure the sustainable utilization of fishery resources. With it came a prohibition to return to, or abandon in the sea or any other waters, catch of species subjected to the ITQ system (most commercial species) over MLS (i.e. a prohibition to highgrade), and all catch for species without an MLS (Section 72 of the 1996 Fisheries Act; Table 1). Discarding is nevertheless allowed for species with high survival rates listed under schedule 6 of the Fisheries Act (Ministry of Fisheries, 1996). The prohibition to discard is associated with the ITQ system and does not have specific objectives; only the general objective of increasing biomass of commercial stock applies. As with other countries, technical measures were implemented together with the ITQ system.

New Zealand has a relatively modest enforcement regime, with limited at-sea surveillance and monitoring undertaken by fishery officers on board New Zealand military vessels and aircraft and a team of observers on commercial fishing vessels. With an estimated 1500 fishing vessels, the Ministry only carried out 1567 vessel inspections for compliance purposes in 2006/2007, thus achieving low surveillance intensity. Nevertheless, the Ministry planned to increase them in the following years (MRAG, 2007).

While discards under the minimum legal size are not reported, discarding actually increased for legally sized fish following the introduction of the ITQ system (MRAG, 2007). This happened despite the introduction of a number of mechanisms to enable fishers to match their catch to available fishing opportunities without holding the relevant quota portfolio to begin with, i.e. through leasing or buying additional quota, borrowing and banking quota, etc. (Lock and Leslie, 2007). By 2007, discarding was considered to be widespread and an increasing problem in New Zealand fisheries (MRAG, 2007). According to Condie *et al.* (2014), at the same time as the introduction of the discard ban there was a small increase in selectivity, but it is difficult to assess the impact of the discarding prohibition as accurate statistics on discards are unavailable. Nevertheless, in 2013, 69% of New Zealand known-status stocks (92 stocks of 133 assessed stocks, out of a total of 350 evaluated stocks) had biomasses above the management targets, i.e. similar to or higher than B_{MSY} (Ministry of Primary Industries, 2013), suggesting that the general objective of sustainable fishing is being achieved.

Discard bans and selectivity

As suggested by the nationwide discard ban cases studied (and in the specific examples given below), a discard ban, if properly implemented, will be an incentive to reduce unwanted catch regardless of whether it is accompanied by compulsory technical measures. This is because fishers will lose space on board that could otherwise be used to store more valuable species and/or sizes. This reduction in unwanted catch may be achieved by changing fishing strategy, i.e. the time, location, or depth of fishing, or by altering gear rigging, and deployment.

In Chile, a year after implementing a research programme on discards as required by law, and before official discard reduction measures were adopted, the industrial trawl fleet targeting hake (*Merluccius gayi gayi*) spontaneously, and on a voluntary basis, developed and started using exclusion grids. These are installed at the entrance to the codend, preventing the entry of giant squids (*Dosidicus gigas*), a species that has limited quota available and thus that can close the fishery prematurely, while the quality of the

hake catch is improved. In the EU, the so-called fully documented fisheries trials, where all catches of a pre-agreed species were landed, recorded, and accounted for against an increased quota, show that fishers rapidly adapted their fishing strategies to reduce unwanted catch (mainly juvenile fish) and effectively increased their commercial catch (Kindt-Larsen *et al.*, 2011). In Norway, individuals in the Norwegian shrimp trawl fisheries helped design the so-called Nordmøre grid and started using it in 1989 to reduce the bycatch of finfish. The grid was well received by the industry, which soon started using it on a voluntary basis, mainly because it would grant permission to access fishing grounds that were otherwise temporarily closed due to high bycatch rates, but also because it improved the quality of the shrimp catch (Isaksen, 2000). Finally, in 2001, the Hoki Fishery Management Company in New Zealand introduced a voluntary code of conduct to reduce the catch of juvenile hoki (*Macruronus novaezelandiae*) based on different measures, such as the requirement to move away from fishing area when a specific level of catch of juvenile fish is reached (so-called moving on provisions), closed spawning areas, among others (MRAG, 2007).

In summary, in all cases studied discard bans have increased the selectivity of some, if not all, of the fisheries involved by incentivizing a voluntary change in fishing behaviour, often before compulsory technical measures were implemented.

Discussion and conclusions

Based on the nationwide discard ban examples presented above, the management goal for adopting a discard ban is normally to limit (and reduce) fishing mortality and reach sustainable fisheries, but also implicitly, and notably in relation to the EU and New Zealand cases, to achieve effective TAC implementation. At the same time, there is also a global objective of reducing discards for various reasons, but always associated with an underlying purpose of limiting the exploitation pattern towards target species and/or sizes. Nevertheless, it is interesting that in at least two cases, namely Chile and Norway, the discard ban is already applicable to several taxonomic groups, instead of being limited to main commercial species. This is in contrast to the New Zealand and EU discard bans, which are only applicable to TAC and/or MLS regulated species, depending on the area. Yet, the EU landing obligation and the Norwegian discard ban could be extended to the full scope of the underlying legislation, i.e. wild living marine resources. This opens up the possibility of applying the discard bans to a larger range of ecosystem components, which is clearly more in line with BH.

The analysis of the discard policies examined indicates that, the discard bans, if properly implemented, will significantly increase fishery selectivity. This may result in the countries' global harvesting patterns becoming narrower, where the range of exploited species, sizes, and potentially trophic levels will be reduced. We note that the BH concept proposed by Garcia *et al.* (2012) *is* selective, but it broadens the selectivity perspective from fleets and fisheries to the scale of ecosystem productivity and impacts. The latter is what may be considered to be a global harvest pattern at ecosystem level, i.e. that the combined impact of highly selective fisheries with different catch components may be balanced.

The implementation of a discard ban requires high levels of at-sea monitoring and effective control, and in all the cases studied, an increase in existing programmes. For poor (or even absent) monitoring and control, as was the case in Chile and New Zealand, discard bans may in fact increase discards, due to associated management measures that strongly limit fishing activity and incentivize discarding, such as TACs and ITQs. To counter these effects, incentives may be used to promote more selective fishing. However, high levels of at-sea monitoring and control and economic incentives are unlikely to be available in many countries around the world, which limits the applicability of discard bans as a fisheries management tool.

If properly implemented, discard bans will tend to increase stock biomass by reducing fishing mortality, particularly on juveniles in recovering stocks, but also by ensuring an effective implementation of TACs. In contrast, if a discard ban is not monitored at-sea, at best TACs will continue to be overshot with negative impacts on the stocks in question. At worst, when linked to increased fishing opportunities to account for the catch that would otherwise be discarded, there will be an increase in fishing mortality for all stocks, and most probably, increased overexploitation. For example, in the EU, TACs are being increased to account for discards (so-called quota uplifts), suggesting that the CFP landing obligation will create more unbalanced harvest. On the other hand, the partial implementation of the ban reduces this effect.

In most examples presented, the objective of the discard ban is to reduce unwanted catch instead of utilizing unused catch, as commonly argued in relation to a BH strategy. This situation has probably arisen because the use of otherwise discarded catch requires changes in the market that will take time to occur, whereas many stocks are still in a more immediate need of recovery. In fact, some of the policies examined, such as the EU landing obligation, prohibit the use of discards for human consumption, thus limiting their effective use. None of the policies included a specific objective with regard to the possible uses of discarded catch, hence limiting future possibilities of a BH.

If full catch retention policies are implemented, they are likely to affect the benthic and megafauna diversity, depending on the ecosystem and the importance of its scavenger benthic community. Heath *et al.* (2014) showed that landing the entire catch of TAC-regulated species in the North Sea, while fishing as usual, has conservation penalties for seabirds, marine mammals, and seabed fauna since they will lose potential prey. In turn, exploited fish stocks will not necessarily benefit, as fishing mortality and exploitation patterns will not be reduced to allow for stock recovery. Furthermore, they concluded that discards represent a relatively small subsidy to the foodweb, but that the cascading indirect ecological effects of curbing their production can still be considerable. These conclusions are also supported by Fondo *et al.* (2015), that to minimize the consequences of discards removal in marine ecosystems, recommend a gradual reduction in fisheries discards to a minimal level that would maintain the ecosystem's stability and allow species exploiting discards to habituate to the food subsidy reduction. Nevertheless, effective reductions in the harvest rates resulting from changes in fishing practices to eliminate the capture of unwanted fish can deliver conservation benefits, especially in heavily exploited systems. However, we argue that discard ban policies may not necessarily reduce harvest rates but will undoubtedly change the underlying selectivity patterns, while their benefits are unclear.

In conclusion, full catch retention policies, as currently implemented, are in contradiction with a BH (Figure 1). This is probably because their original objectives (together with the measures deployed to achieve them) are in opposition to a BH, namely to increase selectivity and likely achieving a more focused global harvest pattern. However, if discard bans were set differently, they could help to achieve and maintain more BH. Their goals should be in line with BH, i.e. to reach a wider global harvest pattern, or at least be established within management regimes that promote high compliance, for instance, through incentive mechanisms or effective

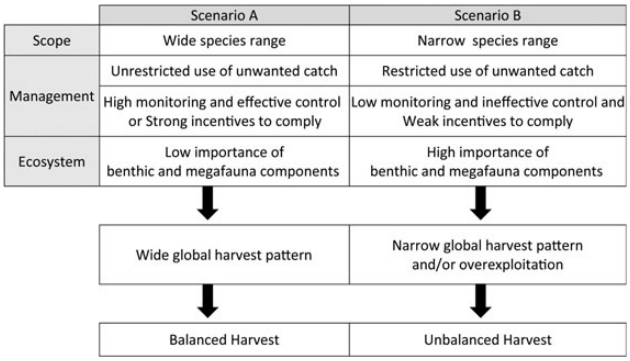

Figure 1. Discard bans related attributes that tend to favour (scenario A) or disfavour (scenario B) balanced harvest. The attributes can be combined in different ways to affect different outcomes with regards to balanced or unbalanced harvest. The Norwegian and Chilean discard bans include attributes of scenario A. The European Union and New Zealand bans are more in line with scenario B.

monitoring and control. Finally, the extent to which a discard ban contributes to achieve a more BH depends also on the relative importance of the ecosystem benthic and megafauna components.

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