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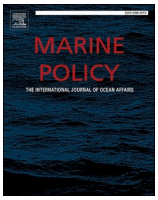

Changing behavior: Can intervention design from the public health sector help solve the problem of fishing gear conflict?

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ABSTRACT

Abandoned, lost, or otherwise discarded fishing gear is associated with significant environmental and socio-economic impacts. Gear loss can be attributed to environmental and operational factors. Gear conflict, which can result in the loss of gear due to interactions within or between fleet métiers, is a significant contributor to gear loss in some fisheries. Traditionally interventions aiming to reduce the occurrence of gear conflict have been designed without a systematic approach and with minimal analysis of the fisher behaviors which lead to gear conflict. This study uses the Behavioral Change Wheel (BCW), a well-established intervention design framework originating from the UK health sector, and applies it for the first time in a fisheries management context in an attempt to understand the specific intervention functions and policy categories which could be used to reduce or avoid the occurrence of gear loss through gear conflict. Through a series of open-ended interviews with static and mobile fishers, ten behaviors were identified which were associated with either the prevention or mitigation of gear conflict (communication between sectors/individuals, marking fishing gear, moving gear when/if requested, adjusting fishing patterns to account for known gear positions, adherence to spatial separation agreements, regular gear maintenance, regular hauling of static gear, reporting snagged static fishing gear, bringing snagged fishing gear back into harbor, and attempting to locate lost fishing gear). While some of these behaviors (such as sharing details of fishing activities and locations) were found in both static and mobile fleet métiers, other behaviors were unique to specific fleet segments (e.g. gear marking behavior from static gear fishers). Analysis of the behavioral subcomponents of each behavior through the BCW framework reveal that intervention functions targeting fisher social and physical opportunities and automatic and reflexive motivations would be most effective when attempting to reduce the occurrence of gear loss between static and mobile métiers. Potential policy categories that would support this work include the introduction of guidelines, fiscal measures, regulation, legislation, environmental/social planning, and service provision- for example, the creation of behavioral contracts by fishers, enforced spatial management guidelines, and the creation of support structures for part-time fishers.

1. Introduction

1.1. The issue of abandoned, lost, and discarded fishing gear

Abandoned, lost, or discarded fishing gear (ALDFG) is associated with a range of negative environmental and socio-economic impacts including ghost fishing and entanglement [1,2], benthic disturbance and smothering [3,4], degradation into microplastics [5], and navigational hazards [6]. ALDFG is thought to account for less than 10% of total global marine debris by volume [7], however oceanic currents and the durability of synthetic materials mean that the impact of ALDFG can occur away from where the gear is lost [5]. Studies have found ALDFG can travel considerable distances and accumulate in high densities [8].

Gear loss, abandonment, or discarding can be either accidental or purposeful and is subject to both environmental and operational factors including severe weather [5,9], snagging on submerged features such as wrecks or rocks [9–11], damage by marine organisms [12], poor gear maintenance/improper design [5], intentional discarding or abandonment [5,9,13], interactions between fishing vessels and other marine users [10] and interactions between fleet métiers (also known as gear conflict) [9,10,13].

Gear conflict is a significant contributor to ALDFG. Inadequate spatial separation, a lack of enforcement, and an overallocation of licenses act as high-level pressures that can contribute to increased gear

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conflict [14]. Interviews with Australian and Indonesian fishers reveal that overcrowded fishing grounds and inappropriately or inadequately marked gear are behaviors resulting from these high-level pressures as fishers struggle to retain fishing ground and earn a living despite reduced catches [14].

Interventions aimed at preventing, reducing, or mitigating the impact of ALDFG can be described as either *preventative* (aiming to reduce the occurrence of gear loss, abandonment, or discarding) or *curative* (reducing the impact of ALDFG or removing it from the environment). Both preventative and curative interventions exist across scales, from international legislation (e.g. MARPOL Annex V [18]) to local initiatives (e.g. the 'Derelict Crab Trap Rodeos' in Louisiana) [5,19]. Examples of preventative and curative tools are shown in Table 1.

Preventative measures are considered by fisheries managers and decision-makers to be cost effective as well as well as being preferred by fishers as, unlike curative measures, they are not associated with increased maintenance costs or lowered economic viability [20]. However, preventative measures alone cannot solve the issue of ALDFG [10,19]. It is likely that multiple measures (both preventative and curative) must be employed across different scales for the occurrence and impacts of ALDFG to be reduced. Interventions need to be designed and applied within the context of individual fisheries and consider both environmental and socio-economic factors. The success of interventions rely on a solid understanding of the behavioral components and beliefs which underpin fisher behavior in relation to gear loss, discarding, and/or abandonment [14]. One study which looked at the causes of gear loss identified fisher behaviors of risk-taking, inadequate maintenance of gear, and insufficient training as being some of the key factors leading to ALDFG [14].

1.2. Gear conflict – A UK case study

Within Scotland (UK) gear conflict mainly occurs between the static and mobile fleet segments and is recognized as a serious issue with environmental, social, and economic impacts [15]. The increased demand on spatial pressure due to the growth of other marine industries such as aquaculture and offshore wind, as well as increased effort in some fleet segments, and advances in fishing technology, has concentrated fishing effort in particular areas, leading to an increase in gear conflict within Scottish inshore waters [15,16]. Despite this, existing legislative framework and fisheries management arrangements are inadequate for tackling deliberate acts of gear conflict (which fall under common law and rarely, if ever, meet the evidential standard necessary for the referral to the Procurator Fiscal). A 2015 report by Marine Scotland, the body responsible for fisheries management, revealed there were no statutory requirements for gear conflict avoidance or resolution [15]. Several voluntary agreements and codes of conduct between static gear and mobile sectors exist around the Scottish coastline, however they can be undermined by nomadic vessels who are either unaware or purposefully ignorant of such agreements [15]. Since the 2015 report Marine Scotland introduced new legislation on the marking of static fishing gear in the hopes of reducing accidental gear conflict [16,17].

Table 1
Some preventative and curative measures for ALDFG Adapted from [5].

Preventative	Curative
1. Gear marking	1. Improved portside infrastructure
2. Technology to avoid unwanted or unnecessary contact with benthos	2. Locating and removing of ALDFG from the environment
3. Gear tracking technology	3. Innovations in gear design or materials (e.g., biodegradable panels, bycatch reduction technology)
4. Innovations in gear design or materials	
5. Input controls (i.e., effort controls)	
6. Spatio-temporal restrictions	
7. Training for fishers	

1.3. A novel approach to ALDFG intervention design

The Behavior Change Wheel (BCW) is a synthesis of 19 frameworks of behavior change which supports the systematic design and evaluation of behavior change interventions [21]. The foundation of the BCW is the COM-B model which provides a lens through which behavior can be understood within the context it is carried out [21]. The model breaks behaviors down into the three interacting components: capability, opportunity, and motivation- which themselves can be further divided [21]:

1. Capability: the physical and psychological capability to perform an action (e.g., strength, knowledge, skills)
2. Opportunity: social and physical opportunity to perform an action (e.g., accessibility, acceptability)
3. Motivation: automatic and reflexive (e.g., habits and competing behaviors)

Although the BCW originates from the UK health sector the underlying frameworks are robust enough to allow the framework to be applied "to any behavior in any setting" and at any scale, from individuals to populations [21]. Using open-ended interviews with static and mobile gear fishers, as well as insights from fisheries representatives, the behavioral components of Scottish fishers in relation to gear conflict was explored and used within the BCW framework to identify novel interventions to help tackle the issue of gear conflict.

2. Methods

2.1. Behavior change wheel

The Behavior Change Wheel consists of three layers (see Fig. 1: The Behavior Change Wheel. Image from [23]. Figure usable with permission under Creative Commons Attribution License (http://creativecommons.org/licenses/by/2.0).Fig. 1). The central layer looks at identifying behaviors which could be changed to achieve the desired outcome. The second layer identifies nine intervention functions, the suitability of which ultimately depend on the COM-B analysis. Lastly, the outer layer of the when identifies seven policies that can be used to deliver the intervention function [22].

There are eight stages necessary for systematic intervention design [21]:

i. Defining the problem in behavioral terms
ii. Selecting the target behavior
iii. Specifying the target behavior
iv. Identifying what needs to change
v. Identifying intervention options
vi. Identifying policy categories
vii. Identifying behavior change techniques
viii. Identifying the mode of delivery

For a behavior to change one of the three components (or six subcomponents) which support the behavior must also change. Intervention designers must define the problem and the population of interest (in this case static and mobile fishers) and explore the context in which the behavior is occurring (for example, at sea and onshore) (stage 1). Designers must then select a behavior to target (stage 2) and specify the behavior (stage 3) by considering the impact of changing the proposed behavior, and how the target behavior interacts with other behaviors in the wider behavioral system (the 'spillover' effect). Once this behavior is understood, designers can use the COM-B model in stage 4 to identify what sub-components of a behavior should be targeted as a catalyst of change [21].

Once the target sub-component has been identified, intervention designers must identify appropriate intervention functions and policy

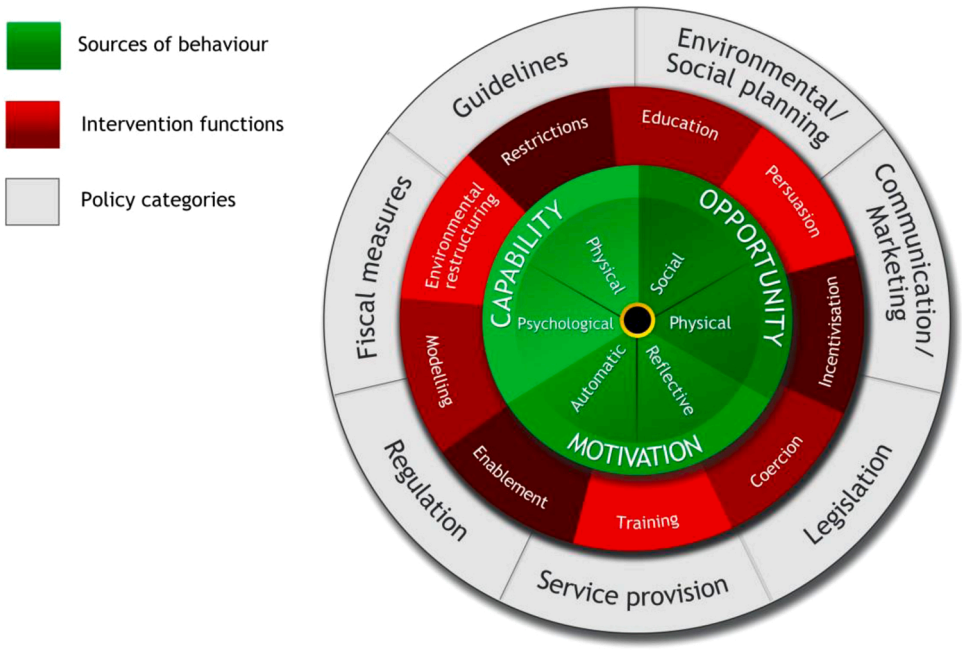

Fig. 1. The Behavior Change Wheel. Image from [23]. Figure usable with permission under Creative Commons Attribution License (http://creativecommons.org/licenses/by/2.0).

categories to achieve the desired change (stages 5). The BCW identifies nine intervention functions which can support behavioral change. These education, persuasion, incentivization, coercion, training, restriction, environmental restructuring, modelling, enablement [21]. The effectiveness of an intervention function in supporting a targeted behavior change is largely dependent on the COM-B analysis- see Table 2.

Once an appropriate intervention function is identified (subject to analyzing the target behavior to be changed- Table 2), a policy category must be chosen to facilitate its delivery (stage 6). The BCW identifies seven policy categories: communication/marketing, guidelines, fiscal measures, regulation, legislation, environmental/social planning, service provision. Some policy categories may be more compatible with particular intervention functions than others- see Table 3.

Upon identifying a suitable intervention policy, the intervention designer must identify a behavior change technique (BCT), the component which catalyzes behavioral change [22]. A BCT must be both observable and replicable. A full list of BCTs is available in Appendix 1- Full list of BCTs As there is no prescribed method for BCT selection, it is important to consider the specific behavior being targeted, and ensure it meets the APEASE criteria (population of interest, affordability, practicability, effectiveness, acceptability, safety, and equity) [24].

2.2. Data collection and analysis

Data was collected from a variety of primary and secondary sources to create a robust understanding of behavior related to gear conflict within Scottish fisheries.

2.2.1. Semi-structured interviews

Semi-structured interviews were conducted with static (n = 3) and mobile (n = 3) fishers from different ports around Scotland, UK. Interviewees were self-selected. Fishers were contacted through their local fishing associations and asked to participate in the study. Interviewees were asked to describe their experiences and perceptions of gear conflict within their fishing areas, as well as to describe the different behaviors they performed to avoid or mitigate gear conflict. Interviewee perceptions and behaviors surrounding specific gear conflict interventions (both preventative and curative) were discussed and defined in behavioral terms [21]. Interviews focused on areas where gear conflict had been reported by the fishing industry as being a major concern.

Table 2
Matrix showing the links between the COM-B model and different intervention functions. Some intervention functions are more likely to support changes in target behaviors than others, depending on the COM-B analysis. Table adapted from [21].

COM-B Components	COM-B Sub-components	Intervention Functions								
		Education	Persuasion	Incentivization	Coercion	Training	Restriction	Environmental Restructuring	Modelling	Enablement
Capability	Physical capability					X				X
	Psychological capability	X				X				X
Opportunity	Social opportunity					X	X	X		X
	Physical opportunity						X	X	X	X
Motivation	Automatic motivation		X	X	X	X		X	X	X
	Reflective motivation	X	X	X	X					

Table 3
Policy categories and their links to intervention functions.

Policy Categories	Definition	Intervention Functions								
		Education	Persuasion	Incentivization	Coercion	Training	Restriction	Environmental Restructuring	Modelling	Enablement
Communication/ marketing	Using media (print, social, broadcast, etc.)	X	X	X	X				X	
Guidelines	Creation of documents to recommend or mandate practice	X	X	X	X	X	X	X		X
Fiscal measures	Increasing or reducing the financial cost			X	X	X		X		X
Regulation	Establishing principles or rules for behavior/ practice	X	X	X	X	X	X	X		X
Legislation	Creating or changing laws	X	X	X	X	X	X	X		X
Environmental/ Social planning	Designing the physical or social environment							X		X
Service provision	Delivering a service	X	X	X	X	X			X	X

Source:Adapted from [21].

Interviews were carried out either in-person at the harborside or over the phone depending on the fisher's preference and location. Where permission was given, interviews were recorded and subsequently transcribed in the qualitative software NVivo to create orthographic transcripts [26]. Where no permission to record and transcribe the interview the interviewer took notes on interviewee responses.

2.2.1.1. Interview design. The use of expert knowledge in data-poor areas is well-established within the field of conservation [26]. However, information collected through interviews can be subject to motivational, accessibility, anchoring/adjustment, and overconfidence biases [27]. Robust survey design can minimize these biases both during the data collection process and when encoding responses [27].

To minimize the potential for these biases, the structure of the interview was based on the expert-elicitation approach outlined by Martin et. al. (2012) [27]. Questions and prompts designed to elicit information from fishers were identified and tested prior to the final interview deployment, and fishers from both static and mobile sectors of the fleet were asked about their own behavior and the behavior of others. However, the sensitive nature of the research topic, combined with asking fishers to recall past events, further increases the risk of bias from reconstruction errors [28,29]. The data collected from fishers was triangulated using other data collected via literature review. A list of the semi-structured questions and prompts can be found in Appendix 2 Questionnaire Questions and Prompts.

2.2.2. Literature review

A literature review on the topic of ALDFG and fisher behavior was carried out. Both published and grey literature was used. Literature was found using keyword searches (made up of broad search terms "Fish* AND (ALDFG OR abandoned OR lost OR discarded OR pollution OR litter)" and "conflict AND (gear OR fish OR vessel OR fleet)". Searches were carried out in Google Scholar and Web of Science. Organizational websites were also searched to identify relevant grey literature.

2.3. COM-B and thematic analysis

Behaviors and behavioral subcomponents (including competing behaviors) associated with gear conflict (either as potentially causing gear conflict or attempting to mitigate or avoid it) were identified and coded into a matrix alongside the COM-B model [21]. Themes from all interviews were identified and coded using an inductive method [26].

Responses from interviews were supplemented by responses from Marine Scotland's consultation on gear conflict [25,27]. These responses were coded in the same method as the interview transcripts. Both interviews and responses from the consultation were used to identify themes through iterative coding.

3. Results

Ten behaviors relating to gear conflict were identified during interviews with fishers and through the literature review. Seven of these were preventative, compared to three of which were curative (see Table 3). Other behaviors relating to gear conflict, such reporting gear losses to relevant authorities are not included in Table 4. While these behaviors are related to gear conflict, they have a broader management

Table 4
Preventative and curative behaviors (and who performs them (i.e. static fishers or mobile fishers), and where the behavior can be performed) identified through interviews with fishers.

Category	Behavior	Who Performs the Behavior	Where the Behavior Is Performed
Preventative	Communication between sectors/ individuals	Static and mobile	Onshore or at sea
	Clearly marking gear	Static	Onshore
	Moving gear if requested	Static	At sea
	Adjusting fishing activity to account for known static gear positions	Mobile	Onshore or at sea
	Adhering to formal and informal spatial separation agreements	Static and mobile	At sea
	Regularly hauling gear	Static	At sea
	Regularly maintaining gear	Static	On shore
Curative	Reporting snagged gear (either reporting to gear owner, relevant fisheries associations, or Marine Scotland)	Mobile	Onshore or at sea
	Bringing snagged gear into the harbor	Mobile	At sea
	Locating lost gear	Static	At sea

purpose and do not directly influence the rate of gear loss/gear recovery.

Of the seven preventative measures, four could be performed by static fishers only, compared to two behaviors which could be performed by both static and mobile fishers, and one behavior which could only be performed by mobile fishers. Curative behaviors, however, can mainly be performed by mobile fishers- with only one of the three behaviors being able to be performed by static gear fishers.

Three of the behaviors identified can be performed either onshore or at sea, while five behaviors can only be performed at sea, compared to two onshore.

3.1. The COM-B model of gear conflict

The sub-components underpinning these behaviors were explored in

Table 5
All behaviors identified by static and mobile fishers and their COM-B components.

Sector	Behavior	Capability		Opportunity		Motivation	
		Physical strength	Psychological Knowledge, skills, stamina	Social Accessible, affordable, socially acceptable,	Physical Sufficient time	Automatic Emotional reactions, desires, impulses, and inhibitions	Reflexive Plans and evaluations
Mobile and Static	Adhering to formal and informal spatial separation agreements	Existence of alternative fishing grounds Existence of spatial separation agreements	Knowledge of spatial separation agreements	Social norm of adhering to spatial separation agreements	Availability of space in alternative fishing grounds Ability to get to alternative fishing grounds	No concept of "ownership" of historical fishing grounds	Belief in benefits of spatial separation agreements
Mobile and Static	Changing fishing behavior based on knowledge of other fishing activities	Existence of alternative fishing grounds	Knowledge of other fishing activities is up to date	N/A	Ability to access alternative fishing grounds	No concept of "ownership" of historical fishing grounds	Planning fishing trip ahead of time
Mobile	Reporting any gear which has been snagged to individuals/ associations	Ability to identify owner of snagged gear (i.e., gear marked appropriately)	Knowledge of how to report snagged gear	Social norm of reporting snagged gear	Time to report snagged gear	No fear of consequences for reporting snagged gear	Belief that reporting snagged gear is the norm and correct course of behavior Understanding of the consequences of reporting snagged gear
Mobile	Contacting associations/ individuals for gear positions	N/A	Knowing who to contact	Social norm of contacting associations and individuals	Adequate time to contact, get responses, and adjust fishing plan as appropriate	Belief contacting associations/ individuals is the correct course of behavior	Intention to contact associations/ individuals
Mobile	Bringing up snagged gear/ returning it to harbor	Physical ability to detangle the gear and bring it aboard (instead of cutting it away) Returning to local harbor at end of trip	N/A	Social norm of returning gear	Adequate time and conditions to detangle gear and bring it aboard instead of cutting it away	No fear of consequences for returning snagged gear	Belief in the benefit of bringing gear to harbor Intention to haul gear Competing behavior: Gear can be cut away or left in situ, or vessel returns to a non-local harbor
Static	Clearly marking gear	N/A	Knowledge of the legislation/rules around gear marking	Social norm of marking gear clearly and according to legislation/rules	N/A	Impulse to properly maintain gear	Planning when gear maintenance can occur
Static	Reporting gear positions to associations/ individuals	Ability to report gear locations regularly (e.g., use of computer or mobile phone)	Knowledge of who to contact	Social norm of reporting gear locations	Time to regularly report gear locations	No fear of information being misused	Willingness to share gear locations Belief sharing gear locations is beneficial Belief gear locations will be treated as confidential and not shared widely
Static	Moving gear if requested	Ability to go to sea to haul gear if requested	N/A	Social norm of moving gear if requested	Existence and availability of alternative fishing grounds Adequate time to move gear	No concept of "ownership" of historical fishing grounds	Intention to move gear if requested
Static	Regularly hauling gear	Ability to go to sea to haul gear regularly	Knowledge of the benefits of hauling gear	Ability to haul gear regularly without losing fishing grounds	Sufficient time to haul the quantity of gear owned on a regular basis	No concept of "ownership" of fishing grounds Concept that hauling gear regularly is correct	Intention to haul gear regularly
Static	Reporting lost gear	N/A	Knowledge of reporting process/ how to report	Social norm of reporting gear losses	Time to go through the reporting process	No fear of consequences when reporting	Belief reporting has benefit

more depth. Interviewees were prompted (see Appendix 2) to discuss the behavioral subcomponents which influenced their willingness or ability to perform the behaviors identified in Table 3. Interviewee responses were organized against the COM-B model of behavior. A full list of all behaviors and behavioral subcomponents identified can be found in Table 5.

3.2. Thematic analysis

Recurring themes were identified in both interview responses and secondary data (e.g., consultation responses [25]). These themes help to contextualize the issue of gear conflict and provide insight into the capabilities, opportunities, and motivations of individuals when it comes to gear conflict.

In addition to the themes of gear loss and recovery, five central themes were identified. Themes were defined as being central if they occurred in the majority of interviews. These five themes were:

1. Spatial pressures
2. Financial cost of gear
3. Fishing effort
4. Fisher/sectoral attitudes
5. Communication

Spatial pressures, including the loss of traditional fishing grounds either as a result of competition with other fishers or the increased activity of other marine users (such as offshore wind) was frequently mentioned as an indirect driver of gear conflict. The theme of loss of fishing grounds were found in all interviews- both static and mobile. The possibility and feasibility of spatial separation measures was common in interviews with mobile fishers. Similarly, the financial costs associated with gear conflict was mentioned in most interviews, with the perception that static gear fishers bore the brunt of the financial consequences of gear conflict. Loss of fishing time was also mentioned due to the time spent attempting to recover gear lost through gear conflict. Both static and mobile fishers perceiving an increase in the fishing effort occurring within their traditional grounds. Linked to this, excessive soak times of static gear was a recurring theme in interviews, with interviewees regarding this as an outcome of increased fishing pressure, competition for space, and the activities of part-time fishers. Fisher/sectoral attitudes were mentioned in all interviews with both static and mobile fishers, with both sides perceiving the other to be somewhat careless when it came to gear conflict. Communication was another common theme, with both sides feeling that communication between sectors was generally good but could still be improved. Communication being influenced by fisher attitude to static or mobile sectors was frequently mentioned.

4. Discussion

Analysis of static and mobile fisher capability, opportunity, and motivation in relation to gear conflict reveals a series of behaviors which can act as targets for intervention to promote positive behavioral change. Understanding the behavioral subcomponents which underpin the target behaviors which can help reduce or mitigate gear loss through gear conflict allows the identification of intervention tools the appropriate policy categories and BCTs which can be used to underpin them [22]. However, some interventions and BCTs are more likely to be successful than others [21], [24]. Further work on the affordability, practicability, effectiveness (including cost-effectiveness), acceptability, safety implications, and equity of the potential interventions outlined must be explored further by decision-makers using consultation with industry and experts [21,28].

It is worth noting that a single intervention may rely on multiple policy categories- for example, the effectiveness of an intervention based in legislation will also rely on the policy category of communication and marketing to be effective [21].

4.1. Identifying and specifying target behaviors- what needs to change?

Ten behaviors relating to gear conflict were ultimately identified (Table 5), however thematic analysis of responses led to the identification of three behaviors which were perceived to be the best candidates for behavioral change in relation to gear conflict due to their perceived effectiveness in reducing the occurrence of gear conflict (Table 6). These behaviors were: a lack of reporting when gear conflict occurs, excessive soak times for static gear, and poor communication between individuals. These findings are echoed in data from secondary sources [25].

For each behavior COM-B analysis reveals the behavioral subcomponents which need to be changed for the desired behavior to occur (Appendix 3). Interviews with fishers, as well as secondary data sources, were used to identify which behavioral subcomponents were needed to change. The relevant intervention functions and potential policy categories were identified (Table 2 and Table 3), along with some examples of prospective BCTs. Some BCTs (and their relevant policy categories) will be more appropriate than others [21].

4.1.1. Improving communication between métiers

4.1.1.1. Static fishers. COM-B Analysis of static fisher behavior in relation to communicating the positions of their gear reveals potential behavioral changes in their social opportunities, and automatic and reflexive motivations (Table 7).

All nine intervention functions have the potential to support these behavioral changes. Changes to social opportunities would be supported by training, restriction, environmental restructuring, and enablement while automatic and relative motivations are supported by education, persuasion, incentivization, coercion, training, environmental restructuring, modelling and enablement, and education, persuasion, incentivization and coercion respectively.

All seven policy categories have potential to be used to deliver an intervention to promote gear location sharing by static fishers. Breaking these down further into potential BCTs which could be used suggests that specific interventions around social comparisons, identification of self as a role model, and behavioral contracts may facilitate positive behavioral change (see Appendix 1- Full list of BCTs). For example, introducing environmental prompts (either in the wheelhouse or harborside) encouraging fishers to report their gear locations will help alter the social opportunity of fishers and facilitate the perception that sharing gear positions is the norm. Concerns over how gear positions may be used (a behavioral barrier founded in fisher automatic motivations) could be alleviated through the introduction of behavioral contracts between static and mobile fishers.

4.1.1.2. Mobile fishers. Similar to static fishers, COM-B behavioral analysis suggests interventions targeting social and physical opportunities as well as automatic and reflective motivations could lead to positive change in relation to communication to prevent the occurrence of gear conflict (Table 8).

Table 6
Behaviors (including type, who performs it, and where the behavior is performed) identified through interviews and literature review as being important in relation to gear conflict.

Category	Behavior	Who Performs the Behavior	Where the Behavior Is Performed
Preventative	Communication between sectors/ individuals	Static and mobile	Onshore or at sea
	Regularly hauling gear	Static	At sea
Curative	Reporting snagged gear (either reporting to gear owner, relevant fisheries associations, or Marine Scotland)	Mobile	Onshore or at sea

These changes targeting social and physical opportunities could be supported by training, restrictions, environmental restructuring, modelling, and enablement, while changes targeting automatic and reflective motivation could use the intervention functions of education, persuasion, incentivization, coercion, training, environmental restructuring, modelling, and enablement (Table 2). All seven policy categories could be used to deliver interventions to facilitate increased communication from mobile fishers (Table 3).

The BCTs which could potentially be employed to change mobile fisher include prompts and cues (e.g., notice in wheelhouse with contact details for different fisheries associations), regularly practicing or rehearsing the behavior needed (e.g., contacting relevant static fishers or associations before leaving port), identification of self as a role model (e.g., identifying as a "communication champion"), and the creation of behavioral contracts.

4.1.2. Regularly hauling gear

Changes to the behavioral subcomponents of individuals social and physical opportunities, and their automatic and reflective motivations are required to encourage the behavior of regularly hauling fishing gear (see Table 9). Five intervention functions could support these changes: training, restrictions, environmental restructuring, modelling, and enablement (Table 2).

These intervention functions can be supported by the policy categories of guidelines, fiscal measures, regulation, legislation, environmental/social planning, and service provision (Table 3). Some possible interventions to encourage regular gear hauling include regulation or legislation around soak times for static fishing gear (with the intent to alter fisher automatic motivations) or establishing behavioral contracts to encourage fishers to regularly haul gear. More work is needed to further explore the behavior and behavioral sub-components of part time static gear fishers as this may influence the analysis.

4.1.3. Reporting snagged gear

For mobile fishers to report the location and details of gear they have snagged and returned to the sea changes need to occur in their social opportunities and automatic motivations (Table 10).

Social opportunities surrounding reporting include perceiving that reporting snagged gear is the social norm. Altering this perception can be done with via four intervention functions: training, restrictions, environmental restructuring, and enablement (Table 2).

There are several policy categories which have the potential to support delivery of interventions targeting behavioral change in reporting snagged fishing gear. These include guidelines, fiscal measures, regulation, legislation, environmental/social planning, and service provision (Table 3). Potential interventions may include the creation of behavioral contracts and environmental cues to create a social norm of reporting gear and strengthening regulations and legislation around reporting snagged gear. Specific BCTs which could be explored include communication campaigns around how to anonymously report snagged gear, regularly rehearsing reporting snagged gear, and the introduction of behavioral contracts.

5. Conclusion

Gear conflict is a significant contributor to ALDFG, and one which could be largely avoided by interventions designed to minimize the likelihood of interaction between fleet métiers. This study reveals interventions designed to target fisher opportunities (both social and physical) and motivations (both automatic and reflexive) are likely to be the most effective in reducing the occurrence of gear loss through gear conflict. These interventions could be supported by several policy categories including guidelines, fiscal measures, regulation, legislation, environmental/social planning, and service provision. While some of these policy categories (such as guidelines, legislation, and environmental planning) have been attempted or proposed in relation to gear conflict previously, others are more uncommon [19,20].

This study demonstrates that systematic intervention design can be used within a fisheries management context. Developing this work further will help provide novel solutions to the issue of gear conflict, as well as providing a systematic framework for intervention evaluation. While outside the scope of this study, the BCW framework could be easily adapted to look at intervention design to prevent or mitigate gear loss from other sources- such as environmental conditions.

Broader sample size and field observations of behavior would be valuable in further understanding the underlying behavioral components which underpin gear conflict (especially in regard to the role part-time static gear fishers play in gear conflict). Self-reported behavior may not fully reflect actions of the individual when performing the behavior [23]. Further work in the form of a larger sample size, in-situ observations of both static and mobile fishers, and workshops with fisheries managers and decision-makers are needed for a full list of potential interventions and their appropriateness to be explored.

Author statement

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Declaration of Competing Interest

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Data availability

The data that has been used is confidential.

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Ethics

Ethical approval was granted by [[university]]. See Additional Files.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2023.105527.

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