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The MSC experience: developing an operational certification standard and a market incentive to improve fishery sustainability

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The Marine Stewardship Council (MSC) standard for sustainable fisheries is represented by three high-level principles and a set of 31 indicators and scoring guidelines, known as the "default assessment tree". Over the 14 years, since it was developed in 1999, the MSC has faced the challenge of maintaining its standard at the level of global best practice, keeping up with developments in the science and management of fisheries, and making sure that certified fisheries maintain their performance at that standard, or raise it where they fall below it. The MSC has had to regularly and widely engage with multiple stakeholders to ensure that its policy development is consistent with stakeholder expectations. Although many fisheries have made significant improvements to their performance, sometimes performance has declined, leading to further requirements for improvement. The MSC needed to design a program that balances credibility, accessibility, and improvement to move the world's fisheries towards sustainability.

Keywords: certification, eco-labelling, global fisheries management best practices, Marine Stewardship Council.

Introduction

Fisheries management is usually seen as the preserve of governments and was firmly dominated by their actions in the 1970s and the 1980s. In the 1990s, however, it became clear that despite significant international agreement on the objectives of fishery management—through the UN Convention on the Law of the Sea (UNCLOS, 1982) and the development of the Code of Conduct for Responsible Fisheries (Code of Conduct, 1995)—world fishery status was still declining. Recent retrospective analyses (Costello *et al.*, 2012; FAO, 2012; Worm and Branch, 2012) show that even for well-understood and commercially important stocks, declines were not arrested until the late 1990s. Furthermore, despite the precautionary and ecosystem approaches being framed in UNCLOS 1982 and fully elaborated in the Code of Conduct 1995, recent reviews have detected relatively poor implementation of the Code by most states even into the 2000s (Pitcher *et al.*, 2009), and almost all observers agree that fish stocks in most areas of the world will not be fully recovered by 2015, a commitment of the Johannesburg World Summit on Sustainable Development 2002 (Froese and Proelß, 2010; FAO, 2012; Cardinale *et al.*, 2013).

The apparent failure of governments alone to deliver sustainable fisheries led to the rise of direct involvement by organizations seeking to mobilize civil society to drive change, either through consumer choice or through pressure on governments and industry, using seafood awareness and ranking campaigns and eco-labelling (Jacquet and Pauly, 2007; Gulbrandsen, 2009). The collapse of the Grand Banks cod stocks in the early 1990s was the trigger for Unilever and WWF to come together, first in dialogue and then to create, in 1997, the most globally recognized of these schemes, the Marine Stewardship Council (MSC; Howes, 2008). The objectives of the two organizations were different—Unilever was primarily interested in maintaining the long-term supply of fish, and for WWF, the motivation was a growing frustration with traditional government-led approaches to public policy reform—but they developed a common solution. The MSC was initially modelled after the Forest Stewardship Council (Gulbrandsen, 2009) and has been very successful, with more than 200 fisheries and 9% of global wild-capture fishery tonnage now certified (www.msc.org). However, it has not been without its critics, who suggest that it is ineffective in creating change in fisheries and does not set its standards high enough (Jacquet *et al.*, 2010; Froese and Proelß, 2012; Karlsen

et al., 2012) or that standards are not applied consistently (Ward, 2008). Others point to evidence that MSC certifications are having significant influence on fishery management practices, particularly in creating transparency, cooperation, and dialogue among previously estranged stakeholders, and contributing to sustainable ecosystem-based fishery management (Kaiser and Hill, 2010; Gutiérrez *et al.*, 2012; Martin *et al.*, 2012; Pérez-Ramírez *et al.*, 2012a; Wiedenfeld, 2012; Agnew *et al.*, 2013).

Clearly, like other policy tools that have been developed with the objective of improving fisheries management, eco-labelling and certification is not as straightforward as it at first seems, nor is it without its difficulties in implementation. Two specific problems that the MSC has faced, since its inception some 15 years ago are how to develop specific operational interpretations of a sustainability standard that are valid in all fishery conditions (ecological and socio-economic); and how to maintain a credible and reliable standard as scientific understanding and accepted best practice management change over time. Fishery management has not only evolved over time, but also shows regional differences, particularly in the definition and implementation of reference points, bycatch regulations, and governance schemes among different national and international management agencies and scientific advisory bodies (Hilborn, 2012). Furthermore, fisheries occur at a huge variety of scales, from small-scale to industrial, community-based to central bureaucratic management, and high seas free access to coastal enhanced fishery operations all with their own characteristics and differences.

Here, we describe the main challenges the MSC has faced in developing and evolving its fisheries standard so that it represents the MSC's stated aim of fisheries management "best practice". In particular, we examine the problem of defining a generic standard that is inclusive of all fisheries globally, and the work needed to keep up with the evolving science behind fisheries management. We describe some of the policy projects developed by the MSC to cope with recent advances in best practice. Finally, we examine the successes of MSC certification and assess the contribution of certification to generating improvements in fisheries management. All authors are MSC staff; hence, we offer this article as an insider's view.

The challenge of a standard setter: defining and operationalizing the standard

The MSC is a market-based programme, which seeks to incentivise fishers to adopt and maintain sustainable practices, rewarding them with an ability to use the MSC eco-label on products. The MSC developed its Principles and Criteria for Sustainable Fishing over the period from 1997 to 1999 through a number of international meetings, and drawing as much as possible on existing, widely accepted agreements and principles [e.g. UNCLOS, 1982; FAO Code of Conduct, 1995; UN Fish Stocks Agreement (UNFSA), 1995; Mangel *et al.*, 1996]. The Fisheries Standard (based around principle 1, assessment of impact on the target species; principle 2, assessment of impact on the ecosystem; and principle 3, assessment of the management system) was developed to require from fisheries not only compliance with the intent of the Code of Conduct, but also demonstration that the actual situation in a fishery meets the outcome implied by this intent. Participants at these initial meetings were chosen carefully to balance the views of the constituencies to which the two founders (WWF, Unilever) belonged (environmental NGOs, processing/retail industry, and others in the seafood supply chain) and other key stakeholder groups (the fishing industry itself; international intergovernmental organizations; independent scientific and other academics; standard setting and accreditation). This balance of sectorial stakeholder interests has been maintained since then through the MSC's governance bodies. The MSC assessment methodology is described in detail by Howes (2008) and MSC (2013).

As a global programme, the MSC faces two important challenges in maintaining its standard—determining requirements that are both generic enough to apply to all wild-capture fishery types across the globe while being specific enough to allow objective, rigorous, and consistent auditing by the MSC's third-party certifiers (CABs, or Conformity Assessment Bodies, which are entirely separate entities, and hence "third party" from the MSC) and balancing the need to change and improve standards in response to evolving scientific knowledge and management practice with the need for stability and reliability inherent in any standard system.

How generic should MSC's requirements be?

Although there are some acknowledged global norms, particularly relating to the objective of sustainable management, regional differences in implementation need to be acknowledged when setting global fisheries standards. International expectations for sustainable fisheries are unambiguously centred on achieving maximum sustainable yield (MSY). UNCLOS (1982) and UNFSA (1995) are specific that the objective of fishery management should be to "maintain or restore stocks at levels capable of producing MSY" (UNCLOS, Article 119.1.a; UNFSA, paragraph 7.2.1), and this statement is qualified and updated in the 2005 release of the FAO guidelines for the eco-labelling of fish and fishery products from marine capture fisheries (FAO, 2009), paragraph 29.2, which requires "Management targets are consistent with MSY (or a suitable proxy) on average, or a lesser fishing mortality if that is optimal in the circumstances of the fishery (e.g. multispecies fisheries) or to avoid severe adverse impacts on dependent predators." MSC has, therefore, adopted B_{MSY} (the stock size that delivers MSY) as its requirement for the target stock, with a modification specifically for ecosystem impacts (see below). Stocks below B_{MSY} are eligible for certification only if they are above a limit reference point, which is above the point where recruitment is impaired, again consistent with FAO (2009), and in this case, will receive a condition on certification that requires them to be rebuilding to B_{MSY}. Stocks below their limit reference point are not eligible for MSC certification.

Although there is agreement on objectives, there are no internationally accepted approaches to harvest control rules and precautionary reference points by which to deliver these objectives. Therefore, these often reflect individual organizations' interpretations and implementations and their application of the precautionary approach. The International Council for the Exploration of the Seas (ICES), for example, bases its MSY approach on attaining a fishing mortality rate at or below F_{MSY} and does not use a B_{MSY} estimate (ICES, 2011). Conversely, the Australia Harvest Strategy Policy defines both limit and target reference points for biomass and fishing mortality, where target biomass (B_{MEY}) is aimed at obtaining the maximum economic yield (MEY) instead of maximizing biological yield (DAFF, 2010) and is therefore assumed to be particularly precautionary with respect to B_{MSY}. The MSC, therefore, requires that there is a harvest control rule that can deliver the outcome, but is not prescriptive on the form of this rule.

How can the MSC standard keep up with international best practice?

Scientific understanding and international management practice both evolve as our knowledge of the marine environment changes. Although it may seem to be relatively easy to include a new requirement associated with changes in best practice (e.g. replacing a requirement of B_{MSY} with B_{MEY}), this could mean that fisheries that were previously judged sustainable might suddenly be judged unsustainable even though they had done nothing differently in practice. Such an abrupt change can be difficult for industry and can create a perception that the MSC is always "raising the bar"—i.e. increasing the performance requirements for a fishery to be certified as sustainable. On the other hand, keeping a standard static forever is at odds with the evolving societal understanding of what constitutes sustainability, and the consequent expectation among the sustainability conscious of continual improvement in management and practices needed to keep pace (Tlusty *et al.*, 2012). Furthermore, the concept of maintaining an evolving standard is central to most international standard-setting approaches (ISEAL, 2010).

Tension is thus set up between the need for review and changes to the standard on one hand and for stability and predictability on the other. The MSC Board of Trustees has attempted to resolve this by requiring that any policy change should be adopted only when there is robust scientific understanding on the specific issue being addressed, as well as widespread support within fishery management and policy circles.

Earlier in MSC's history, concerns had been raised by stakeholders about the lack of information and uncertainty on how, why, and when changes to the standards and requirements were being made and how they would be affected. The policy development processes used by MSC have evolved to meet this criticism and aim to be consistent with international norms for standard setting, such as those published by ISEAL (2010).

The 3 principles and 21 interpretive criteria published in 1999 were high-level statements of the standard which did not lend themselves easily to being used as performance indicators (PIs) for scoring fisheries. Before 2008, the MSC allowed CABs to develop their own indicators for scoring each fishery under assessment, which ultimately led to dissimilar interpretations of the standard (Ward, 2008). The first major review of the MSC assessment methodology took place between 2005 and 2008 and was triggered more by a desire to improve the consistency of assessments than to develop the standard. It led to the release, in 2008, of a standard set of indicators and scoring guidelines ("default assessment tree"; Hoggarth *et al.*, 2010) taking into account the most recent developments in sustainability best practice, such as are reflected in the FAO ecolabelling guidelines (FAO, 2009), and the MSC Board requirement that there be no changes in the level of the standard (the "bar"). The MSC is currently (2013) consulting on further revisions to the default assessment tree.

The 2008 default assessment tree was created with 31 PIs across the three principles. Principle 1, which assesses the status and management of the target species that will carry the logo if the fishery is certified, has seven indicators. Principle 2, which assesses the ecosystem impacts of the fishery, has 15 indicators, divided into five separate areas of assessment: retained species, which are any species that are sold but that will not be covered by the MSC logo; bycatch species, which are not retained; ETP (endangered, threatened, and protected) species that are covered in national or international legislation; habitat; and ecosystem trophic interactions. Principle 3, which covers the wider management system, has nine indicators covering the legal framework of the management system, consultation, long-term and short-term objectives of the system, incentive and disincentives for sustainable fishing, decision-making processes, compliance and enforcement, research planning, and management performance evaluation.

The level of performance required to achieve a score of between 60 and 100 was defined, such that scores can be assigned by CABs at 5-unit intervals (e.g. 60, 65, 70) and, as before, fisheries were required to achieve at least an average 80-level score on each principle and at least a 60-level score on each PI. Fisheries may achieve certification with some PIs scoring between 60 and 80, but then receive "conditions" which require them to take action to improve the performance of these indicators to at least an 80-level within 5 years, following an agreed action plan with defined milestones. Given that an average of 80 is required at the principle level, the number of PIs that can score less than 80 in a certified fishery is limited, ensuring a minimum of sustainability consistent with management best practices as described earlier. The MSC requires that fisheries are subject to an annual surveillance audit, at which progress against the action plan is checked, and a full reassessment of the fishery is required every 5 years. For example, to maintain the certificate, a fishery needs to demonstrate at each annual audit that effective actions are taken to improve stock status when below management targets (e.g. below B_{MSY}). Analysis of the three principle-level scores achieved in fisheries before and after the change provides evidence that the requirements (the "bar") were not effectively changed during the 2008 revision (Figure 1).

Since then, stakeholders (e.g. certified fisheries, CABs, and environmental NGOs) have continued to ask for increasing specificity in the requirements, again primarily to ensure consistency in delivering the intent of the MSC standard. The next section examines

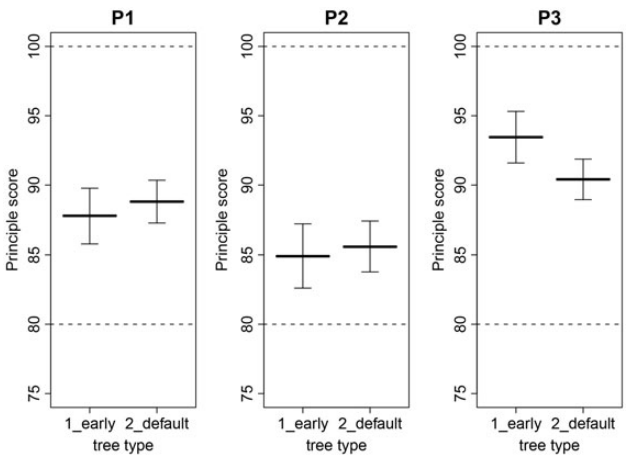

Figure 1. Normalized aggregate scores from the early (pre-Default Tree) and late (Default Tree) assessments for principles P1, P2, and P3, generated from a generalized linear model derived by analysing 217 units of certification, where the model has year, gear, species, area, and assessment tree type as explanatory variables. The dashed line at 80 indicates the required passing score and 100 indicates the maximum score possible. Separate GLMs were generated for each of P1 (residual deviance 1860 with 168 d.f.), P2 (2637 with 171 d.f.), and P3 (1845 with 180 d.f.). The mean and 95% confidence intervals are given.

some of the key challenges faced by the MSC in creating more specific requirements.

Incorporating best practices in the MSC standard

Although the 1999 principles and criteria required that target populations be maintained at levels of high productivity and that overfishing and depletion be avoided, no specific benchmarks (e.g. a stock has to be at B_{MSY}) were defined. The 2008 default assessment tree introduced much greater specificity to the standard, requiring that all target species (those carrying the MSC eco-label) be above a limit reference point (B_{LIM}) that ensures that recruitment is not impaired, and are fluctuating around a target reference point equivalent to the biomass that produces MSY (B_{MSY}). It furthermore requires that there are harvest control rules based on reference points that will deliver corrective measures—such as reducing fishing mortality—when stock status declines.

The default reference points were set at $B_{TARGET} = B_{MSY} = 40\%B_0$ (where B_0 is the biomass level in the absence of fishing) and $B_{LIM} = 50\%B_{MSY}$, although fisheries are able to use proxies (such as fishing mortality) and empirically determined reference points if available, and so long as they deliver the same intent of achieving MSY. These defaults were based on the scientific work done in the 1990s (Mace, 1994; Restrepo *et al.*, 1998) and later incorporated into harvest control rules by a number of administrations (e.g. NMFS, 1998). Within principle 1, fisheries most often receive scores between 60 and 80 (and therefore receive a "condition" for improvement) on the PIs addressing reference points and decision rules, these being the parts of management strategies that are most often poorly defined. These conditional certifications are creating the right incentives for substantial improvement in many fisheries (Table 1).

In the European context, the EU failed to implement an explicit MSY-based harvest control rule for most of its stocks (except some in multiannual recovery/management plans) despite the commitment to MSY made by the European Commission and the Member States in 2002, and the implementation of a plan for moving to MSY by the Commission in 2006 (EC, 2006). Thus, before the implementation of the default assessment tree, the ICES "precautionary" reference point (B_{pa}), and in some cases the fishing mortality proxy (F_{pa}), had been interpreted by CABs as suitable targets in some MSC assessments.

Given this difficulty of interpretation and concerned about the impact of the 2008 default assessment tree on fisheries already certified, the MSC undertook a specific study of MSY and proxy reference points using surplus production models for European stocks in the MSC programme. The study determined that B_{pa} was lower than B_{MSY} for all stocks analysed and that F_{pa} was almost always higher than F_{MSY}. As a result of these findings, MSC issued a Policy Advisory (#12) to CABs in early 2010 clarifying the appropriate interpretation of the requirement for target reference points to be "consistent with B_{MSY}" in situations such as in ICES and elsewhere. This resulted in some fisheries being scored lower on the PIs for stock status and harvest control rules and receiving conditions (i.e. the fishery can maintain the certificate as long as it makes improvements to establish appropriate reference points and rebuild stocks within specified time frames).

Even in 1999, the MSC recognized that the ecological role of a target species should be taken into account when determining whether the reference points and harvest control rules were adequate for the sustainable management of both the target species and the ecosystem of which it is a part. Although the need for this was implied in the Code of Conduct, the actual consequence for reference points was not made explicit until the FAO eco-labelling guidelines in 2005. The 2008 default assessment tree includes an explicit requirement for consideration of the relevance of the reference points given the ecological role of low-trophic-level (LTL) species (i.e. forage species) as recognized by several organizations, including the North Pacific Fisheries Management Council which categorized eulachon, smelts, and capelin, among other groups, as "forage" species and prohibited directed fishing on them (NPFMC, 2012).

The MSC approach is to allow all wild-capture fisheries to enter the programme and demonstrate their sustainability, and therefore, an outright prohibition on the assessment and certification of LTL species was not considered appropriate. However, once again, although widely acknowledged to be an important introduction into the default assessment tree, this generic MSC requirement proved not to be specific enough to assess the level of exploitation deemed as sustainable for forage species. Consequently, the MSC worked for 3 years to understand exactly what management response should be appropriate for these species. This work involved specific commissioned research and several rounds of consultations and workshops with a wide range of stakeholders (industry, management, academia, and conservation sectors). As a result, the MSC default target reference point for key LTL (KLTL) stocks was set at $B_{TARGET} = 75\%B_0$ which is expected to generate yields close to MSY and to avoid significant impacts on other ecosystem components (Constable *et al.*, 2000; Smith *et al.*, 2011; Pikitch *et al.*, 2012). The default limit reference point was also adjusted for KLTL stocks to 50% of the target reference point. Proxies for the biomass reference points can be used, such as $50\%F_{MSY}$ for B_{TARGET}. Model-based analysis of potential ecosystem responses can be used to adjust these default levels so long as the ecosystem perturbations remain small.

Acknowledging that this is a relatively difficult scientific area in which to work, MSC has also presented, for the assistance of CABs and fisheries, a simple method for determining whether a species should be considered as KLTL species in any particular ecosystem (MSC, 2013). This is based on the description of wasp-waisted ecosystems given by Cury *et al.* (2000) as being "typically dominated by only one, or at most a few" LTL species that transfer a very large proportion of the total primary production through the lower part of the foodweb, that account for the vast majority of predator diets, and that control the abundance of both the prey and the predators of these LTL species.

Although the examples given above pertain to refinements of the principle 1 part of the standard, the major focus of work to achieve better-defined requirements is now shifting primarily to principle 2 parts of the default assessment tree.

Changes in fisheries in response to the MSC standard

MSC's "Theory of Change" (MSC, 2010) explains how certification provides incentives for fisheries to improve in two ways. First, as explained above, there is the requirement for certified fisheries to make improvements in those PIs with scores between 60 and 80, so as to enable that PI to be reassessed as meeting the 80-level requirements within specified timelines but never longer than one 5-year certification period. Second, there is the incentive for fisheries that are performing at a lower level than the standard (i.e. that have some PIs that cannot even reach the 60 scoring level or that cannot meet the requirement that each principle has an average score of at least 80) to make the necessary improvements to reach the pass level if they wish to become certified (Martin *et al.*, 2012; Tlusty, 2012).

Table 1. Progress with making improvements required by conditions placed on principle 1 for 18 fisheries certified in 2010.

Principle 1 PI	Number of fishery units certified in 2010 with conditions	Improvements by 2012
Stock status (the stock is required to be above the point where recruitment is impaired and fluctuating around B_{MSY})	1 (5%)	One improvement. North Sea plaice has increased in biomass to around B_{MSY} (well beyond $B_{TRIGGER}$) and fishing mortality has declined to F^{a}_{MSY}. Set against this improvement, the status of the Iberian sardine stock, which did not receive conditions in 2010 declined right after certification, with stock size dropping below $B_{LIM.}$ The certificate was suspended in January 2012 and was reinstated in January 2013 due improvements in the stock and significant changes to management[b]
Reference points (appropriate target and limit reference points are required to deliver the required stock status)	5 (25%)	Two improvements. For North Sea plaice, the appropriateness of the fishing mortality target reference point as an estimate of F_{MSY} was confirmed by ICES[a]. For Antarctic krill (a KLTL species), analysis of the current harvest control rule confirmed that the target reference point of 75% of unexploited biomass was appropriate[c]
Stock rebuilding (where the stock is depleted, there is evidence of stock rebuilding within a specified time frame)	0	No conditions were placed on this PI
Harvest strategy (defined as the combination of monitoring, stock assessment, harvest control rules, and management actions)	5 (25%)	Two improvements. For Barents Sea cod, the harvest control rule is now being used to set the TAC, whereas this link was missing in 2010[d]. For South Brittany sardine, a harvest control rule has been defined which links quotas to stock status, whereas this link did not exist before (this also satisfies a condition on harvest control rules below)[e]
Harvest control rules (these are required to use effective tools, such as quotas, and to reduce fishing mortality as limit reference points are approached)	6 (30%)	Two improvements. For South Brittany sardine, a harvest control rule has been defined which links quotas to stock status, whereas this link did not exist before[e]. For Iberian sardine, a harvest control rule has been adopted, it is being used to set catch limits, has been internally and externally peer-reviewed, and is officially incorporated in national regulations[b]
Information (sufficient information on removals and stock abundance is required to allow the harvest control rule to work)	4 (20%)	Two improvements. For Barents Sea cod, information on discards and other mortality sources have improved through the use of observers and logbooks, has been incorporated into stock assessments, and is currently confirmed as negligible[d]. The North Sea plaice fishery has implemented its own on-board observer and discard monitoring programme after being excluded from the government monitoring programme[a]
Stock assessments (a stock assessment consistent with the requirements of the harvest control rule, and taking into account uncertainty, is required)	0	No conditions were placed on this PI

The 18 fisheries had between them 20 principle 1 fishery units (fleet × stock). 2010 was the first year in which a large number of fisheries were assessed using the default tree. Fisheries were selected for this analysis if they had presented at least two surveillance reports by the end of 2012. Although fisheries must satisfy their conditions within 5 years, 30% of the conditions placed on these fisheries had been satisfied by the end of 2012 (2 years). The fishery names describe the client fishery, which can be a specific name or a group of fishers (see footnote).

[a]Osprey Trawlers North Sea twin-rigged plaice.

[b]Portugal sardine purse-seine.

[c]Aker Biomarine Antarctic krill.

[d]Barents Sea cod and haddock.

[e]South Brittany sardine purse-seine.

[f]Scottish Fisheries Sustainable Accreditation Group (SFSAG) North Sea haddock.

[g]North West Atlantic Canada harpoon swordfish. Other fisheries analysed: American Western Fish Boats Owners Association (WFOA) North Pacific Albacore tuna; Barents Sea cod and haddock; Canada Highly Migratory Species Foundation (CHMSF) British Columbia Albacore Tuna North Pacific; Cornwall Fishers sardine; EURONOR saithe (French fishery); Faroese Pelagic Organization Atlanto-Scandian herring; Irish Pelagic Sustainability Association (IPSA) western mackerel;; Norway North East Arctic Offshore cod; Norway North East Arctic Offshore haddock; Pelagic Freezer-Trawler Association Atlanto-Scandian Herring; Swedish Pelagic Producer Organization (SPPO) North Sea herring; Scottish Pelagic Sustainability Group (SPSG) Atlanto-Scandian herring.

Table 2. Progress with making improvements required by conditions placed on principle 2 for 18 fisheries certified in 2010 which had presented surveillance update reports by the end of 2012.

Principle 2 PI	Number of fisheries certified in 2010 with conditions	Improvements by 2012
Retained species status (the fishery must not pose a risk of serious or irreversible harm and does not hinder recovery of non-target species, i.e. species sold without the MSC logo)	13 (43%)	Two improvements. For Antarctic krill, the bycatch of larval fish was examined using observer data and determined to pose a negligible risk to populations, which was not possible with the information available at certification in 2010[c]; the North Sea plaice fishery implemented its own on-board observer and discard monitoring programme, which allowed the identification of only dab as a main retained species and determination that dab stock size is within biological limits. At certification, in 2010, the extent of interaction with other species was not known sufficiently[a]
Retained species management (the fishery management system must have a strategy to deliver the required status for retained species)	4 (13%)	Three improvements. For Antarctic krill, the management strategy for minimizing risk to larval fish populations was reassessed in the light of new data and determined to be satisfactory[c]; the North Sea haddock fishery has adopted more selective gear for both its demersal trawl and Danish seine fishery units since certification, reducing the catch of main retained species (juvenile cod and whiting) to within acceptable limits[f]
Retained species information (information needs to be adequate to support the management strategy)	4 (13%)	Two improvements. The North Sea haddock fishery introduced an electronic logbook system from January 2012 for both its demersal trawl and Danish seine fishery units with full recording of all retained and discard species, improving the information on retained and bycatch species substantially[f]
Bycatch species status (same as above but for species that are discarded)	0	No conditions were placed on this PI
Bycatch species management (the fishery management system must have a strategy to deliver the required status for bycatch species)	2 (7%)	Two improvements. The North Sea haddock fishery has implemented a zero targeting policy for spurdog for both its demersal trawl and Danish seine fishery units, which constitutes an effective policy for reducing threat to this species[f]
Bycatch species information (information needs to be adequate to support the management strategy)	4 (13%)	Two improvements. For the North Sea plaice fishery, and for the south Brittany sardine purse-seine fishery, better data collection from observers allow identification of bycatch and retained species which was not possible before[a,e]
ETP species status (the fishery must not pose a risk or serious or irreversible harm to ETP species and must comply with national and international legislation)	2 (7%)	One improvement. For the Iberian sardine fishery, a Code of Good Practice to mitigate bycatch mortality has been developed and additional research has determined that the impacts of this fishery on ETP species, particularly for marine mammals, are lower than previously assumed[b]
ETP species management (fishery management must comply with national/international legislation and ensure that the fishery does not hinder recovery of ETP species)	2 (7%)	One improvement. In advance of specific MPA designation, the North Sea plaice fishery has been providing detailed mapping information to planners since certification and is now avoiding fishing in potential MPA areas[a] (see also Toonen and Mol, 2012)
ETP species information (information needs to be adequate to support the management strategy)	13 (43%)	Two improvements. For the North Sea plaice fishery, better data collection from observers ensure that interaction with ETP species is recorded.[a] For the Iberian sardine fishery, institutional collaboration allowed an increase in on-board observer coverage, which allowed a characterization of the interactions of the fishery and ETP species to support the management strategy[b]
Habitat status (the fishery does not cause serious or irreversible harm to habitat structure)	7 (23%)	No conditions have yet been completed for this element, although progress is being made with the required improvements
Habitat management (there is a strategy in place to deliver the habitat status requirement)	1 (3%)	One improvement. Although not a condition of certification, in advance of specific MPA designation, North Sea plaice fishery is providing detailed mapping information to planners and is now avoiding fishing in potential MPA areas[f]

Continued

Table 2. *Continued*

Principle 2 PI	Number of fisheries certified in 2010 with conditions	Improvements by 2012
Habitat information (information is sufficient to support the strategy)	1 (3%)	One improvement. For the South Brittany sardine purse-seine fishery, the introduction of observers has allowed the collection of data on habitat impacts and the spatial extent of the fishery, which was not possible before[e]
Ecosystem status (the fishery must not cause serious or irreversible harm to the key elements of ecosystem structure and function)	0	No conditions were placed on this PI
Ecosystem management (there is a strategy in place to deliver the ecosystem status requirement)	1 (3%)	No conditions have yet been completed for this element, although progress is being made with the required improvements
Ecosystem information (there must be adequate knowledge of the impacts of the fishery on the ecosystem)	0	No conditions were placed on this PI

The 18 fisheries had between them 30 principle 2 fishery units (fleet × stock × gear). Note that although the same number of fisheries are analysed here as in Table 1 (18), the number of units differs depending on the number of gears that each fishery is using. For instance, there are five separate gears employed in each of Norway North East Arctic Offshore cod and Norway North East Arctic Offshore haddock (Danish seines, demersal trawl, gillnets, hooks and lines, longlines). ETP stands for endangered, threatened, or protected. Footnote marks refer to the full fishery names, given as footnotes to Table 1.

The improvements generated by fisheries responding to MSC requirements can be significant. For example, the New Zealand hoki fishery was first certified in 2001. Concerns were raised about both Eastern and Western hoki stocks in the first assessment period, and on MSC re-assessment, the Western hoki stock received a rebuilding condition. Both stocks have now rebuilt to at or above B_{MSY} (MPI, 2012) with the western stock increasing by 300% over its low point in 2005 (Gutiérrez *et al.*, 2012). Other conditions placed on certification have led to improvements in observer coverage and reduced interaction with seabirds (MRAG, 2011a, b; Richard *et al.*, 2011).

The South African hake (*Merluccius paradoxus* and *M. capensis*) fishery entered the programme in 2004. Conditions placed on the certification required the fishery to better understand the stock structure of the two *Merluccius* species, develop stock rebuilding measures for bycatch species (principally kingklip *Genypterus capensis*), consider creating protected areas to limit trawling impact, and first determine and then reduce the amount of seabird bycatch. All these conditions have been met, and reducing seabird mortality has been particularly successful (Field *et al.*, 2013). Studies by observers commissioned by the industry in late 2004 determined high incidental mortality of seabirds, particularly albatross, primarily from warp strikes (Watkins *et al.*, 2008). Following the introduction of mitigation measures, recent estimates suggest that there has been an 86% reduction in albatross mortalities (Powers *et al.*, 2011; Albatross Task Force, 2012).

Comprehensive statistics on the number of improvements made are not yet available because the majority of fisheries have been certified for fewer than 5 years, the time allowed for delivering improvements associated with conditions. However, Tables 1–3 indicate the relative numbers of conditions that are raised, their distribution and the sorts of improvements being generated across a wide range of fisheries.

Not all fisheries experience continuous improvements after being certified. In some cases, environmental performance has declined after certification, and fisheries have received new conditions. For example, for the North Sea herring fishery, concerns about steady decline in stock status triggered an "expedited audit" in July 2007, concluding that the stock was below precautionary limits (B_{pa}), thus justifying additional conditions that required rebuilding measures to be implemented (Intertek Moody Marine, 2008). For the Hastings Dover sole fishery, an increase in cod bycatch due to changes in fishery dynamics attracted new conditions on improved bycatch monitoring and observer coverage on all 27 fishing vessels (Intertek Moody Marine, 2009). At its second certification in 2009, the South African hake fishery received a new condition to improve the status of the *M. paradoxus* stock. The stock subsequently increased by ~30% in biomass in the last 3 years (from 59% B_{MSY} to 88%; Rademeyer, 2011). The continual scrutiny of fisheries in the program—through annual surveillance and 5-yearly recertification—ensures that such occasional reversals of performance are quickly identified and rapidly and transparently communicated to all stakeholders.

Conclusions

The MSC has attracted a large number of fisheries to undergo assessment for certification, but not all assessments are successful. At present (1 May 2013), 200 fisheries are certified, 103 are under assessment, and 22 fisheries have failed or withdrawn, for a variety of reasons, from the programme.

Some examples of improvements have been presented above, but more comprehensive analyses have been undertaken by Martin *et al.* (2012) and Wiedenfeld (2012). These studies support the conclusion that the conditions raised at MSC certification lead to significant on-the-water changes to environmental status or management in many, but not all, cases. In particular, Martin *et al.* (2012) found that for many of the conditions raised in principle 2 (ecosystem), the situation that led to a condition being raised was a lack of information on an issue (such as lack of information on the level and significance of seabird bycatch) and an improvement in knowledge was sufficient to increase certainty that the fishery was not causing negative impacts. Economic benefits are reported by many fisheries, including through the generation of price premiums (Roheim *et al.*, 2011), and social benefits have been particularly relevant in developing country fisheries (Pérez-Ramírez *et al.*, 2012b). Again, these are often present, but not always.

Table 3. Progress with making improvements required by conditions placed on principle 3 for 18 fisheries certified in 2010 which had presented surveillance update reports by the end of 2012.

Principle 3 PI	Number of fisheries certified in 2010 with conditions	Improvements by 2012
Legal and customary framework (the management system exists within an appropriate and effective legal and/or customary framework)	0	No conditions were placed on this PI
Consultation, roles, and responsibilities (the management system has clear roles and responsibilities and effective consultation processes that are open to interested and affected parties)	1 (6%)	No conditions have yet been completed for this element, although progress is being made with the required improvements
Long-term objectives (there are clear long-term objectives which incorporate the precautionary approach)	2 (11%)	One improvement. For the Atlantic Canada swordfish fishery, ICCAT and Canada Department of Fisheries and Oceans (DFO) have collaborated to put in place new policies requiring the application of precautionary approach in management[g]
Incentives for sustainable fishing (the management system provides economic and social incentives for sustainable fishing and does not operate with subsidies that contribute to unsustainable fishing)	1 (6%)	One improvement. For the North Sea plaice fishery, perverse incentives to use less selective gears have been removed through changes in management that allow an increased catch quota for those vessels with low levels of cod bycatch[a]
Fishery specific objectives (the fishery has clear, specific objectives designed to achieve the outcomes expressed by MSC's principles 1 and 2)	3 (17%)	Two improvements. For the South Brittany sardine fishery, a harvest strategy that is responsive to the state of the stock, and rules concerning bycatch species, have been agreed and documented as decisions of the Commission for Coastal Fisheries (CRPMEM).[e] For the Iberian sardine, strong progress has been made in developing the management approach to the fishery, with a fishery management plan and for the first time the promotion of a regional approach to the management of the stock[b]
Decision-making processes (the fishery-specific management system includes effective decision-making processes)	5 (28%)	Three improvements. For the Canada harpoon fishery, a participatory process led to the development of a management plan for the whole fishery, which was requested and driven by all stakeholders, including the catching and processing industry and fishery managers.[g] For the South Brittany sardine, the decision-making process is now formalized and envisages a precautionary approach based on available scientific information, monitoring, and transparency.[e] For the Iberian sardine, a participatory group involving all relevant stakeholders has been formed (the Sardine Fishery Management Group), with established decision-making processes that have resulted in measures and strategies to achieve the fishery-specific objectives[b]
Compliance and enforcement (monitoring, control, and surveillance mechanisms ensure the fishery's management measures are enforced and complied with)	0	No conditions were placed on this PI
Research plan (the fishery has a research plan that addresses the information needs of management)	1 (6%)	No conditions have yet been completed for this element, although progress is being made with the required improvements
Management and performance evaluation (there is effective and timely review of the fishery-specific management system)	0	No conditions were placed on this PI

Footnote marks refer to the full fishery names, given as footnotes to Table 1.

The challenge that the MSC has faced in developing its standard has been to operationalize general fisheries management approaches—the ecosystem approach, management of LTL species, harvest control rules, and reference points—so that they can easily and consistently be audited by CABs and be broadly applicable to a very wide range of global fisheries. The need to balance credibility, accessibility, and improvement that MSC attempts to fullfil has been recognized by Bush *et al.* (2012) as the "devil's triangle".

In some areas of the standard, scientific evidence and accepted best practice are more established than in others. For instance, in setting defaults for reference points and control rules for single species fisheries, the MSC made use of well-established scientific literature and management practice. Developing a clear policy for LTL

species, multispecies fisheries, developing world community managed fisheries, and enhanced fisheries has proven more challenging. Enhancement includes assisted hatching followed by release and wild capture (so-called hatch-and-catch fisheries), the example being north Pacific salmon fisheries; and wild capture followed by grow-on (so-called catch-and-grow), the example being mussel fisheries. Similarly, within the realm of ecosystem impacts, it has been relatively easy to set requirements for ETP species (to ensure consistency with national legislation), but it is proving much more difficult to develop specific guidelines for the assessment of significant habitat impact.

Thus, significant challenges remain, particularly in developing practical, operational definitions of what constitute acceptable impacts, which, in the language of the default assessment tree, do not cause serious or irreversible harm to habitat or ecosystem structure and function. Many of these issues are being addressed during the review of the fishery standard in 2013.

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