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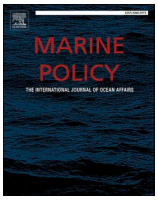

The new Marine Stewardship Council requirements to improve ghost gear management: Insights from the policy development process

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ABSTRACT

Abandoned, lost or discarded fishing gear, otherwise known as 'ghost gear', impacts marine ecosystems in a variety of important ways. The growing recognition of these impacts has led to an evolution of fisheries management with a focus on gear loss avoidance and ghost gear mitigation. The Marine Stewardship Council has responded to the global ghost gear challenge through important revisions made to its Fisheries Standard during the recent Fisheries Standard Review (FSR). Fisheries certified against the Fisheries Standard will now be required to explicitly assess and manage their ghost gear impact on target stocks, on bycatch and on marine habitats - this outcome received strong support during public consultation undertaken for the policy development process. These changes are aimed implementation of best practice management strategies which emphasise gear loss preventative measures supplemented by mitigation and remedial action to minimise impact of ghost gear. The paper covers key insights of the policy development process which supported these changes including best practice research, policy design, public consultation, and impact testing. Conclusions of the policy process are discussed, included their likely implications for fisheries currently certified and those planning to seek certification against the MSC Fisheries Standard.

1. Introduction

Abandoned, lost, or otherwise discarded fishing gear (ALDFG), often called 'ghost gear', is considered to be a significant portion of global marine debris, but comprehensive global datasets on the proportions, volumes and concentrations of ghost gear are largely unknown [1]. Although exact estimates of global fishing gear loss have been difficult to quantify[2], a recent study based on fisher interviews and fishing effort estimated that 2% of all gear, comprising more than 78,000 km^2 of nets, 740,000 km of longlines, and more than 25 million pots and traps, are lost annually [2]. These estimates are similar to another study based on remote observations of fishing vessel activity with technical gear models that found approximately 49,000 tonnes, or 2.5% of all gear, was lost annually [3]. However, other studies have found much higher rates of loss, with up to 30% for pot and trap fisheries [4,5]. In the North Pacific, it is estimated that fishing nets alone constitute 46% of the plastic observed [6].

ALDFG or ghost gear loss, whether intentional or unintentional, has been shown to have devastating ecological and financial consequences [7]. Whilst ghost gear is a term which characterises the main impacts of ALDFG, the MSC has treated ALDFG and ghost gear as equivalent in this paper and within the Fisheries Standard because management responses would be largely the same for either aspect [8]. Also, these terms are used interchangeably by numerous fishery management bodies, fisheries, Non-Governmental Organisations (NGOs) and the media more broadly (for example see [9–13]).

The main direct effect of ghost gear is the mortality of organisms that become entangled in lost or discarded fishing gear. Other impacts include cyclic fishing, where trapped organisms attract other species, which also become entangled [14,15], as well as impacts to habitat and environmental quality [16]. Ghost gear specifically impacts fisheries sustainability negatively as mortality of individuals continue, reducing population sizes and productivity without contributing to seafood production or any other advantage for society. Losses of gear can negatively

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impact catch rates, compromise the efficacy of harvest strategies, alter marine habitats, increase bycatch of non-target species, as well as reduce gear efficiency and associated fisheries profits [2,17–20].

For these reasons, initiatives to quantify, communicate and mitigate the impacts of ALDFG have been created at international, regional, and national levels.

The Global Ghost Gear Initiative (GGGI) is the first global programme to address the problem by building evidence, defining best practices, and developing solutions [1,12]. The GGGI published the second edition of their best practice guidelines for fisheries, which includes specific strategies to reduce ALDFG through strategic spatial or temporal restrictions, gear and vessel redesign, improved gear marking, improved disposal mechanisms and improved reporting [12].

The United Nations Sustainable Development Goal (SDG) 14 affirms that the sustainable harvest of marine resources and the reduction of marine pollution initiatives, such as ghost gear, are inherently linked [21]. Accordingly, the United Nations General Assembly (UNGA) directs states and regional fishery management organisations to adopt effective management measures to address ghost gear [22,23]. Also, intergovernmental efforts led by the United Nations Environmental Program (UNEP) are underway to develop an international, legally binding instrument on plastic pollution [24]. To assist in meeting international law and obligations to reduce plastic pollution, the Food and Agriculture Organization (FAO) of the United Nations has issued guidelines specifically on fishing gear marking systems to improve reporting, traceability, recovery and disposal of ALDFG or unwanted fishing gear [25]. Other United Nations groups bodies are working on ghost gear issues in support of SDG 14, including the International Maritime Organization (IMO), through the "IMO Action Plan to address marine litter from ships" initiative [26].

A multitude of ghost gear initiatives are also underway at regional and national levels. Examples include the NOAA Marine Debris Programme which works to reduce the prevalence and impact of marine debris through education, monitoring, research, and remedial action [27]. The MARELITT Baltic project is another such example, which brought together government, public and private partners to address the problem in the Baltic Sea region [28].

Ecolabelling and certification programs are based on the premise of market-based incentives to drive improvements in seafood production [29]. As such, there are several examples of how certification programs can improve fisheries sustainability while also meeting or increasing the demand for sustainably harvested products [30]. However, ecolabelling programs and certification schemes are increasingly being called upon to address additional challenges in sustainable fishing practices beyond healthy target stocks, including labour issues, pollution, threatened species and other ecosystem impacts [31]. Although the drivers and ecological consequences of ALDFG have been shown to widely vary based on context, the robustness of fisheries management and market-based incentives are important factors for intervention [32]. For these reasons, the MSC's ecolabelling program is well suited to incorporate assessment of ALDFG impacts and interventions within its fishery certification process, as it contains a robust evaluation of ecosystem impacts and the effectiveness of management interventions within the framework of its fishery certification standard.

The basis for the MSC ecolabelling program is the MSC Fisheries Standard (hereby referred to as the Fisheries Standard). The Fisheries Standard sets out performance-based requirements that a wild-capture fishery must meet to enable it to claim that its fish come from well-managed and sustainable sources [8]. The Fisheries Standard evaluates fishery performance via "performance indicators (PI)" made up of constituent "scoring issues (SI)". The standard is composed of three principle components evaluating sustainability of the target fishery (Principle 1), environmental impacts of the fishery (Principle 2) and management (Principle 3) (Appendix C). Third party fishery assessment teams, referred to as Conformity Assessment Bodies (CABs) present and rationalise their evaluation within "scoring tables" which form part of MSC fishery assessment reports. In some cases, fisheries are required to institute further actions aimed at improving their performance over the lifetime of the certificate – these are termed conditions of certification.

MSC stakeholders raised concerns regarding how ghost gear impacts are considered in the Fisheries Standard. It was argued that the indirect way the issue is handled, principally through non-mandatory guidance to the standard rather than the standard itself, led to inconsistent and ineffective mitigation of ghost gear impacts by fisheries certified to the MSC standard (hereby referred to as MSC fisheries). Additionally, it was unclear to the MSC whether the standard was incentivising best practice ghost gear management in MSC fisheries. The MSC also considered it likely that ghost gear management strategies had advanced considerably over recent years in response to a growing appreciation of the scale and nature of its impact on the marine environment.

The objective of this paper is to present MSC's new approach for responding to the global ghost gear challenge through recent revisions to the Fisheries Standard. In this context the paper covers the updated ghost gear requirements, their development process and implications for assessment and management of ghost gear impacts. These requirements were developed through MSC's recent Fisheries Standard Review (FSR) process.

2. Methods

The MSC created a ghost gear project within the broader context of the Fisheries Standard Review. Its aims were to investigate concerns regarding how ghost gear impacts are considered in the Fisheries Standard, and, if necessary, revise the standard to ensure these impacts are considered explicitly and that MSC fisheries implement effective ghost gear management strategies reflecting advances in best practice. The scope of the project focussed on the aspects of ghost gear central to the MSC vision and mission and which the standard could directly address (e.g., ghost fishing). Wider impacts linked to marine plastic pollution from fishing operations (e.g., waste disposal), whilst deemed important, were considered peripheral to the current scope of the standard, thus outside of the project. However, it was also recognised that better managing the loss of gear would by extension reduce the amount of pollution caused by fishing. Also, it was acknowledged that these issues are covered by existing international and domestic legislation, conventions, and directives (e.g., Annex V of the International Convention for the Prevention of Pollution from Ships - MARPOL 73/78).

The review phase started in 2019 alongside other projects within the FSR. This comprised of i) work to understand the state of best practice in ghost gear management and ii) work to understand whether and how ghost gear was hitherto assessed within MSC fishery assessments. A small project team of MSC personnel were tasked with this work. All those working on the project had no working affiliations with the subject matter reviewed, including any fishery standard organisations or third-party fishery assessment teams.

2.1. Research and analysis

2.1.1. Best practice review

In 2019, the project team conducted a literature review of global synthesis reports, peer reviewed and grey literature on the state of ghost gear management. Whilst reports and articles were not subjected to a full content analysis, broad themes in management responses were identified to develop an overall understanding of ghost gear management across various fishing typologies. This review was supplemented by discussion with relevant industry experts and stakeholders at various fora in 2019. Outputs of the best practice review supplemented conclusions from a previous 2018 review commissioned by the Global Ghost Gear Initiative, authored by consultancy group Ocean Outcomes. This review offered a general appraisal of the Fisheries Standard as a tool for incentivising best practice solutions to ghost gear impacts, including providing some historical perspective of how the issue has been handled

in previous standard versions.

A benchmarking exercise was carried out in 2019 by the project team, to compare how the MSC Fishery Standard considered the issue of ghost gear relative to other fishery standards. Fishery standards included in the review were: Monterey Bay Seafood Watch Standard for Fisheries (Version F3.2), Alaska RFM Fisheries Standard (Version 2.0); Iceland Responsible Fisheries Management Standard (Control Document Revision 2.0); Friends of the Sea Standard (Revision 3.1); Fair Trade USA Fisheries Capture Standard (Version 1.1); and Responsible Fishing Scheme (RFS) Standard (Crewed Vessel RFS Standard Final Version 7).

A direct comparison was difficult given the differences in the way the issue is codified, assessed, and operationalised within and between scheme documents. Thus, the appraisal was limited to whether there was an explicit requirement or criterion for scoring ghost gear-related impacts. Additionally, it was noted if these requirements mandated explicit management responses directing minimisation of ghost gear impacts.

2.1.2. Review of fishery assessments

The project team conducted a review of MSC fishery assessment reports to clarify whether and how ghost gear impacts were assessed within MSC fisheries. This review considered 33 Public Certification Reports characterised by passive gear fisheries (e.g., gillnets, longlines, pots, and traps). Passive gear fisheries were selected on the basis that ghost gear prevalence and impact are comparatively higher than mobile gear fisheries (e.g., trawl) [2,33]. Consideration was limited to fishery assessments subject to the most recent version of the Fisheries Standard at the time; Fisheries Standard Version 2.01. This version had incorporated some clarifications on ghost gear assessment and so served as a consistent basis to compare fishery assessments. Reports reviewed represented about half of all fisheries which had completed an assessment against that version of the standard at that time.

The MSC project team's guiding assumption was that *ghost gear*, as an issue, had more of an influence on fishery assessment performance if it was referenced within scoring tables or conditions of certification. Keywords such as *ghost gear*, *ghost fishing*, *derelict fishing gear*, *loss*, *lost, abandoned*, and *discarded,* were searched in the reports sampled. When found, the terms were categorized into those mentioned in the scoring tables, and those forming part of ghost gear-related conditions.

2.2. Policy development

Research and analysis in the first phase of the project demonstrated that ghost gear impact assessment by those applying the standard was generally inconsistent, incorrect and at times absent. Where ghost gear impact was noted and assessed, improvements in on-the-water management of its impacts were rare. Most fishing standards reviewed had more explicit ghost gear requirements in comparison to the MSC Fisheries Standard, which were mostly directed at minimising ghost gear. Lastly the review highlighted that best practice management responses were characterised by gear loss avoidance strategies supplemented by ghost gear mitigation and remediation measures.

In response to these findings, the MSC Board of Trustees agreed that the MSC should develop standard revision options aimed at delivering the following outcomes:

- *Consideration of ghost gear impact needs to be explicit in fishery assessments.*
- *Gear loss avoidance strategies and ghost gear impact mitigation actions should be incentivised in MSC certified fisheries.*

The aim of the policy was broadly to seek alignment with FAO Code of Conduct for Responsible Fisheries [34] and advancements in management best practice.

2.2.1. Stakeholder engagement

Public consultation was initially carried out between May and July 2020. This focussed on designing solutions to the issue researched in earlier phases of the project. Stakeholders engaged in this process via an online launch conference (1), online workshops (3) and an online survey. Stakeholders' insights and sentiment on whether and how ghost gear management should be considered by the Fisheries Standard were elicited through open plenary discussion and discussion in smaller 'break-out' groups. The consultation survey largely replicated the questions posed during the consultation workshops. The survey questions were designed using a Likert Scale to capture stakeholder sentiment regarding the key elements of policy options. Response options generally included the following categories: "Strongly disagree", "Disagree", "Neither Agree nor Disagree", "Agree" and "Strongly Agree". In total, 117 people participated in the conference, 72 people attended the workshops and we received 47 responses to the survey [35].

The second round of public consultation was carried out between May and July 2021. This focussed on obtaining stakeholder views on a range of policy proposal options designed to resolve the ghost gear issue and meet the MSC's policy objectives. Proposals were informed by impact assessment work which incorporated feedback received via the public consultation and feedback from MSC governance bodies. Governance bodies here included the MSC Technical Advisory Board (TAB) responsible for providing technical and scientific advice to the MSC Board (BoT) of Trustees and MSC Executive, and the MSC Stakeholder Advisory Council (STAC), responsible for providing advice to the BoT on relevant strategic, policy or operational issues. The key consultation activities comprised a launch conference attended by 302 participants and an online survey which attracted 35 respondents [36]. The launch conference was similar in scope to the consultation event held the previous year, with general sentiment and reactions to policy options summarised for further analysis. The survey questions were designed in a similar way as was done previously using a Likert Scale to capture stakeholder sentiment regarding the key elements of policy options.

A final round of public consultation was carried out between February and April 2022 of the draft revised standard, which included the preferred ghost gear policy option. This iteration, like previous ones, was informed through impact assessment work, consultation feedback and discussions with MSC governance bodies. Most stakeholders engaged in this process via an online survey, with the ghost gear policy component receiving 75 responses [37]. The survey here was designed in the same way as ones used in the first two rounds of public consultation.

Thematic analysis of the consultation feedback was carried out to help inform the impact assessment of policy options [38]. The main sentiment of each response was identified as either "positive" or "negative", with key themes identified for each of these categories. The strength of sentiment, as well as any information or evidence presented to support responses was summarised within each theme identified. The thematic analysis was repeated by two different MSC staff members to improve objectivity and mitigate any perception bias.

2.2.2. Impact Assessment

To measure impacts of options during the development of the project MSC's impact assessment framework was followed[39,40], with a particular focus on comparison of options using scenarios. The framework directs appraisal of policy options to understand their potential effects across six defined impact types which include "effectiveness", "acceptability", "feasibility", "accessibility and retention", "simplification" and "auditability". This evaluation was informed through research, consultation, pilot and auditability testing, and discussions with MSC governance bodies.

As this policy project was intended to strengthen the assessment and management of ghost gear impacts in line with evolution in best practice management (i.e., "raising the assessment bar"), it was generally accepted that there would be important *intended* impacts across all/most

impact types. Importantly, the process also served to help identify and resolve unintended consequences from proposed changes. The aims of this process were to capture, measure and assess intended impacts and where possible mitigate unintended impacts through policy revisions.

The most important impact types in this project were "acceptability", "effectiveness" and "feasibility" as they served to assess stakeholder sentiment and provided key indications of whether the proposals meet objectives. These impact types also served as general proxies for other impact types in the framework.

3. Results

3.1. Research and analysis

3.1.1. Best practice review

The review highlighted several notable examples of best practice as summarised and discussed in Macfadyen et al. [19], Gilman et al. [16], Restrepo et al. [41], GGGI [12] and FAO [25,42]. Generally common amongst these were three ghost gear management strategies (Table 1): i) preventative action aimed at avoidance of ghost gear; ii) mitigation action aimed at reducing the impact of ghost gear and (iii) remedial action aimed at recovering ghost gear. Similar strategies were identified in the GGGI review. In general, preventative strategies were favoured over strategies deploying mitigation or remedial action as they are more effective at reducing ghost gear impact and generally cheaper to implement [43]. However, commentators noted there are gear-specific or fishery-specific situations where all types of action in combination is most beneficial (e.g., gear positioning technology in combination with retrieval programmes). The other theme common to literature reviewed was a recognition that gear loss is more prevalent in static gear fisheries (e.g., gillnet fisheries, pot fisheries, etc.) [2,33].

Table 1
Common types of ghost gear management responses (adopted from Macfadyen et al. [19] & Gilman et al. [16]).

Type of intervention	Example of measures
Prevention	Marking and identification of fishing gear
	Spatial and/or temporal measures to reduce gear conflict
	Fishing input controls to limit gear use (e.g., limits on soak time for passive gear types)
	Gear design to reduce whole or partial loss of the fishing gear
	Vessel design to reduce gear and other aquatic litter discarding
	Use of end-of-life fishing gear disposal facilities
	Fisher education and awareness on preventing gear loss
Mitigation	Gear design to reduce the incidence and duration of ghost fishing
Remediation	Lost gear reporting, location and recovery initiatives

3.1.2. Fishery standards benchmarking exercise

Most standards reviewed (5 out of 6), were assessed as having more explicit ghost gear requirements than were in the MSC Fisheries Standard (v2.0). These requirements tended to focus on minimizing gear loss as well as impact consideration (Table 2).

3.1.3. Review of MSC fishery assessments

Whilst ghost gear was considered to some extent in most reports (75%) reviewed (33 reports reviewed), its assessment was qualitative and inconsistent, and, in many cases incorrect. This is best demonstrated through Fig. 1 which presents the prevalence of ghost gear consideration by scoring issue. Of note is the wide spread of ghost gear assessment across multiple parts of the Fisheries Standard. This may be due in part to the indirect way the issue was handled by the Fisheries Standard (i.e., it is not explicitly directed through a single scoring issue). However, the high prevalence for ghost gear impact consideration within performance indicator 2.3.1, scoring issue (c), is very likely an error in application of standard intent. This SI deals with *indirect impacts* on Endangered, Threatened or Protected species – impacts of ghost gear should be assessed as direct impacts of fisheries.

Another notable result was the general contrast in ghost gear consideration by scoring issue within reports reviewed. Scoring issues associated with Principle 1 (target stock assessment) and Principle 3 (management assessment) accounted for 14% of all occurrences identified (10/73). The vast majority of scoring issues which attracted some ghost gear considerations were within Principle 2, with 86% (63/73) of occurrences identified. This can be explained by the focus of Principle 2 on environmental impacts (e.g., habitats and bycatch) of the fishery assessed. Also, there is arguably the most explicit requirement for assessment of ghost gear impact within Principle 2 part of the standard which focusses on all forms of "unobserved mortality" caused by the fishery.

There were only two instances of ghost gear related conditions of certification (6% of assessed reports); the review also highlighted a general absence of gear loss data or any attempt to quantify its impact, with much of information used by CAB teams primarily anecdotal in nature. Discussions with CAB team members revealed a general difficulty in obtaining quantitative information (gear loss or lost gear impact).

Consideration of ghost gear impact was also found to be absent in 25% of reports reviewed. CAB team members highlighted that this may be linked to how ghost gear is handled within the standard. The issue is nested within non-obligatory guidance directing the assessment of all sources of unobserved mortality, including but not limited to lost gear.

Table 2
Comparison of ghost gear consideration by fishery standards.

Fishery Standard	Explicit/Implicit ghost gear requirement	Detail
MSC Fisheries Standard v2.0	Implicit	Implicit consideration of ghost gear impact primarily via its contribution to unobserved mortality (via ghost fishing) of target catch, bycatch and impacts on habitats.
Monterey Bay Seafood Watch Standard for Fisheries (Version F3.2)	Explicit	Ghost gear impacts are expected to be explicitly considered for "Moderate" to "Highly effective" bycatch minimization strategies (Factor 3.2). Additionally, information collection for scientific research and monitoring (Factor 3.3) can only be "Highly effective" if it includes specific info regarding gear loss and location.
Alaska RFM Fisheries Standard (Version 2.0)	Implicit	Several clauses emphasise the use of gears/techniques aimed at minimising ghost gear impact but it's unclear whether fisheries are explicitly assessed against the intent of these clauses.
Iceland Responsible Fisheries Management Standard (Control Document Revision 2.0)	Explicit	Several clauses mandate steps to be taken to avoid the loss of fishing gear and ghost fishing linked to lost and abandoned gear.
Friends of the Sea Standard (Revision 3.1)	Explicit	Several clauses obligate fisheries to collect data on ghost gear impacts on non-target species and to have measures in place to minimise loss of gear. Obligations around using non-entangling Fish Aggregation Devices (FAD) are also explicit in clauses.
Fair Trade USA Fisheries Capture Standard (Version 1.1)	Explicit	Risk assessments of gear loss and impact is obligated. Where identified to have been lost, the intent is that gear loss is minimised and where possible gear recovery strategies implemented.
Responsible Fishing Scheme (RFS) Standard (Crewed Vessel RFS Standard Final Version 7)	Explicit	The requirements/criteria obligate members to have procedures in place to avoid losing gear however the standard doesn't evaluate impacts of ghost gear (ALDGF).

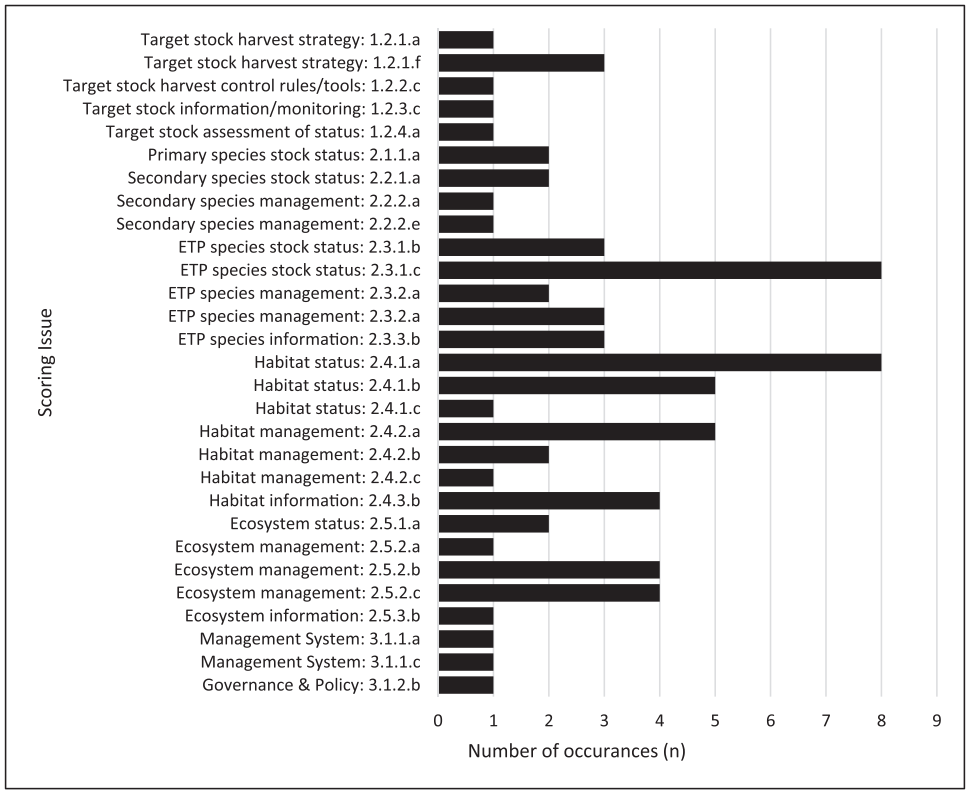

Fig. 1. Chart showing frequency of ghost gear consideration (n) by scoring issue in assessment reports evaluated.

In this context, CAB team members referenced the challenges in obtaining information on gear loss coupled with the challenges in equating gear loss to cryptic mortality of target/bycaught species. The result would be that the issue would remain somewhat undetected in catch profiles and so wouldn't surface within assessment reports.

3.2. Policy Development

3.2.1. Stakeholder engagement

The most important outcome of 2020's public consultation was overall support for more explicit ghost gear consideration by the standard (Fig. 2) but there was no consensus in how the standard should change to support this outcome. It was recognised by most stakeholders that ghost gear impacts are hard to measure, so are hard to quantitatively assess. From an assessment perspective, having robust ghost gear management in place supported by information was considered a good fisheries outcome. Stakeholders raised several key challenges posed by any new requirements on ghost gear management: some responders cited (30% of responses) "a lack in adoption of ghost gear measures linked to a lack of reporting or monitoring measures" or general "lack of data" on loss (16% of responses). Other respondents (25% of responses) reported "concerns over ghost gear scoring in assessment reports" linked to the diversity in gear types, fishery scenarios and gear loss levels. The "increased cost for fisheries" (11% of responses) linked to "adding complexity/raising the assessment bar" also came up as a theme of challenge by respondents.

The consultation surfaced many examples of best practice management of ghost gear. The strongest theme highlighted in responses (59% of responses) to a question about best practice, was "gear loss prevention, supported by a combination of ghost gear mitigation and gear recovery". Respondents also highlighted that lost or abandoned Fish Aggregating Devices (FAD) should also be managed through any new ghost gear criteria.

Most respondents who "Agreed" or "Strongly Agreed" (89% of

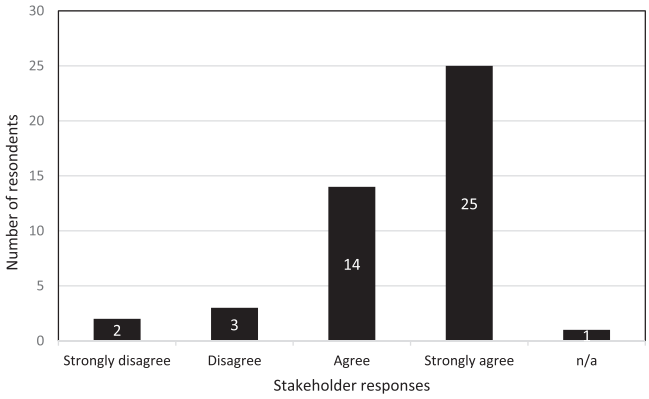

Fig. 2. Likert plot of responses to 2020 survey question regarding whether respondents agree with the sentiment that "ghost gear impact should be explicitly considered within a revised Fisheries Standard".

responses) that ghost gear impact should be explicitly considered within the standard, cited an importance to manage ecological impacts. Within this broad theme of ecological protection, some common sub-themes noted by respondents were a need to manage, "ETP entanglement", "marine mammal entanglement" and "marine plastic". Respondents (11% of responses) who "disagreed" or "strongly disagreed" did so on the basis ghost gear impact was not considered "a priority issue in revised standard" or that any such measure to address the problem "may penalise fisheries with good monitoring in place".

In 2021, feedback from the public consultation was generally neutral to positive across questions for the proposals. In general, NGOs, supply chain actors, academics and CABs reflected positive sentiment towards proposals (Fig. 3). Themes of respondents supportive of proposals (41% of all responses) reflected general agreement with structure and focus of draft requirements. This was linked to acknowledgement of advances in

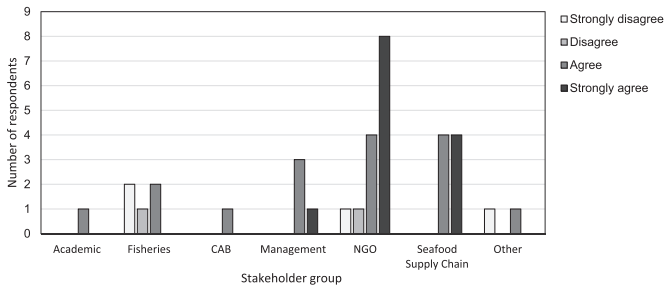

Fig. 3. Likert plot of *acceptability* of preferred proposal (new management requirement directing ghost gear management) by stakeholder group responding to the 2021 consultation.

recognition of ghost gear impact and mitigation. However, several of these supportive respondents (17% of all responses) highlighted concerns around potential ambiguity of requirement wording and a need to improve clarity.

In general, commercial fisheries reflected negative sentiments towards proposals. For example, 17% of all responses to questions on acceptability of new proposals reflected negative sentiment (Fig. 3). Of these respondents, most had identified as commercial fisheries. Themes highlighted included concerns around the "duplicative structure leading to depression of Principle 2 scores", perceived additional complexity and ambiguity of some of the proposed requirement language leading to increased objection risks. Respondents stressed the need for "case studies" to help clarify understanding of requirement application. Further, there were perceptions of additional costs linked to additional data and management needs.

Parts of the proposal which received the most positive sentiment were the elements dealing with abandoned or lost drifting Fish Aggregating Devices (FADs). For example, 80% of respondents found it acceptable that lost or discarded FADs be included in the proposals to manage ghost gear. Parts of the proposal which received the most negative sentiment were in response to impacts on fisheries in the MSC programme and fisheries looking to join. Approximately 43% of respondents disagreed with the sentiment that proposals will make it easier for new fisheries to become certified or stay certified. Like with previous consultations, themes highlighted by responses were characterised by perceived and/or actual additional information and management needs which may increase costs. All stakeholders highlighted a need to ensure that requirements and guidance [36] were clear.

Sentiment of CABs, commercial fisheries, supply chain representatives and some governance/management stakeholders responding to the final public consultation in 2022 were slightly more negative compared to 2021. For example, 54% of respondents disagreed with sentiment that the proposal was acceptable, albeit that many of these respondents agreed with the importance of dealing with the problem of ghost gear. The proposal was slightly more resolved than in previous consultations so these stakeholders could better identify some perceived challenges of the revisions. In line with previous feedback these challenges were represented by perceived increased cost and capacity concerns linked to added information and management needs. Stakeholder groups including NGOs, academics, consumers, and other standard setters generally reflected a positive sentiment to proposals in line with previous feedback.

3.2.2. Impact assessment

The impact assessment evaluation supporting this policy project are covered in Mclennan et al. [40] and Mclennan [39]. The results discussed below summarise these.

The business-as-usual (BAU) scenario analysis showed that ghost gear impacts were addressed indirectly in the MSC Fisheries Standard (v2.0) through vague guidance leading to incorrect and ineffective outcomes. Furthermore, outcomes are not reflective of advances in best practice management. The option, whilst feasible for some assessment teams and fisheries, was considered unacceptable by many stakeholders.

The impact assessment demonstrated that the preferred option resolves all issues raised by stakeholders and identified by the policy development process. Additionally, this work confirmed that proposed changes would achieve the policy objectives through requiring a dedicated management strategy informed through evidence about impact and best practice. It resolves the issues identified in the project via i) revision of requirements in Principle 1 to explicitly include consideration of impact of ghost gear and ii) the introduction of a new scoring issue (SI) requiring fisheries to implement a management strategy to minimise ghost gear (including lost or discarded FAD) and its impact on Principle 2 (Table 3 and Appendix A). This SI is replicated within In-scope species, Endangered, threatened or protected and out-of-scope species (ETP/OOS), and Habitats components. Best practice is clarified through new guidance and definitions.

All issues raised during consultation and pilot testing have been addressed through revisions to the proposals. The option is very effective at meeting MSC's policy objectives and as such very acceptable to their stakeholders. The option will strengthen auditability (relative to BAU) and set clear expectations for fisheries entering the programme and those seeking recertification. Furthermore, whilst emphasising that fisheries should implement best practice (e.g., ghost gear preventative measures), the option avoids prescription so is scalable and thus feasible for fishery partners. The option does add complexity via new scoring issues and there are some minor accessibility concerns for jurisdictions who don't manage ghost gear, including FADs, however this is offset by the improvement in fishery outcomes.

4. Discussion

The changes to the Fisheries Standard respond to the problem of ghost gear in several important ways. Firstly, fisheries will now be required to explicitly assess and manage ghost gear impact on target stocks, on bycatch (in-scope or ETP/OOS species) and on habitats. These components were chosen to ensure this assessment and management sufficiently covers all ecosystem receptors at risk from ghost gear impact. This approach aligns with the ecosystem-based management approach enshrined within the MSC Fishery Standard [8].

The UN Fish Stocks Agreement requires States and Regional Fisheries

Table 3
Principle 2 ghost gear requirements of the preferred policy option [8].

Principle 2 Scoring component	Performance indicator (PI)	Scoring issue (SI)	Scoring guidepost (SG)		
			SG60 Minimum acceptable	**SG80** Best practice	**SG100** State of the art
In-scope species Endangered, threatened or protected species (ETP) and out-of-scope species (OOS) Habitats	2.1.2 2.2.2 2.3.2	Ghost gear management strategy	There are measures in place, if necessary, for the Unit of Assessment that are expected to minimise ghost gear and its impact on [in-scope species; ETP/OOS species; habitats].	There is a partial strategy in place, if necessary, for the Unit of Assessment that is expected to minimise ghost gear and its impact on [in-scope species; ETP/OOS species; habitats].	There is a strategy in place, if necessary, for the Unit of Assessment that is expected to minimise ghost gear and its impact on [in-scope species; ETP/OOS species; habitats]

Management Organisations (RFMOs) to minimise pollution and catches by ghost gear specifically [34]. The FAO Code of Conduct for Fisheries [44] directs states to minimise gear loss and ghost gear impact. This intent has been codified within the MSC Fisheries Standard since its inception in 1999, as articulated in MSC's Principles and Criteria [45]. The research and policy analysis undertaken during this project showed that the Fishery Standard, v2.01 treated ghost gear issues implicitly which does not align with the original articulation and intent of the MSC Principles and Criteria (and FAO Code of Conduct by extension) and is insufficient in terms of the current scope and scale of the ghost gear challenge.

The second important element of the change has been *how* best practice is now codified within the standard. Operationalising best practice in an outcome-based fisheries standard generally absent of any prescribed management response measure represented a challenge. Within Principle 2, fisheries management responses are generally categorised as "measures", "partial strategy" or "strategy". "Measures" represent "minimum acceptable practice" achieving a score of SG60; "partial strategy" represent "best practice" achieving a score of SG80 and "a strategy" represents "state of the art management" achieving a score of SG100. The difference in categories generally relates to the difference in quality, scope and coherence of management responses, with SG100 being the highest score possible. The project team designed the policy proposal to make use of this improvement pathway and combine it with application of a ghost gear management hierarchy, including referencing several best practice examples. The intent is that fisheries' ghost gear measures require at least one form of preventative measure to achieve SG60 (Table 1) and one or more preventive actions working together to prevent ghost gear to achieve SG80. Ghost gear management strategies (SG100) should combine preventive measures with mitigation or remediation to minimise impact. Whilst this improvement pathway is not prescriptive, it succeeds in directing management action through a best practice lens focusing proactive measures at source of the ghost gear issue.

Another important element to tackle was the management of lost and abandoned FADs (both anchored and drifting). Lost and abandoned FADs represent significant risks for marine ecosystems through ghost fishing, species entanglement and habitat impacts [46,47]. The prevalence and scale of FAD loss is also understood to be high and a major contributor to marine litter – a study, Consoli et al. [47] estimated that approximately 1.6 million anchored FADs were abandoned in the Mediterranean Sea between 1961 and 2021. They have also been characterised as representing some of the highest ghost gear risks for marine ecosystems relative to other gear types and components [43]. Whilst the Fisheries Standard v2.01 does direct assessment of FAD impacts (e.g., ghost fishing impacts) through generalised requirements on unobserved mortality and habitat impact, there is no explicit focus. This was also a clear stakeholder issue prevalent in every consultation (approximately 80% of respondents): most respondents emphasised a need for changes to address the ghost gear risks from FADs. In response, the MSC incorporated an explicit FAD management element into the revised requirements. The intent directed by the changes is that all ghost gear impacts of lost and abandoned FADs need to be explicitly assessed and managed to minimise impact on Principle 2 species and habitats. Like other aspects of the policy, FAD management will be framed by the ghost gear management hierarchy; additionally, some examples of best practice management have been highlighted (Appendix A). One relatively small but important challenge was that FADs were not formally defined as a "fishing gear" by the Fisheries Standard so would not be ordinarily covered by the *ALDFG* framed ghost gear definition. This was resolved through expanding the ghost gear definition to cover operational components of fishing gear which included FADs.

The FSR changes mean fisheries in the MSC programme and those looking to join will need to better evaluate ghost gear impacts and, where evident, apply management strategies aimed at resolving these. As of May 2023, any new fishery entering the MSC programme will need to apply these requirements while currently certified fisheries will have a maximum of 6 years to apply them[8]. These management strategies should emphasize ghost gear avoidance, with higher performance scores achieved when strategies are supplemented with mitigation or remediation efforts. In practice this also means that information on ghost gear prevalence in fisheries needs to be collected and better resolved. To help illustrate how the new requirements will impact MSC fisheries the MSC have included a ghost gear scoring scenario within Appendix B.

With approximately 15% of global catches certified, comprising 539 fisheries (as of October 2022), to the MSC Fisheries Standard, there will be a significant number of fisheries that may need to strengthen the way they manage ghost gear in response to these changes. In this context our research and policy development work has highlighted that static gear fisheries (e.g., pot, trap, longline and gillnet) and fisheries using drifting FADs (e.g., tropical tuna purse seine fisheries) are more likely needing to adjust to the ghost gear revisions than other gear types. This is linked to higher inherent rates of loss and impact compared to active or towed gears. In relative terms, these fisheries comprise a significant proportion of MSC fisheries. For example, static gear fisheries comprise around 20% of fisheries currently engaged in the MSC programme (i.e., in-assessment or certified).

Stakeholders responding to consultations highlighted the *expert judgement* of CABs applying the revised ghost gear requirements represented a risk for assessment consistency and effectiveness. These concerns are not new and are not limited to these requirements – this has been raised in numerous submissions to the MSC, in response to wider FSR consultations and has been the subject of numerous objections to individual fishery certifications. In this case, concerns have focussed on potential ambiguity around the term "negligible" as it relates to ghost gear impact. For context the requirements are set up to direct fisheries to minimise ghost gear and its impact, "*to the point where the risk of ghost fishing or ghost gear impact are either demonstrably absent or negligible*" [8]. To help CABs apply this "negligible" concept consistently, the MSC defined specific ghost gear risk considerations regarding its potential impact on vulnerable species and sensitive habitats.

The MSC decided against codifying a more precise definition for *negligible impact* given the risk of unintended consequences. This relates to the fact that a link between the prevalence of ghost gear and its impact on different ecosystem components varies extensively between fishing scenarios and often requires case specific consideration. An example to help illustrate this point: a single string of lost lobster pots in the eastern Canadian waters may cause population level impacts on critically endangered species such as the North Atlantic right whale. However, this same level and type of gear loss elsewhere could be considered to have *negligible impact* on the basis that potential gear species interactions are evidenced as being absent or minimal.

Fundamentally some expert judgement will always be an important element of Fisheries Standard application given the variability of fishery types and fishery management frameworks globally. Whilst this may lead to some case specific inconsistency, the MSC assurance system caters for such situations via several ways including training, assessment calibration, peer review, stakeholder engagement and disputes resolution (objection process).

5. Conclusions

Our analysis, research and stakeholder engagement showed that version 2.01 of the Fisheries Standard was not driving effective consideration or management of ghost gear impact within MSC Fisheries. This work also showed that this version of the Fisheries Standard was outdated in relation to current best practices to assess and manage ghost gear impacts. These factors motivated for changes to the Fisheries Standard aimed at improved on-the-water management of ghost gear impact.

The policy development process underpinning the changes to the Fisheries Standard has been a comprehensive undertaking over the last 5

years. Every step in the policy development journey helped contribute to the scope, design and intent of MSC's new ghost gear requirements. The intention of documenting this policy project here is to help others involved in responding to the ghost gear issues.

Through the Fisheries Standard and ecolabelling programme, MSC will lever positive on-the-water improvements, improving ocean health and helping to contribute to UN SDGs and other global initiatives tackling the ghost gear challenge.

CRediT authorship contribution statement

Shaun McLennan: Conceptualisation, Investigation, Methodology, Research, Formal analysis, Data curation, Writing – original draft, Writing – review and editing, Visualization, PRoject administration. **Beth Polidoro**: Conceptualization, Writing – original draft preparation, Writing – review & editing. **Tim Huntington**: Investigation, Writing – review & editing. **Rod Cappell**: Investigation, Writing – review and editing. **Victor Restrepo**: Writing – review & editing, Supervision. **Karen Mundnich:** Investigation, Writing – review & editing, Project administration. **Ernesto Jardim:** Conceptualization, Writing – original draft preparation, Writing – review & editing, Supervision, Project administration.

Data Availability

Data will be made available on request.

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Declaration of interests

None.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2023.105840.

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