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Review of the monitoring and regulatory landscape for bycatch in UK marine waters

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For: OEP

Date:
22 February 2025

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Produced by MarFishEco Fisheries Consultants Ltd

for

The Office for Environmental Protection

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Executive Summary

Bycatch—the unintentional capture of non-target species during fishing operations—continues to represent a critical pressure on the UK's marine ecosystems. Its impacts ripple through biodiversity, food web dynamics, and benthic habitats, posing a significant challenge to achieving Good Environmental Status (GES) under the UK Marine Strategy. The target to achieve or maintain GES in UK marine waters is set out in the Marine Strategy Regulations 2010 (MSR), which transpose the Marine Strategy Framework Directive (MSFD) into domestic law and now apply as EU-derived assimilated law under the Retained EU Law (Revocation and Reform) Act 2023. Addressing bycatch is essential to fulfilling this commitment and ensuring the health of UK marine ecosystems.

The UK has established a robust regulatory framework to tackle bycatch, anchored in key legislation and policies such as the Fisheries Act 2020, the Bycatch Mitigation Initiative (BMI), and the ongoing implementation of Fisheries Management Plans (FMPs). These policies align with international commitments under the OSPAR Convention and retain the MSFD framework to ensure a consistent and effective approach. However, while the framework itself is comprehensive, significant issues arise from the lack of a joined-up approach to its implementation. This fragmentation undermines enforcement, compliance, and, ultimately, the success of bycatch reduction and mitigation efforts.

The challenge is compounded by shortcomings in monitoring and evaluation. Although substantial bycatch data is collected in specific contexts, the absence of central repositories prevents the UK from obtaining a holistic view of progress toward GES objectives. Monitoring efforts are often limited to specific fisheries, regions, or taxa, with insufficient mechanisms in place to evaluate change or success at a national level. Without standardized, comprehensive data collection and integration, it is difficult to assess whether the regulatory framework is delivering the intended outcomes.

Climate change and industrial expansion exacerbate the problem. Shifts in species distributions, altered ecosystem interactions, and the displacement of fishing activities into previously unfished or sensitive areas heighten the risk of bycatch and complicate mitigation strategies. Moreover, while substantial attention is paid to particular species, such as cetaceans and seabirds, fish species bycatch—pervasive across UK fisheries—remains under-prioritized despite its significant impacts on benthic habitats and ecosystem stability.

To address these challenges, the UK must take decisive actions to ensure the effectiveness of its bycatch mitigation strategies:

- Strengthen Policy Implementation: Introduce binding targets within the BMI and FMPs, supported by enforceable timelines, measurable outcomes, and mechanisms to ensure compliance and accountability.
- Enhance Monitoring and Evaluation: Develop a standardized and centralized repository for bycatch data to provide a UK-wide perspective on bycatch trends, progress, and challenges.

- Expand Remote Electronic Monitoring (REM) and observer programs, ensuring broad geographic and sectoral coverage.
- Adopt a Comprehensive Approach to Bycatch: Broaden the focus to include fish species bycatch alongside marine megafauna to address ecosystem-wide impacts and support benthic and food web health.
- Promote Joined-Up Implementation: Foster greater coordination among regulatory bodies, regional authorities, and fisheries managers to ensure consistent enforcement and seamless integration of bycatch policies across the UK.
- Incorporate Adaptive Management: Equip policies with the flexibility to respond dynamically to climate-driven changes in species behaviour, distribution, and ecosystem interactions.
- Encourage Collaboration and Innovation: Partner with fishers, NGOs, and policymakers to co-design practical, scalable mitigation measures supported by financial incentives and innovative technologies.

Bycatch is not only an environmental challenge but also a socio-economic one, directly affecting fisheries sustainability, marine biodiversity, and the livelihoods of coastal communities. Tackling it effectively will require a unified and data-driven approach that prioritizes integration, monitoring, and stakeholder engagement. By maintaining its alignment with GES principles and leveraging its legislative frameworks, the UK has the tools to lead in sustainable fisheries management. A more cohesive and coordinated approach to bycatch mitigation will enable the UK to protect its marine ecosystems while supporting resilient and sustainable fisheries for future generations.

Contents

Glossary of Acronyms

- **ACAP** – Agreement on the Conservation of Albatrosses and Petrels
- **AEWA** – Agreement on the Conservation of African-Eurasian Migratory Waterbirds
- **ASCOBANS** – Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
- **BATmap** – Bycatch Avoidance Tool
- **BMP** – Bycatch Monitoring Programme
- **CEMP** – Coordinated Environmental Monitoring Programme
- **CMS** – Convention on the Conservation of Migratory Species of Wild Animals
- **DAERA** – Department of Agriculture, Environment and Rural Affairs
- **DEFRA** – Department for Environment, Food and Rural Affairs
- **EU CFP** – European Union Common Fisheries Policy
- **FAO** – Food and Agriculture Organization
- **FMP** – Fisheries Management Plan
- **GES** – Good Environmental Status
- **GSSI** – Global Sustainable Seafood Initiative
- **IUU** – Illegal, Unreported, and Unregulated (fishing)
- **ICES** – International Council for the Exploration of the Sea
- **IFCA** – Inshore Fisheries and Conservation Authority
- **IWC** – International Whaling Commission
- **JFS** – Joint Fisheries Statement
- **JNCC** – Joint Nature Conservation Committee
- **MMO** – Marine Management Organisation
- **MPA** – Marine Protected Area
- **MSFD** – Marine Strategy Framework Directive
- **MSC** – Marine Stewardship Council
- **OSPAR** – Convention for the Protection of the Marine Environment of the North-East Atlantic
- **OEP** – Office for Environmental Protection
- **PETS** – Protected, Endangered, and Threatened Species
- **REM** – Remote Electronic Monitoring
- **ROV** – Remotely Operated Vehicle
- **SMASS** – Scottish Marine Animal Stranding Scheme
- **SSB** – Spawning Stock Biomass
- **UKMS** – UK Marine Strategy
- **WGBYC** – Working Group on Bycatch of Protected Species
- **WWF** – World Wide Fund for Nature

CHAPTER 1. Good Environmental Status and Bycatch

What is GES?

The marine environment provides valuable natural resources, supporting diverse wildlife, stabilising the climate, and generating employment opportunities. In addition, coastal ecosystems play a crucial role in protecting communities from extreme weather events, while various coastal and marine activities sustain the livelihoods of many Europeans.

Despite their importance, marine ecosystems are increasingly under threat from unsustainable practices and human activities. Growing demands for food, shipping, and offshore renewable energy production, among other uses, intensify pressures on these ecosystems. These pressures contribute to pollution, biodiversity loss, seabed degradation, overexploitation, the spread of non-native species, marine litter, underwater noise, and the impacts of ocean warming and acidification.

Key assessments, such as the UK Marine Strategy (UKMS)[1] evaluation and the 2023 OSPAR Quality Status Reports[2], reveal the scale of these challenges. The UK failed to achieve GES for 11 out of 15 indicators in 2019, and early indications suggest that this trend is unlikely to reverse in the upcoming 2024 UKMS assessment (as of February 12th, 2025, this remains unpublished). Biodiversity indicators, particularly those related to birds, seals, and cetaceans, highlight significant pressures such as habitat degradation, prey availability, and, critically, bycatch.

To address these challenges, the European Union established a comprehensive framework to protect and conserve its coasts and seas while promoting their sustainable use. Central to this effort is the MSFD,[3] which aims to achieve GES for EU marine waters and safeguard the resources underpinning marine-related economic and social activities. The MSFD establishes the legally binding implementation of the ecosystem-based approach for managing Europe's marine environment. While the MSFD and GES are originally borne from EU legislation, the UK continues to follow these post-Brexit under the Marine Strategy Regulations (2010), which originally transposed the MSFD into domestic law and now apply as EU-derived assimilated law pursuant to the Retained EU Law (Revocation and Reform) Act 2023.[4]

GES Descriptors and Indicators

The concept of GES is described in the MSFD through 11 descriptors that encompass various aspects of marine ecosystems, ranging from biodiversity to human-induced pressures (Table 1). These descriptors are tools that can be used for the collective aim of ensuring that marine ecosystems are safeguarded while supporting sustainable use. Each descriptor includes specific criteria and associated indicators, which together form a structure for monitoring and evaluation of GES. Indicators are technical tools designed to quantitatively or qualitatively measure the status of criteria, while criteria serve as benchmarks for assessing the degree to which GES has been achieved.

For example, Descriptor 1 (Biodiversity) includes criteria such as the population status of marine species, with indicators like the abundance and distribution of seals or seabirds. This standardised structure allows policymakers and managers to systematically track progress, identify gaps, and prioritise actions for improving marine environmental health. However, data from the OEP's 'Marine Strategy Insights for England and Northern Ireland' underscores the significant levels of bycatch in marine megafauna species that indicate there is still considerable work for the UK to do (see Box 1).

Box 1. A snapshot of the bycatch issue from the OEP commissioned report "Marine Strategy Insights for England and Northern Ireland: A Data-Driven Review" (2024).

1. **Impact on Birds**:
    - An estimated 2,200–9,100 fulmars are caught annually in offshore longline fisheries.
    - Approximately 1,800–3,300 guillemots are caught each year in static net fisheries.
    - Bycatch remains a leading cause of seabird population declines, exacerbating threats like habitat loss and prey scarcity.
2. **Impact on Seals**:
    - In 2020, an estimated 356 seals were bycaught in UK fisheries, primarily juvenile grey seals, marking a 27% decrease from the previous year. However, confidence intervals reveal significant uncertainties in these estimates.
    - Seal bycatch occurs predominantly in the southwest of the UK, with grey seals migrating from Scotland's Western Isles being most affected.
3. **Impact on Cetaceans**:
    - Harbour porpoise and common dolphin bycatch rates in the UK exceed acceptable thresholds.
    - Fisheries remain the leading cause of cetacean mortality, driven by entanglement in fishing gear.

Bycatch

Bycatch, the unintended capture of non-target marine organisms,[5] can represent a significant threat to marine biodiversity and challenges the achievement of GES. Bycatch can deplete vulnerable species,[6] disrupt ecosystem balance,[7] and undermine the sustainability of fisheries.[8] Addressing this issue is critical for the effective management of UK marine ecosystems. The management of fisheries bycatch in UK marine waters is governed by a framework of regulatory and policy measures that reflect national, regional, and international commitments to sustainable fisheries. Bycatch poses significant ecological and economic challenges, making its effective management a key priority in marine conservation and fisheries governance. This report seeks to assess how the MSFD GES framework is relevant to bycatch, critically evaluate the existing regulatory and policy frameworks within the UK to address bycatch, synthesise UK monitoring, compliance and enforcement efforts related to bycatch, and overall identify areas where improvements can be made, providing clear, actionable and (where possible) time-bound recommendations.

This report

This report aims to:

1. Assess the relevance of the MSFD GES framework in addressing bycatch.
2. Critically evaluate the UK's regulatory and policy frameworks for bycatch management.
3. Synthesize current UK monitoring, compliance, and enforcement efforts related to bycatch.
4. Identify areas for improvement and provide actionable recommendations to enhance bycatch management.

CHAPTER 2. Linking Bycatch to Good Environmental Status (GES) Indicators

GES relevance to bycatch

In the context of the MSFD, bycatch is most directly addressed through descriptors that pertain to biodiversity, population status, and ecosystem function, with relevant indicators targeting aspects such as the abundance of key species and the impacts of anthropogenic activities on non-target organisms (Table 1). Effective management of bycatch in marine fisheries that utilises GES to measure progress therefore depends on selecting and prioritising indicators that accurately reflect bycatch dynamics and their implications. Among the diverse indicators considered towards achieving GES, only certain ones are directly relevant to bycatch. Even within this subset, some indicators are more significant due to their closer alignment with the assessment of bycatch impacts on species and ecosystems. This report identifies these critical indicators and explores their relevance through examples derived from the literature.

Table 1: GES descriptors and their indicators taken from the MSFD. Relevance of each descriptor and their respective indicator was determined by conducting a literature review searching for links between each descriptor:indicator and bycatch and then having three independent experts assess and corroborate the findings from the review.

Descriptor Number	Descriptor Name	Description	Indicators relevant to bycatch
1	Marine biodiversity	Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions	• 1.1: species distribution • 1.2 population condition • 1.3 habitat distribution • 1.4 habitat extent • 1.5 habitat condition
2	Non-indigenous species	Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems	• 2.1 abundance and state of non-indigenous species • 2.2 impacts of non-indigenous species
3	Commercial fish and shellfish	Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock	• 3.1 level of pressure of the fishing activity • 3.2 reproductive capacity of the stock • 3.3 population age and size distribution
4	Food webs	All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity	• 4.1 productivity of key species or trophic groups • 4.2 proportion of selected species at the top of the food web • 4.3 abundance/distribution of key trophic groups/species

Descriptor Number	Descriptor Name	Description	Indicators relevant to bycatch
5	Eutrophication	Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters	NA*
6	Seabed integrity	Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected	• 6.1 physical damage, • 6.2 condition of benthic community
7	Hydrographical conditions	Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems	• 7.1 spatial characterization of permanent alterations • 7.2 impact of permanent hydrographical changes
8	Contaminants	Concentrations of contaminants are at levels not giving rise to pollution effects	• 8.1 concentration of contaminants
9	Contaminants in seafood	Contaminants in fish and other seafood for human consumption do not exceed levels established by Union legislation or other relevant standards	NA*
10	Marine litter	Properties and quantities of marine litter do not cause harm to the coastal and marine environment	NA*
11	Energy, including underwater noise	Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment	• 11.2 continuous low-frequency sound

*The MFE evaluation found no relevant relationships / links (evidenced in peer review publications) between bycatch and the descriptors 5) Eutrophication, 9) Contaminants in Seafood and 10) Marine litter. Whilst it could be argued (somewhat tenuously) that there are links between all the descriptors, their respective indicators and bycatch, we relied only on peer-review outputs to corroborate such links, hence the NA's identified above.

GES descriptors relevant to bycatch

To evaluate the importance of each GES descriptor deemed relevant to bycatch from the literature review (all bar D, 5,9,10), 3 separate measures were used to evaluate the indicators within each descriptor. These measures were:

1) the likelihood of occurrence
2) the potential severity of impact
3) the geography/spatial area of the potential impact within the UK

Three independent experts were provided with the literature review table that compiled evidence to show the relevance between marine bycatch and each indicator. They were then asked to score each indicator based on the 3 measures noted above using a scale of 1-5 (1 = unlikely, minor and small and 5 = likely, severe, large spatial extent). The scores from each measure were combined to give an additive "importance" score:

Likelihood + *Severity* + *Extent* = *Importance Score*

The mean importance score for each indicator was then calculated:

Importance score indicator x, expert A. |
Importance score indicator x, expert B. | → *Average Importance score per indicator*
Importance score indicator x, expert C. |

The importance scores per indicator were then used to calculate an overall importance score per GES descriptor.

Average Importance score per indicator X.x. |
Average Importance score per indicator X.y. | → *Average Importance score per Descriptor*
Average Importance score per indicator X.z. |

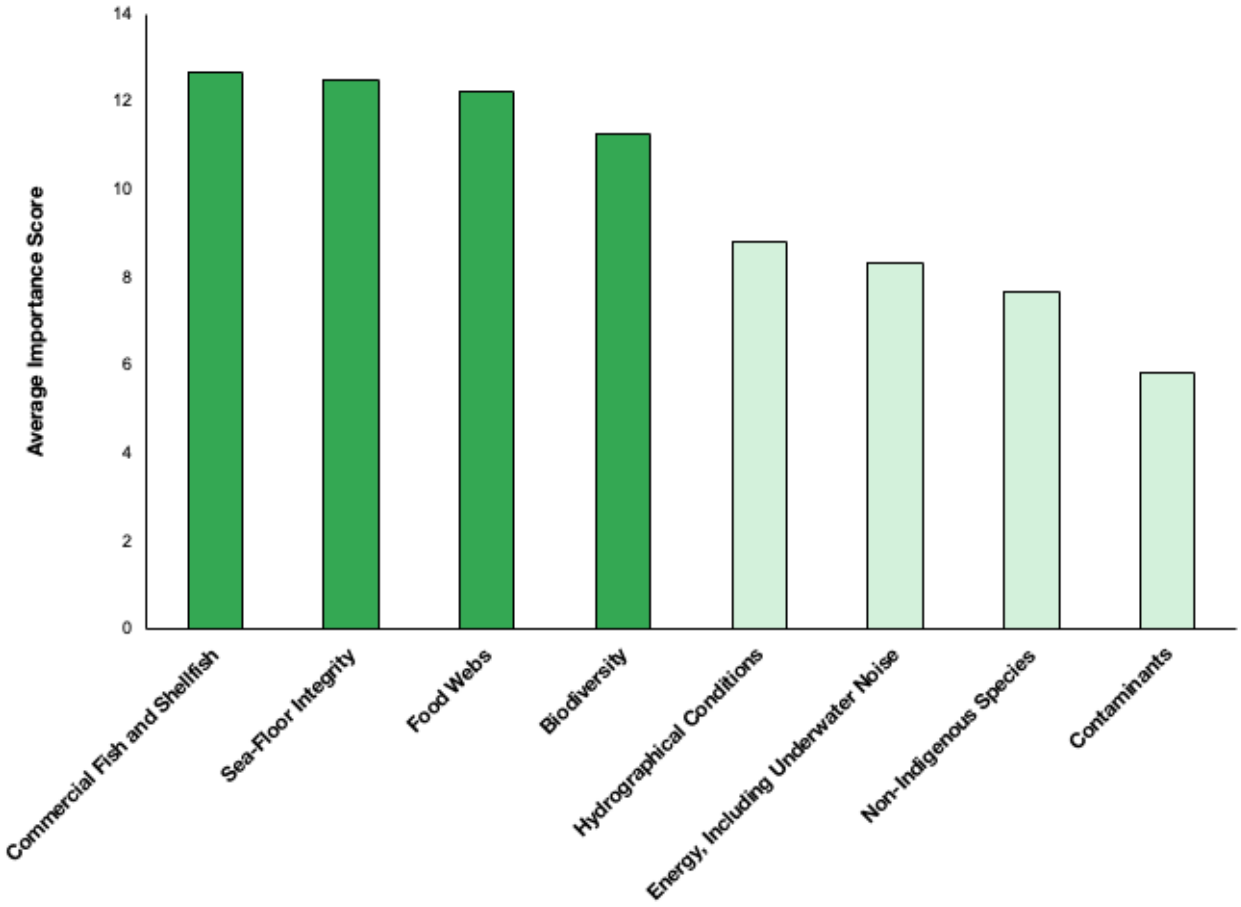

Figure 1: Bar chart showing the results of the independent review of GES descriptors and their importance/relevance in relation to marine fisheries bycatch. Dark green indicates those descriptors found to be more relevant to bycatch (light green = less relevant), herein referred to as 'high-impact' indicators.

The expert assessments provided a crucial foundation for the recommendations and conclusions drawn in this paper. Given the complexity of marine bycatch and the variability in available data, expert judgement played a key role in interpreting the relevance and severity of different indicators. By systematically evaluating the compiled evidence, the experts were able to provide informed insights that strengthened the analysis beyond what could be derived from literature alone. This approach ensures that the recommendations reflect not only documented findings but also the nuanced understanding of specialists familiar with the challenges of bycatch management in practice.

Assessing the relevance level of the descriptors clearly shows that four stand out as being more relevant to bycatch: commercial fish and shellfish, sea floor integrity, food webs, and biodiversity (Figure 1) – the 'high-impact'. This is somewhat intuitive as the first is directly related to fishing activity the second has a very strong relationship with any fishing that involves the contact of fishing gear with the seabed, the third involves the removal of animals which in turn has a bearing on food web dynamics and the fourth involves species in general, something that all fisheries interact with. The four descriptors that appear less important can

be argued to have a secondary or indirect relationship with bycatch, being important only when considering how bycatch may be occurring. Hydrological conditions are impacts that likely occur once a species is removed through bycatch, underwater noise is relevant when considering the acoustics of the fisheries that may cause bycatch, non-indigenous species is relevant only once bycatch has occurred (and is potentially transplanted) and contaminants is a secondary impact of bycatch associated with hydrological conditions and fishing gear contact with the sea floor.

Breaking the descriptor importance / relevance scores down into their constituent measures (likelihood, severity and geography) (Figure 2) reflects largely the same pattern as the results of the descriptor importance scores (Figure 1). When breaking down the relevance scores into their constituent parts, the likelihood of bycatch causing impacts on the descriptors is much lower once we move past the top four descriptors. Considering this, efforts around bycatch and GES should be focused on these top four descriptors, as they also have a higher severity (relatively) of impact, should the impact occur. The assumed extents of the bycatch impacts associated with each descriptor show slightly less difference between the top four and the lower four descriptors but still higher overall. These scores can be broken down per indicator, to see how the overall descriptor scores were calculated (Annex 1).

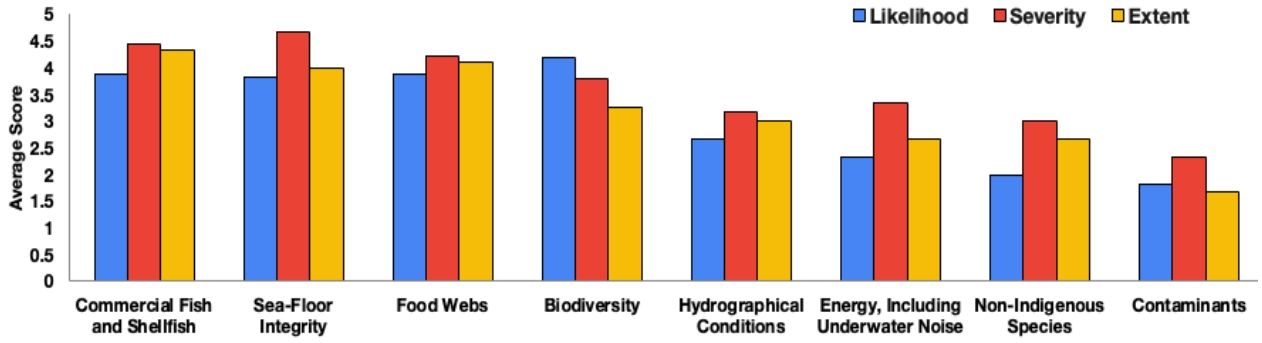

Figure 2: Bar chart showing the results of the independent review of each measure (likelihood, severity, geography) for the GES descriptors and their magnitude in relation to marine fisheries bycatch.

Examples of GES indicators related to bycatch

Below, examples of indicators from each GES descriptor that are related to bycatch are described along with select examples from the literature where applicable. This is by no means a comprehensive thesis of each indicator, but rather a summary to help exemplify those indicators that are seen to overlap with the impacts of fisheries bycatch. The relevance of each indicator to bycatch is described along with (where possible) studies exemplifying this relevance and a description of what changes in bycatch could hypothetically mean for the indicator under consideration. The indicators below are ordered as per Figure 1 (most relevant to bycatch through to least relevant).

Indicator 3.1 Level of Pressure of the Fishing Activity

While intended to capture target species, fishing activities may remove unintended species as bycatch, intensifying overfishing and negative ecosystem impacts. Increased bycatch amplifies the ecosystem pressures that fisheries exert on marine systems by hastening declines in both target and non-target species, disrupting population age and size structures vital to maintaining biological limits.[9] In the UK, over a third of fish stocks are overfished[1] and many stocks across Europe do not meet GES (Box 2). UK stocks such as Cod in the Celtic Sea and West of Scotland and Whiting in the Irish Sea are particularly affected due to continued high bycatch levels.[10] High bycatch levels are also seen in specific fisheries in the UK. For example, fisheries targeting *Nephrops* not only directly remove non-target species but also casue habitat-altering effects potentially precluding the recovery of demersal fish species in inshore waters.[11]

Box 2. Summary of 2018 assessment of GES under the MSFD article 8 for Commercially exploited fish and shellfish.

To achieve the objectives of the Common Fisheries Policy and the Marine Strategy Framework Directive's Good Environmental Status (GES) for Descriptor 3 on commercially exploited fish and shellfish, fishing mortality rates, reproductive capacities (spawning stock biomass), and age/size distribution must support population biomass levels above those capable of producing Maximum Sustainable Yield (MSY) by 2020*. Only 10.5% of exploited stocks can be assessed against both fishing mortality and SSB criteria, and 39.3% against at least one of them, highlighting gaps in data availability and assessment coverage (see below. Blue = assessment possibility, green = assessed. Note, data gaps remain for many stocks).

Stocks in relation to meeting two of the primary criteria defining the MSFD's GES objective: achieving (1) a fishing mortality and (2) a reproductive capacity compatible with having population biomass levels above those capable of producing MSY	North-East Atlantic Ocean	Baltic Sea	Black Sea	Mediterranean Sea	EU
Percentage of stocks for which it is possible to assess whether both of the GES primary criteria are met out of all exploited stocks	16.0	5.0	0	0	10.5
Percentage of stocks for which it is possible to assess whether at least one of the two GES primary criteria are met out of all exploited stocks	36.4	40.0	77.8	41.8	39.3
Percentage of assessed stocks meeting both the GES primary criteria	44.1	12.5	0	0	26.7
Percentage of assessed stocks meeting either of the two GES primary criteria	38.2	50.0	14.3	6.1	28.5
Percentage of assessed stocks meeting at least one of the two GES primary criteria	82.3	62.5	14.3	6.1	55.2
Percentage of assessed stocks not meeting either of the two GES primary criteria	17.7	37.5	85.7	93.9	44.8

*Whilst the status of commercial fish stocks has been evaluated as part of the MSFD GES framework, to our knowledge no such assessments have been carried out specifically for bycatch impacts or bycatch species (although we acknowledge some target species in one fishery may also be bycatch in another – therefore bycatch may have been addressed indirectly in some cases).

[1] Overfishing is defined as catching marine creatures at a rate faster than they can reproduce, leading to a decline in fish populations and various negative impacts on marine ecosystems and communities.

Bycatch rates vary depending on the fishery, largely determined by the gear use and fisheries effort, with indiscriminate gears like trawls and dredges generally having a higher bycatch rate than more selective gears like hook and line, and pots and traps. A good example of this is the UK scallop fleet. In a study off the Isle of Man, almost all (97.6%) of scallop tows generated fish bycatch, with a total of approximately 50 species recorded.[12] If bycatch can be successfully reduced, the recovery of vulnerable bycatch species can therefore help to alleviate ecosystem pressures associated with bycatch[2] and facilitate sustainable fisheries management.

Indicator 6.2 Condition of Benthic Community

The condition of benthic communities is directly connected to the impacts of bycatch, especially in fisheries that make direct contact to seafloor ecosystems like trawl and dredge fisheries. Bycatch may alter the condition of benthic communities by removing species that are critical to maintaining the structure and function of the benthos.[13] Damage to the seafloor from a trawl pass will have a more pronounced impact in sessile and sedentary species that cannot avoid the path of the towed gear.[14] These impacts can also include impacts to the sediment integrity, thereby causing changes to the whole benthic ecosystem.[15]

Montero et al. (2020) demonstrated how bycatch in squat lobster fisheries affects non-target benthic species by causing changes in relative abundance, thereby disrupting ecosystem processes and degrading overall habitat health.[16] Such impacts can be exacerbated if the species negatively impacted is itself an ecosystem engineer and important in the maintenance of the benthic ecosystem health. These include species that burrow and turn-over sediment, or species that build biogenic habitats like reefs or beds. Increased bycatch can therefore have large-scale impacts on benthic communities through direct damage and secondary impacts on the species impacted, reducing biodiversity, and impairing ecosystem functionality over the long-term. Conversely, reductions in bycatch may allow benthic habitats and populations to recover, re-establishing more stable, healthier and resilient habitats, critical for overall ecosystem sustainability.

Indicator 4.1 Productivity of Key Species or Trophic Groups

The productivity of key species or trophic groups is relevant to bycatch because it directly ties population dynamics to food web stability. By reducing the population sizes of key species, bycatch can disrupt food web productivity and create cascading effects throughout the ecosystem.[17] Trophic cascades arise when predators limit the population size or behaviour of their prey, which in turn promotes the survival and abundance of organisms at the next lower trophic level.[18]

[2] Note: whilst bycatch may be reduced, the impacts of gears on seabeds is still a problem often not solved through improved fisheries selectivity.

Long-term studies of inshore fish assemblages, such as those on the Northumberland coast of the UK, show declines in both the abundance and diversity of key species, alongside a reduction in the proportion of large individuals in contemporary populations. The loss of large predatory fish or elasmobranchs destabilises trophic relationships by removing key prey regulators.[11] Food web imbalances have also been noted when considering the bycatch that impacts the specific life stages or sexes of a certain species. For example, Luck et al. (2022) found that bycatch mortality, particularly of female seals, had disproportionate impacts on population viability compared to male or juvenile mortality.[19]

If bycatch rates increase, key species productivity can decline, destabilizing trophic interactions and reducing overall marine ecosystem resilience. In contrast, decreased bycatch could improve productivity by allowing population recovery and the stabilisation of food webs, contributing to a healthier and more balanced food web structure critical for long-term ecosystem function.

Indicator 1.1 Species Distribution

Species distribution is directly relevant to bycatch due to its focus on the effects of removing individuals from specific areas. This unintentional removal through bycatch can disrupt species distributions and lead to localized population declines. For example, Northridge et al. (2020) quantified the bycatch of seabirds across various fishing gears, demonstrating significant population-level effects. The study highlighted the risk of localized extinctions in vulnerable areas. Similarly, Abelló and Esteban (2012) identified bycatch as a primary driver for Balearic Shearwaters' decline to Critically Endangered status.[20] Similarly, Luck et al. (2022) demonstrated that bycatch in static gear fisheries reduced grey seal population growth by 99% over a century.[19] Such trends exemplify the severe impact bycatch can have on the distribution of certain species.

If bycatch rates increase, the consequences could include accelerated declines in the distribution of affected species, potentially isolating populations and diminishing genetic diversity. For species whose distributions are known to be adversely impacted by bycatch, reductions in bycatch may therefore facilitate recovery in depleted populations, fostering more stable and natural ‘baseline’ species distributions.

Indicator 7.2 Impact of Permanent Hydrographical Changes

The impact of permanent hydrographical changes may not be directly linked to bycatch but may still be influenced through indirect pathways. Bycatch can alter the populations of species that interact with the seabed and water column, indirectly affecting hydrographical conditions and associated marine ecosystem processes. For example, Epstein et al. (2022) found that demersal fishing, including associated bycatch activities, disrupts seabed sediments, which

are critical for carbon storage, nutrient cycling, and sediment stability (also highlighting the relationship between bycatch and descriptor 6 – seafloor integrity).[21] These disruptions can influence water column dynamics, particularly if key benthic species that mediate these processes are removed. Although the direct impact of bycatch on hydrographical conditions is likely considered a secondary or indirect impact, increased bycatch could exacerbate these effects by further reducing the populations of species integral to maintaining sediment stability and water column interactions / benthic-pelagic coupling.

Indicator 11.2 Continuous Low Frequency Sound

While bycatch does not directly contribute to low-frequency sounds, it can exacerbate the stress experienced by marine species, making them more susceptible to such acoustic disturbances. Putland et al. (2017) found that noise from marine traffic reduces communication space significantly for vocalising fish and marine mammals - by up to 87.4% for Bryde's whales and 61.5% for bigeye fish.[22] During close approaches of large vessels, this reduction can reach 99%, far exceeding natural variability. These effects disrupt species' communication and navigation systems, potentially hindering reproduction, foraging, and migration. Increased bycatch could potentially add to the stress (via other means described in other indicators) on species already coping with noise pollution, potentially compounding these impacts, although this remains highly speculative. It is also noteworthy that the fisheries that rely on fishing gears that contact the seafloor have important acoustic impacts for marine communities.[23] These are also the same fisheries that generally have increased rates of bycatch (see indicator 3.1). Therefore, the relationship between bycatch impacts and acoustic stressors are somewhat positively correlated and should be considered together when discussing GES descriptor 11.

Indicator 2.2 Impacts of Non-Indigenous Species

Impacts of non-indigenous species connects indirectly to bycatch through its role in potentially facilitating the spread of non-native species. When non-indigenous species are caught and inadvertently transported and released, bycatch may contribute to their introduction into new areas, potentially having ecosystem altering impacts.[24] Increased bycatch could therefore exacerbate the spread of non-native species, leading to ecological imbalances and a reduction in native biodiversity. On the other hand, reducing bycatch may limit the potential of such accidental transfers (particularly in fishery port scenarios), reducing potential negative consequences on the integrity of native ecosystems. Hypothetically, if bycatch continues unchecked, combined with the transport of seafood products between areas, it could result in higher levels of non-indigenous species abundance in sensitive areas, competing with and potentially displacing native species.

Indicator 8.1 Concentration of Contaminants

Concentration of contaminants, though not directly linked to bycatch, may be indirectly affected by the removal of species that play roles in filtering or processing contaminants within marine ecosystems. These species contribute to maintaining water quality and ecosystem

health. Pandey et al. (2020) highlights how species that neutralize contaminants or regulate their dynamics are essential for sustaining ecosystem balance.[25] Their removal through bycatch could disrupt these natural processes, potentially leading to increased contaminant concentrations or shifts in contaminant distributions. Increased bycatch could exacerbate these effects by reducing populations of key filtering species, indirectly degrading water quality.

Synergies in GES indicators and bycatch impacts

When considering the relevance of different descriptors and indicators to bycatch it is important to note that synergies or overlaps between descriptors and indicators are present and rarely would any operate independently. The consequence of this is that certain changes in one indicator may also correlate to changes in another. In addition, when considering the different impacts caused by bycatch, cumulative impacts may be present in which for example, the increased removal of species because of bycatch, may decrease the integrity of the seabed, which in turn can have a positive feedback effect on the productivity of the species being impacted by bycatch. It is therefore important to considering the synergies / overlaps between within the GES framework.

For example, Descriptors themselves can overlap such as Descriptor 3 (Commercial Fish and Shellfish) and Descriptor 6 (Seafloor Integrity) are inherently linked because trawl fisheries that often catch target and non-target species (i.e. bycatch) also impact seafloor habitats, affecting their integrity and the ecosystem services they provide (Figure 1). Within a single descriptor, indicators are often more closely linked that descriptors by nature of their grouping within a Descriptor. For example, within Descriptor 1, changes to indicator 1.1 (Species Distribution) are closely tied to indicator 1.3 (Habitat Distribution), as species rely on habitats for survival, and alterations to habitats frequently drive changes in species distribution. Overlaps also occur between indicators across descriptors. For example, 3.1 (Level of Pressure of the Fishing Activity) directly influences 4.2 (Proportion of Selected Species at the Top of the Food Web), as fishing intensity affects the availability and survival of top predators.

To evaluate the synergies / overlap within the GES, three experts independently scored each potential pair of indicators using an X-Y matrix, assigning scores from 1 (minor overlap) to 5 (major overlap). This scoring considered indicator to indicator overlaps without considering bycatch impacts. The reason to do this is to first understand how much synergy potentially exists within the GES indicators. Discrepancies in scoring following the independent exercise were resolved through discussion to reach a consensus rather than calculating an average score. The final scores formed the basis of a "synergy / overlap score" for each descriptor, illustrating the potential extent of interconnectedness across the GES framework (Figure 3).

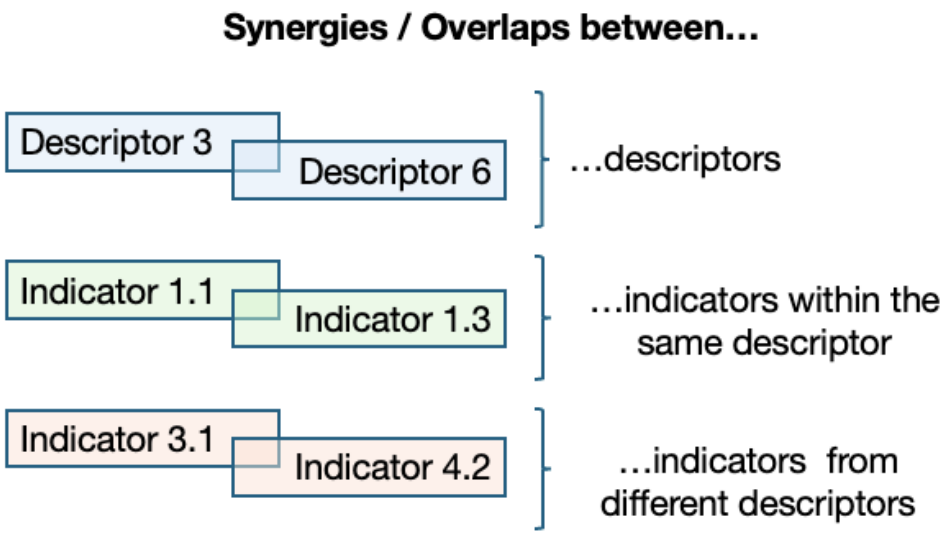

Figure 3. Diagram highlighting examples of where different synergies / overlaps can exist within the GES framework.

The matrix displays approximate groupings of colour across the matrix (Figure 4). A notable observation is that the higher synergy scores tend to appear in the descriptor groups most relevant to bycatch (Commercial and Shellfish, Food Webs, Sea-Floor Integrity and Biodiversity) (Figure 5). This pattern can be attributed to two key factors. Firstly, indicators within these groups share similarities in design and function, leading to a natural alignment in how they interact. For example, indicators targeting species composition or population health often rely on overlapping data sources and methodologies, amplifying their synergistic effects. Secondly, these indicators often capture ecological processes that are inherently interconnected. Similarly, bycatch, as a phenomenon, simultaneously impacts biodiversity, population stability, and ecosystem functions as seen when looking at the relevance of the different indicators to bycatch.

The synergies observed suggest that efforts to improve or mitigate bycatch impacts will likely influence a range of ecological outcomes across different indicator groups, again emphasising the integrated nature of the marine ecosystem. This exercise also corroborates the importance scores represented by the green bars in Figure 1. The highest overlap scores were consistently associated with the most relevant indicators, demonstrating that synergies may contribute to cumulative impacts between different indicators. This reinforces the notion that certain interactions between descriptors and indicators can have compounding effects on ecosystem health. Additionally, this finding aligns with our literature review, where lower-scoring items in the synergy table were rarely supported by substantial peer-review evidence that linked bycatch to the low-scoring indicators. This somewhat underscores the validity of a potentially subjective scoring exercise and highlights the importance of focusing on relevant high-impact synergies when using GES to evaluate progress in bycatch mitigation.

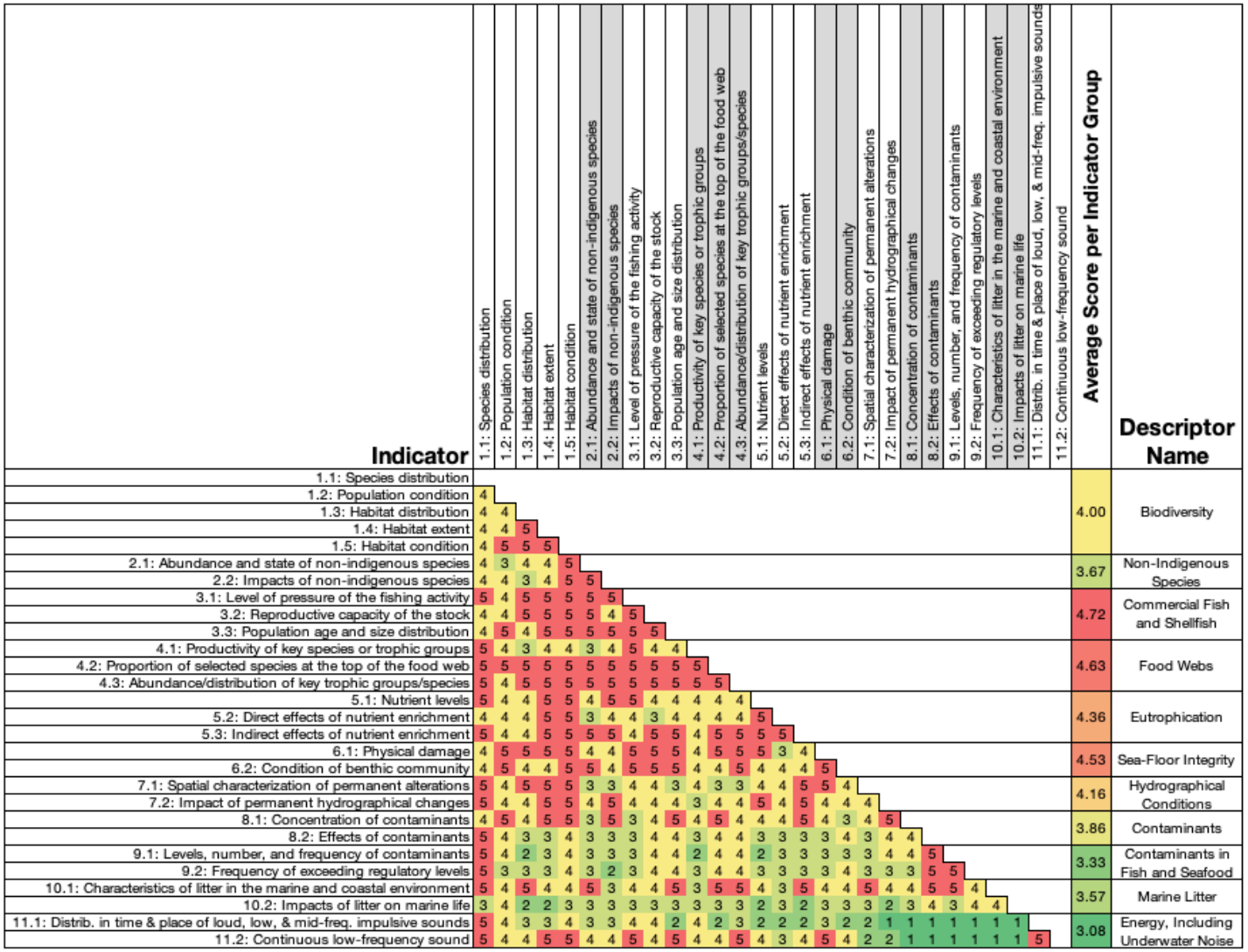

Figure 4: Potential synergistic impacts across the different indicator groups. The larger cells on the right-hand side of the matrix present the average scores for each indicator group, providing an overall picture of their interactions. (see also Figure 5).

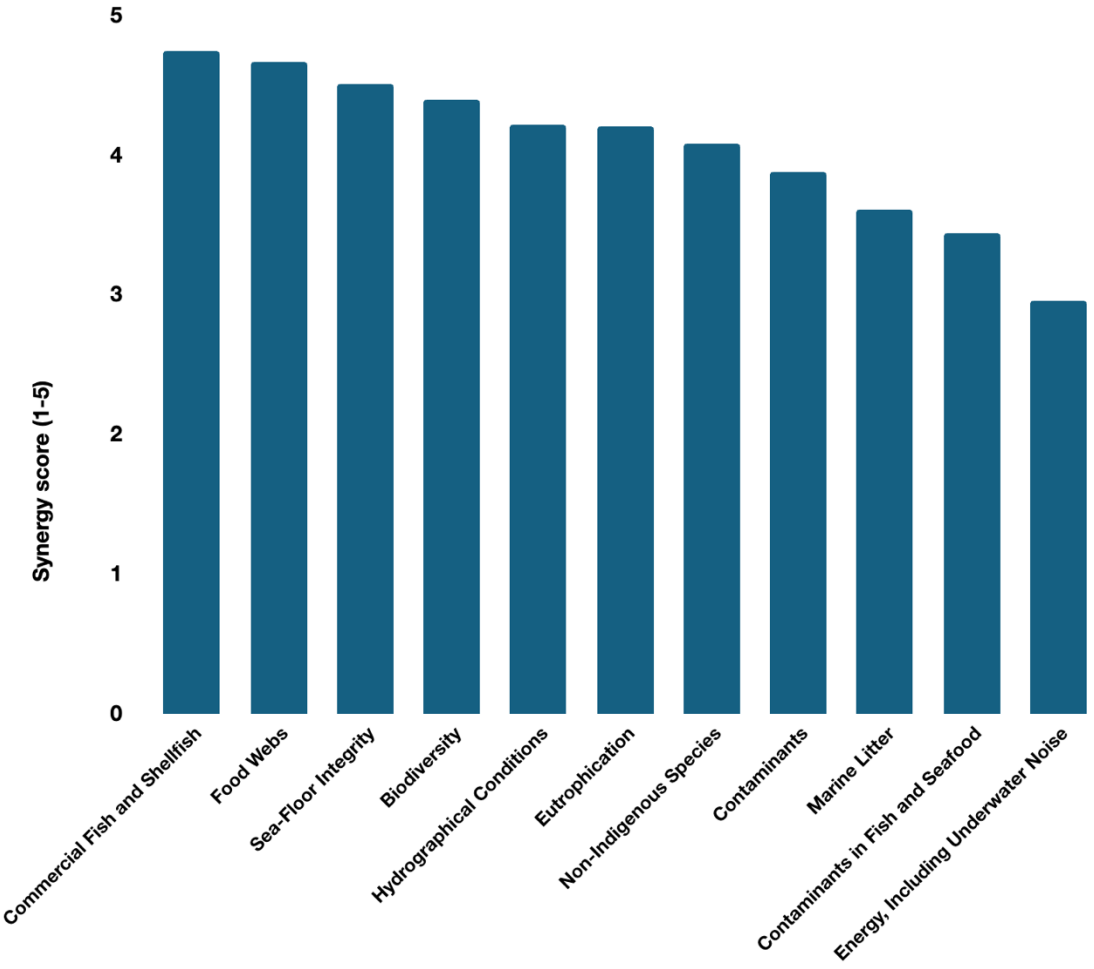

Figure 5. Bar Chart displaying the final synergy scores per GES Descriptor (calculated as the average across all indicators scores within each descriptor).

Focus needed on high-impact indicators

This chapter highlights the intricate relationship between bycatch and the MSFD through the lens of GES descriptors and indicators. The analysis underscores that while all GES descriptors are interconnected, certain descriptors—namely biodiversity, commercial fish and shellfish, food webs, and sea-floor integrity—stand out as most relevant to bycatch impacts. These descriptors directly address the ecological and population-level effects of bycatch, such as species distribution, population condition, and habitat integrity. Therefore, specific indicators within the GES descriptors are critical tools for evaluating bycatch dynamics and their broader implications for marine ecosystems.

By exploring the synergies between indicators and descriptors, bycatch impacts often cascade across multiple ecological processes, potentially amplifying cumulative effects. For instance, the relationship between trawling activities, species composition, and benthic integrity reflects how bycatch simultaneously affects ecosystem structure and function. The scoring methodology used herein, supported by expert evaluations, further highlights the importance of focusing mitigation efforts on high-impact descriptors and indicators. This also reinforces the need for targeted actions to address the interconnected challenges of biodiversity loss, habitat degradation, and food web instability caused by and / or associated with bycatch.

CHAPTER 3. UK Bycatch Regulation and Policy

This chapter explores the current strengths, weaknesses, opportunities, and threats within the UK's bycatch management system, evaluating the potential for policy evolution, technological advancements, and greater public-private partnerships to drive further progress. Additionally, an implementation analysis of key legislation and policies, including the Fisheries Act 2020 and the UK Marine Strategy, will assess the effectiveness, equity, responsiveness, and robustness of the regulatory framework, identifying areas for potential improvement. Potential opportunities presented in the chapter are considered through the environmental governance framework established by Bennett and Satterfield (2018), which was created to aid evaluations and deliberations of governance to '*design and improve the capacity, functioning, and performance of environmental governance systems*.'[26] This framework was chosen to conduct a standardised analysis of various bycatch policies relevant to the UK. Bennett and Satterfield's framework is useful for such an analysis as it provides 'distinct, comprehensive, direct, operational, understandable and unambiguous' attributes and objectives of environmental governance. Bycatch management may be improved with consideration to these objectives, which were chosen by the authors through a comprehensive review of the analytical elements of governance, and the literature on environmental governance. Their framework (see Table 2 for example) defines four overarching categories of aims or objectives of governance: effective, equitable, responsive, and robust. The four objectives are defined by the authors as follows:

1) effective governance supports the maintenance of system integrity and functioning;
2) equitable governance employs inclusive processes and produces fair outcomes;
3) responsive governance enables adaptation to diverse contexts and changing conditions; and
4) robust governance ensures that functioning institutions persist, maintain performance, and cope with perturbations and crises.

This chapter examines relevant bycatch regulations (Table 3) through this governance lens, as it is a comprehensive framework that can guide policymakers as they consider management of bycatch.

Table 2. Excerpt from Bennett and Satterfield (2018) [26] environmental governance framework *defin*ing *four overarching categories.*

Objectives	Attributes (Qualities or Capacities)	General Characteristics or Inputs (Capacity)	Intended Outputs (Functioning)	Intended Outcomes (Performance)
Effective Supports maintenance of system integrity and functioning	Direction	Scope, goals and aims are comprehensive, clearly articulated and communicated to stakeholders. Clear boundaries on action and scope exist.	Defines what effective action encompasses and sets milestones for achieving success.	Improvement in ecosystem functioning. Greater biodiversity or species. Increases in productivity of system of provisioning of ecosystem services. Better environmental health.
	Coordination	The roles, functions, and mandates of different governments, agencies and organizations are coordinated. A coordinating body or unit is present.	Produces system of rules for use, mechanisms for exclusion, management actions and spatial coverage that are complementary and adequate to achieve objectives. Provides a forum for discussion, debate, negotiating and resolving trade-offs.	
	Capacity	Capacity, skills and resources for implementation are sufficient and are being actively developed. Capable and visionary leadership is present. Mechanisms are present to resolve conflicts between groups.	Enables successful decision-making and the initiation, organisation, implementation and evaluation of actions.	
	Informed	Planning and management decisions and actions are informed by best available information and integration of a diversity of knowledge types and systems.	Increases the likelihood that management actions will lead to effective outcomes.	

Table 3. Timeline of bycatch-related policies (etc) reviewed as part of this chapter.

Title of Publication	Authors/Organization	Date Published	Type (e.g. treaty, retailer scheme, voluntary agreement, etc.)
International Convention for the Regulation of Whaling (ICRW)	IWC	1946	Multilateral Treaty
Marine Mammal Protection Act	NOAA (US)	1972	US federal regulation
Convention on the Conservation of Migratory Species of Wild Animals	UNEP (CMS)	1979	Multilateral Treaty
Wildlife and Countryside Act 1981	HM Government	1981	UK Public General Act
United Nations Convention on the Law of the Sea	UN	1982	Multilateral Treaty
The Wildlife (Northern Ireland) Order	HM Government	1985	Northern Ireland Orders in Council
Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)	UNEP/CMS	1991	Multilateral Treaty
OSPAR Convention	OSPAR Commission	1992	Multilateral Treaty
The Conservation (Natural Habitats, etc.) Regulations	HM Government	1994	UK Statutory Instruments
Code of Conduct for Responsible Fisheries	FAO	1995	Voluntary Framework
The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)	UNEP/AEWA Secretariat/CMS	1995	Multilateral Treaty
The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland)	HM Government	1995	Northern Ireland Statutory Rules
International Plan of Action for the Management of Fishing Capacity	FAO	1998	Voluntary Framework
MSC Fisheries Standard	Marine Stewardship Council	1998	Industry Scheme
Product Certification and Ecolabelling for Fisheries Sustainability	FAO	2001	FAO technical paper
Marine Strategy Framework Directive	European Parliament	2008	Directive
Guidelines for best practices to reduce incidental catch of seabirds in capture fisheries	FAO	2009	Voluntary guidelines

Title of Publication	Authors/Organization	Date Published	Type (e.g. treaty, retailer scheme, voluntary agreement, etc.)
Marine Strategy Regulations	HM Government	2010	UK Statutory Instrument
EU Common Fisheries Policy	European Commission	2013	Regulation originating from EU
Sustainable Seafood Coalition Codes of Conduct	Sustainable Seafood Coalition	2014	Industry Scheme
WWF Global Seafood Charter	WWF	2015	Industry Scheme
Bycatch Mitigation Initiative	IWC	2016	Multi-pronged Project by IWC
The Conservation of Habitats and Species Regulations	HM Government	2017	UK Statutory Instrument
The Conservation of Offshore Marine Habitats and Species Regulations	HM Government	2017	UK Statutory Instruments
25 Year Environment Plan	HM Government	2018	Policy framework
Agreement on the Conservation of Albatrosses and Petrels	CMS Parties	2018	Multilateral Treaty
Regulation (EU) 2019/1241 of the European Parliament	European Parliament	2019	Retained EU Regulation
UK Marine Strategy - UK updated assessment and Good Environmental Status	UK Fisheries Policy Authorities (Defra, Welsh Government, Scottish Government, Daera (NI))	2019 update	Policy framework
Fisheries Act 2020	HM Government	2020	UK Public General Act
Scotland's Fisheries Management Strategy 2020-2030	Scottish Government	2020	Policy Plan
UK Dolphin and Porpoise Conservation Strategy	Scot. Gov. Defra, Welsh. Gov. DAEREA, JNCC, Natural England, NRW, SNH	2021	High-level Report
FAO Guidelines to prevent and reduce bycatch of marine mammals in capture fisheries	FAO	2021	Voluntary Guidelines
Cornwall Seabird Bycatch Mitigation Project	RSPB, Birdlife International, Cornwall IFCA, Natural England, and Cornish gillnet fishers	2021	Research Project
Joint Fisheries Statement	UK Fisheries Policy Authorities (Defra, Welsh Government, Scottish Government, Daera (NI))	2022	Policy Paper (enables the UK fisheries policy authorities to develop fisheries management plans)
Marine wildlife bycatch mitigation initiative	Defra	2022	Policy Paper

Title of Publication	Authors/Organization	Date Published	Type (e.g. treaty, retailer scheme, voluntary agreement, etc.)
Environmental Improvement Plan	HM Government	2023	Policy framework
State of Nature 2023	State of Nature Partnership	2023	Assessment Report
Consultation on remote electronic monitoring	Defra	2023	Consultation
Consultation on discards reform	Defra	2023	Consultation
Bass Fisheries Management Plan	Defra	2023	Policy Paper
Channel demersal non-quota species fisheries management plan (FMP)	Defra	2023	Policy Paper
Crab and lobster fisheries management plan (FMP) for English waters	Defra	2023	Policy Paper
King scallop fisheries management plan (FMP)	Defra	2023	Policy Paper
Whelk fisheries management plan (FMP) for English waters	Defra	2023	Policy Paper
Consultation on the proposed Southern North Sea and Eastern Channel Mixed Flatfish Fisheries Management Plan (FMP)	Defra	2023	Consultation

A list of bycatch-related policies, treaties, frameworks, initiatives, strategies and plans were established via a series of google searches and expert knowledge within the MFE team (Table 3). First, Bycatch-related policies were primarily identified by searching international treaties and conventions aimed at broader wildlife and species protection. Key frameworks included the International Convention for the Regulation of Whaling (1946), the Marine Mammal Protection Act (1972) in the US, and the Convention on Migratory Species (CMS) (1979). These set foundational protections for marine species but were not solely focused on bycatch. A UK-focused summary of this legislation is shown in Table 4.

Table 4. Summary of UK-related Marine legislation largely focused on bycatch between 2008 and today. Orange = general marine, Green = EU-related, Pink = UK fisheries related, White = Other.

Year	Legislation / Policy / Instrument	Detail	Description
2008	Marine Strategy Framework Directive		Aims for GES for EU marine waters - legally binding implementation of the ecosystem-based approach for managing EU marine environment.
2009			
2010	Marine Strategy Regulations		The UK's domestic legislation implementing the MSFD and achieving GES by 2020 and the formation of a UK Marine Strategy
2011			
2012			
2013	EU Common Fisheries Policy	LO agreed (Discard Ban)	A set of rules for sustainably managing European fishing fleets and conserving fish stocks.
2014			
2015		LO pelagic TAC species	
2016		LO demersal TAC species	
2017	*Conservation of Habitat and Species Regs*	*incl.* Cons. of Offshore habitats and species regs	*Overlaps with UK marine conservation goals.*
2018	*UK 25 Year Plan*	*Overlaps with Marine Strategy*	*The government's vision for improving the environment over the next 25 years*
2019	UK Marine Strategy Update	LO all TAC species + EU Reg 1241	Some progress but challenges remain, particularly climate change, biodiversity and litter // Technical Measures Regulation retained - to regulate how fishing is conducted, focusing on the minimization of ecological impacts.
2020	Fisheries Act	Clean Catch uk begins	Primary UK fisheries legislation post CFP. UK now manages its own fisheries , negotiating shared stock agreements with the EU under the Trade and Cooperation Agreement (TCA).
2021	With Brexit, the UK leaves the CFP and now manages its own fisheries under the Fisheries Act 2020, negotiating shared stock agreements with the EU under the TCA.		
2022	Joint Fisheries Statement (JFS)	FMPs begin	8 objectives, (5th = bycatch), specific policies and actions
	Bycatch Mitigation Initiative (BMI)		BMI is part of objective 5 of JFS and builds on UK bycatch monitoring program(est. 1996) and Clean Catch UK.
2023	*Environment Improvement Plan*	FMPs ongoing	FMPs are primarily part of sustainability objective of JFS but overlap across all. 6 frontrunner FMPs have been published.
2024	UK Marine Assessment Update	(FMPs ongoing)	Update not yet published - expected in 2025
2025	TODAY	FMPs ongoing	More FMPs due to be published.

ACRONYMS	
FMP	Fishery Management Plan
GES	Good Environmental Status
LO	Landing Obligation
TAC	Total Allowable Catch
TCA	Trade and Cooperation Agreement
Italicised text	*Not specific marine - focused legislation*

UK and European entities began adopting treaties with specific conservation mandates in the early nineties, such as the ASCOBANS agreement (1991) for small cetaceans and the OSPAR Convention (1992) for the North-East Atlantic. The UK introduced regulations through legislation like the Wildlife and Countryside Act (1981) to align with international conservation goals. In the late 1990s, voluntary frameworks like the FAO's Code of Conduct for Responsible Fisheries (1995) and the Marine Stewardship Council's Fisheries Standard (1998) emerged. These initiatives, along with FAO guidelines for best practices to reduce incidental catch of seabirds in capture fisheries (2009), promoted sustainable practices across the industry, including bycatch reduction / mitigation.

The Marine Strategy Framework Directive (2008) and Common Fisheries Policy (2013) continued shaping the UK's approach to marine environmental protection and fisheries (including bycatch mitigation), pushing for reduced bycatch and sustainable practices. Industry-specific schemes, like the Sustainable Seafood Coalition Codes of Conduct (2014), have also contributed somewhat to the refinement of calls to improve fishing practices / reduce bycatch. The Bycatch Mitigation Initiative (2016) by the International Whaling Commission, and later the UK's transposition of the EU Habitats and certain parts of the Wild Birds Directives through the Conservation of Habitats and Species Regulations (2017), whilst broader have also demonstrated a focus on protecting marine life through statutory instruments.

The Fisheries Act, passed in 2020, set a legal foundation for post-Brexit fisheries management in the UK. The UK has continued efforts with the UK Dolphin and Porpoise Conservation Strategy (2021) and several fisheries management plans (2023) targeting species like bass, scallop, crab and lobster, mixed flatfish, cockle, spat. skates and rays, and whelk. Defra also published the Marine Wildlife Bycatch Mitigation Initiative in 2022 which aims to outline how the UK will achieve its ambitions to minimise and, where possible, eliminate the bycatch of sensitive marine species. Supporting these drives, the UK government has launched several consultations on REM and discard reform indicating an ongoing push towards data-driven, adaptive management to tackle bycatch (see
Box 3).

The progression of UK bycatch initiatives and policies reflects a movement from engagement through broad international treaties to more detailed, species- and region-specific management plans. This trend underscores the UK's shift towards more tailored and proactive bycatch reduction strategies, incorporating voluntary, regulatory, and consultative approaches to support improved bycatch management on paper, and this review assesses whether it is borne out in practice. The following review does not discuss in detail all the policies and legislation listed in Table 2 but rather highlights those with particular relevance (i.e. those indicated in Table 3) to current and proposed bycatch management in the UK.

Box 3. Overview of recent UK bycatch-related consultations (REM and discard reform).

Advancing Bycatch Management through Consultations on REM and Discards Reform

Effective bycatch management requires collaboration between government and industry. For change to occur, the government must first propose potential solutions and then engage stakeholders—fishers, regulators, and enforcement agencies—through consultations. This approach ensures that policies are practical, widely supported, and avoid eroding trust between fishers and authorities. Without such engagement, uptake of new measures is likely to falter, hindering progress toward sustainable fisheries.

The UK Government, through Defra, has exemplified this collaborative approach by conducting two key consultations under the Fisheries Act 2020: Remote Electronic Monitoring (REM) and Discards Reform. These initiatives highlight innovative approaches to sustainable fisheries management through technological advancements and policy reforms.

Remote Electronic Monitoring (REM)

The REM consultation focused on implementing electronic monitoring systems with cameras to improve data collection and compliance in UK fisheries. Key benefits include:

- Reliable Data Collection: Enables real-time monitoring of bycatch, identifying hotspots and informing data-driven management.
- Transparency and Accountability: Builds trust through verifiable records of fishing activities.
- Informed Policy Development: Supports evidence-based decisions with high-quality data.

Key proposals involved transitioning from voluntary to mandatory REM, offering financial incentives for uptake, and addressing stakeholder concerns over costs and privacy. While smaller operators voiced concerns over financial burdens, many stakeholders supported mandatory REM as a vital tool for reducing bycatch and enhancing enforcement, as well as having potential to reduce other regulatory burdens, for example by allowing access to fishing grounds that may otherwise be closed to them.

Discards Reform

The Discards Reform consultation aimed to refine measures for minimizing bycatch and waste in English waters. Proposals included:

- Technical Measures: Gear modifications and alternative fishing techniques to reduce discards.
- Discard Prevention Charge (DPC): Economic penalties to discourage wasteful practices.
- Stricter Exemptions: Tightening landing obligation exemptions to align with sustainability goals.

Stakeholders called for better enforcement through increased observer coverage, unannounced checks, and fines for undeclared bycatch. Recommendations also emphasized adaptive management and robust evaluation mechanisms to ensure effectiveness.

Key Takeaways

Both consultations underscore the importance of combining technological innovation with economic incentives and robust enforcement to promote sustainable fisheries. REM emerges as a transformative tool for bridging enforcement gaps, while discard reforms balance ecological and economic priorities through targeted measures like gear modifications and financial penalties. By addressing stakeholder concerns, particularly cost barriers for smaller operators, and fostering inclusive governance, these initiatives have the potential to drive significant progress in bycatch mitigation and sustainable fisheries management.

The Fisheries Act and Joint Fisheries Statement (JFS)

The Fisheries Act (2020) is a key regulatory framework in the UK that guides management of fisheries resources in UK waters following departure from the EU and consequently the Common Fisheries Policy.[27] The Fisheries Act lists eight fisheries objectives:

1) the sustainability objective
2) the precautionary objective
3) the ecosystem objective
4) the scientific evidence objective
5) the bycatch objective
6) the equal access objective
7) the national benefit objective
8) the climate change objective

The bycatch objective states that "*(a) the catching of fish that are below minimum conservation reference size, and other bycatch, is avoided or reduced; (b) catches are recorded and accounted for, and; (c) bycatch that is fish is landed, but only where this is appropriate and (in particular) does not create an incentive to catch fish that are below minimum conservation reference size"*. The Act requires fisheries policy authorities (Fisheries Act defines these as: Defra SoS, the Scottish Ministers, the Welsh Ministers, and 'the Northern Ireland dept') to prepare and publish both the Joint Fisheries Statement (JFS)[28] and FMPs[3] and outlines the measures that these regulations should include, which are discussed further in the respective sections of this review.[29] The JFS is designed to set out the policies of the fisheries policy authorities for achieving, or contributing to the achievement of, the fisheries objectives.

While The Act is the primary source for fisheries management policy in the UK post-Brexit, there are assimilated EU regulations including Regulation (EU) 2019/1241 (aka the Technical Measures Regulation) of the European Parliament and of the Council on the conservation of fisheries resources and the protection of marine ecosystems through technical measures.[30] This Regulation states that technical measures should minimize fishing impacts on sensitive species and habitats, and support compliance with environmental directives, with targets set to assess their effectiveness in reducing unwanted and incidental catches (paras 8,9). Member states are also directed to put mitigation measures in place to '*afford the strict protection for sensitive marine species*' (para 17). Annex XIII of the regulation accounts for mitigation measures to reduce incidental catches of sensitive species. This therefore requires that a fisheries administration collects data on incidental catch, and based on that data, provide for

[3] FMPs aim to assess the status of stocks, and must set out policies to restore stocks to, or maintain them at, sustainable levels. Each FMP will set out goals and the actions needed for their achievement. The precise mechanisms needed will depend on the goals set out in the plan. Defra (and the other national fisheries authorities) will coordinate the implementation of the plan.

additional mitigation measures for the reduction of incidental catches of the concerned species or in a concerned area (Annex XIII para 2,3). These mitigation measures must then be monitored to assess their effectiveness.

In determining fisheries opportunities under the Fisheries Act, the distribution of catch and effort quotas must consider criteria established by the national fisheries authorities that are transparent and objective, and include criteria relating to environmental, social and economic factors (section 25(1)). Regarding bycatch, there are a few key provisions to consider for this review. The Act specifies that the national fisheries authority must seek to incentivise the use of selective fishing gear, thereby mitigating the catch of non-target species (section 25(3)(a)). Additionally, the Secretary of State has the power to establish discard prevention charging schemes (section 28) under which chargeable persons are required to pay a charge in respect of unauthorised catches of sea fish. This provision may apply to bycatch as the catch of non-target species could fall under the definition of unauthorised catch as meaning '*in relation to a chargeable person who is the holder of an English sea fishing licence, an amount of sea fish caught in any period by the fishing boat named in that licence that exceeds the amount which that boat is authorised by the Marine Management Organisation to catch in that period*' (section 29(2)(a)). The specifics of how to meet the fisheries objectives, including the bycatch objective, are detailed in the JFS. The Fisheries Act emphasises reducing bycatch through selective fishing gear and recording catches to avoid wasteful discards. It introduces measures like discard prevention schemes, where fishers may be fined for unauthorised catches, including non-target species (section 28). The Act is designed to ensure that fisheries management is guided by transparent, objective criteria that account for environmental, social, and economic factors.

Bycatch management in the UK does have various strengths including a coordinated regulatory framework, support for technological innovation, industry collaboration, and international compliance. **When considering the Act**, **there are attributes present that indicate an effective legislative framework**. For example, with comprehensive and distinct aims described through the fisheries objectives, there is a clear direction for the policy, including boundaries on action and scope. Additionally, **the various fisheries authorities in the UK are tasked with working jointly to produce implementation reports on the JFS and fisheries management plans (section 11). Such coordination is a key attribute of an effective policy**. Although The Act does not include conflict resolution practices, there are provisions wherein the Secretary of State '*may by regulations make provision for the Marine Management Organisation ("the MMO") to impose charges in respect of the exercise by the MMO of a relevant marine function*' (section 34(1)), including provisions about the resolutions of disputes. These provisions, along with the financial assistance powers provided for in Schedule 6, support an effective policy. **The scientific evidence objective of the Act, which promotes the sharing of data and the use of best available scientific advice, creates a foundation for an informed, and therefore effective, practice.** There is opportunity for provisions that promote greater accountability and efficiency, to ensure that relevant authorities act on

mandated decisions, and to maximise productivity of management actions. **The Act has attributes rendering it responsive and robust, but there remain opportunities for improvement.** Since key provisions of The Act are explained further in the JFS, these attributes will be discussed in the following section. Regarding implementation of the Act, its objectives are to be met through the implementation of its supplementary instruments, so the implementation of the JFS and the subsequent FMPs[29] will be the focus of the remainder of this section.

Box 4. Overview of the Landing Obligation[38] (CFP) and the current state of play for the UK's fisheries.

The UK is no longer obligated to follow the Landing Obligation under the EU's Common Fisheries Policy (CFP) since leaving the European Union. However, the UK has chosen to incorporate key elements of the Landing Obligation (LO) into its domestic fisheries management framework through the Fisheries Act 2020.

Key Points:

1. **UK's Approach Post-Brexit**:
    - While the UK is not bound by EU legislation, it has kept and adapted aspects of the Landing Obligation to align with its fisheries sustainability goals (note: the LO does not apply to non-quota species).
    - The Fisheries Act 2020 establishes the framework for UK fisheries management and sets out sustainability objectives, including minimizing discards.
2. **Discard Prevention**:
    - The UK aims to reduce discards and promote more selective fishing practices, which aligns with the original intent of the Landing Obligation.
    - UK fisheries policy encourages compliance with discard reduction through various measures, such as Remote Electronic Monitoring (REM) and bycatch quotas.
3. **Flexibility for UK Fisheries**:
    - The UK now has greater flexibility* to tailor discard policies to its specific fisheries and regional conditions.
    - Fisheries management plans, such as those under the JFS and species-specific Fisheries Management Plans (FMPs), set out discard mitigation measures tailored to UK waters.
4. **International Commitments**:
    - The UK must adhere to discard reduction obligations in international agreements, such as those negotiated with the EU under the UK-EU Trade and Cooperation Agreement (TCA) and in regional fisheries management organizations (RFMOs).

*Whilst this may be the case on paper, many industry stakeholders do not feel UK legislation, nor management, is flexible or dynamic enough to make practical and useful changes on the timescales that are needed – i.e. based on seasonality, stock abundance and other factors.

Like the Act, the JFS has well defined objectives, providing clear direction for the policies set forth. While the Act defines the fisheries objectives, the JFS goes a step further and provides an interpretation of them. In the interpretation of the bycatch objective, the JFS states that '*policy authorities are committed to ending the wasteful practice of discarding and*

to increasing the level of accountability for fishing activities at sea' (2.1.17). The JFS also commits to '*ensuring that all catches of fish are accounted for with a preference that all catches of fish managed by Total Allowable Catch (TAC) are landed, unless: there is strong evidence fish will survive the capture process or; there are limits to the application of technical mitigations or; landing the fish will result in excessive disposal costs*' (2.1.18). These interpretations, derived from the objective's definitions from The Act, inform the outputs defined in the governance framework for effective action.

The coordinated approach across UK fisheries authorities to follow scientific evidence and monitor progress is another aspect of effectiveness (3.2.2). The JFS promotes coordinated data collection and calls for a Coordinating Authority to coordinate the preparation and management of the FMPs on behalf of other fisheries authorities acting jointly (Annex A). The JFS emphasises building skills and capacity within the fisheries sector by promoting training and resource allocation to manage fisheries sustainably (4.2.17.3). Informed decision-making is embedded in the policy through data collection (3.2.8), monitoring (3.6;5.7), and the use of scientific research (4.2.3.3). **The participatory decision-making provisions (Art 3.6) integrates stakeholder knowledge, further enriching effective decisions.** The JFS includes transparency mechanisms such as public reporting on fisheries management outcomes (3.5). It sets out a clear framework for enforcement and compliance (4.2.6), ensuring that those managing fisheries are held to account if they do not adhere to sustainable practices. **These various attributes contribute to an effective framework for the management of bycatch, so long as the published FMPs are in accordance with the provisions of the JFS.**

The JFS is also adaptive and anticipatory, reflective of a responsive policy. For example, fisheries authorities can introduce or modify discard exemptions based on best available scientific evidence (4.2.8.2). Furthermore, the JFS references the UK BMI[31] and how fisheries policy authorities will achieve the goals of the ecosystem and bycatch initiatives by improving '*understanding through scientific monitoring and research, identifying bycatch "hotspots" of high risk, developing and adopting effective mitigation measures, supporting fishers to implement mitigation measures, and working with international partners to reduce the bycatch of sensitive species globally*' (4.2.8.5).

By delegating the responsibility to the various fisheries authorities in the UK, fisheries policy can be flexible and adaptable to changing circumstances and can be geographically specific. The JFS sets out the purpose of the Fisheries Management Plans (FMPs) and is reviewed every six years. These mandated reviews create the opportunity to adapt bycatch policies as required due to any new developments in relevant practices or technologies.

Fisheries authorities are also to give attention to bycatch of sensitive species, such as cetaceans, seals, seabirds, and elasmobranchs, as part of their sustainability objectives. The 2022 Bycatch Mitigation Initiative supports these efforts by setting objectives to enhance scientific understanding, identifying bycatch hotspots, implementing effective mitigation

measures, and promoting new technologies.[31] These actions contribute to the long-term environmental sustainability of fisheries and promote compliance. **The JFS does note that it may be necessary to prioritise one fisheries objective over another in certain instances and encourages fisheries authorities to use the precautionary approach and evidence-based measures.**

While the JFS creates a framework that has provisions to create effective, adaptive, and robust fisheries policies, its implementation is to be seen through the FMPs. The first five FMPs were published in December 2023: bass, channel demersal non-quota species, crab and lobster, king scallop, and whelk. Each FMP has clear direction through the listing of key goals and actions including to minimise discarding of bass bycatch where survival rates are low (bass FMP key goal 3),[32] investigate key issues in current unwanted and protected species bycatch within the fishery (channel demersal non-quota species FMP Action 1),[33] assess the efficacy of existing bycatch avoidance and mitigation measures (crab and lobster FMP potential actions),[34] contribute to the initiative by improving monitoring of bycatch, identifying and managing (through bycatch mitigation measures) bycatch hotspots (whelk FMP).[35] The seabass, channel demersal non-quota species, and king scallop FMPs also emphasise coordination through the Benthic Impact Working Group, while the whelk FMP calls for a coordinated approach in inshore and offshore waters in relation to the implementation of minimum conservation reference sizes, which may need to be set at the local level.

The FMPs also call for informed and accountable decision-making, with provisions for monitoring and review. This includes provisions in the seabass FMP to *'encourage better monitoring, gear modifications and engagement with relevant schemes to help reduce the bycatch of sensitive species associated with bass fishing*,' and to '*review the practice of shallow inshore and shore-based netting to determine whether additional protections are needed to prevent migratory fish bycatch.*' Similar provisions exist in the channel demersal non-quota species FMP including the establishment of '*data collection requirements to monitor and track key Channel demersal non-quota species fishing impacts on bycatch of unwanted and protected species*.' **This informed approach contributes to the effectiveness of the FMPs, and the review aspect allows for adaptability of the policies.**

While the FMPs propose effective, responsive, and adaptive measures, they do not implement them. **The provisions proposed in the FMPs will have to go through a separate implementation phase before they are enacted and allow for enforcement actions to be taken.** During the implementation phase, appropriate mechanisms will have to be utilised to achieve the key goals and actions set forth in the FMPs. As listed in the FMPs themselves, these mechanisms could include voluntary measures, licence conditions, national and regional byelaws and statutory instruments. The five published FMPs also state that in the implementation phase, stakeholder opinions will be considered in choosing appropriate delivery mechanisms.

The policies set forth by the Act, the JFS, and the subsequent FMPs create a strong regulatory framework. However, there has not yet been implementation of the policies, so there exists a weakness in practice. While the provisions have the potential to create an effective response to bycatch, the absence of enforcement capabilities due to the lack of implementation and enactment of the policies means that there are still significant regulatory gaps. There is a clear opportunity to engage with stakeholders and utilise best scientific evidence to choose appropriate mechanisms to implement these policies. **There is the threat of regulatory overlap depending on the mechanisms chosen. For example, national and regional byelaws that overlap with international regulations could cause confusion.** For example, if an FMP introduces a national requirement for specific gear changes, but these modifications conflict with existing international obligations under agreements such as the International Convention for the Conservation of Atlantic Tunas (ICCAT), fishers operating in both domestic and international waters could face contradictory compliance requirements. This complexity can lead to inconsistencies in compliance requirements, making it difficult for fishers and stakeholders to navigate the regulatory landscape effectively. This complexity can lead to inconsistencies in compliance requirements, making it difficult for fishers and stakeholders to navigate the regulatory landscape effectively. Consequently, **regulatory overlap may hinder the timely execution of management measures and undermine accountability, ultimately jeopardising the sustainability objectives set forth in the FMPs**. Adopting more prescriptive language in the FMPs, as suggested by OEP, can ensure fisheries authorities are sufficiently constrained by policies.[36] For example, using language such as 'will' and 'shall' rather than 'could' and 'can.' Enhanced clarity and coordination among regulatory bodies are essential to streamline compliance and ensure cohesive governance of bycatch activities.

EU-derived Regulation

The UK's approach to assimilated EU legislation, particularly concerning environmental regulations, presents both opportunities and challenges. The Nature Recovery Green Paper[37] emphasized the previous government's commitment to halting species decline by 2030 and acknowledges the complexity of existing regulatory frameworks. It also highlighted that while the UK has retained a significant portion of EU environmental law, there is flexibility to adapt these laws to better suit domestic needs. However, despite this potential for adjustments, progress remains limited, with assimilated legislation continuing to be applied in its original form in certain areas. This highlights a missed opportunity to shape a more tailored approach to environmental governance post-Brexit.

One of these assimilated regulations is Regulation (EU) 2019/1241 of the European Parliament and of the Council on the conservation of fisheries resources and the protection of marine ecosystems through technical measures (Technical Measures Regulation) states that parties should '*reduce unwanted catches and eliminate discards*' (para 7).[30] The goals of the regulation are further described in Article 23 wherein fisheries authorities are given the power to define '*pilot projects that develop a system of full documentation of catches and discards based on measurable objectives and targets, for the purpose of a results-based management of fisheries*' (Art 23(1)). It aligns with the effective governance principles of the governance framework by seeking to enhance bycatch management through selective fishing gear and practices (Art 23(2)). The article encourages innovation by allowing pilot projects to explore new approaches to reducing bycatch, with a clear focus on measurable objectives and outcomes, thus contributing to improved ecosystem health and greater biodiversity.

In terms of coordination, **the article promotes collaboration between various fisheries administrations,** including the Secretary of State, Scottish Ministers, Welsh Ministers, and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland (Art 23(4b)). **This ensures that the implementation of pilot projects is harmonised across jurisdictions, addressing regulatory overlap and facilitating smoother governance**.

Furthermore, **accountability is built into the process** through the requirement that, following the completion of each pilot project, a report be published within six months detailing the outcomes, including changes in selectivity and environmental impact (Art 23(3)). This transparency ensures that decision-makers are accountable to stakeholders and enables broader application of successful innovations.

Finally, the regulation incorporates elements of responsiveness and adaptability, as pilot projects are initially limited to one year, with the possibility of extension based on results (Art 23(2)). **This creates a flexible approach, allowing fisheries to respond to changing environmental conditions and improve management practices over time.**

The Technical Measures Regulation offers significant potential for bycatch reduction through the promotion of innovative pilot projects and comprehensive documentation of catches and discards, providing a flexible framework that encourages adaptive management. However, **its limited scope, with pilot projects restricted to 5% of vessels and a one-year timeframe, may constrain long-term impact. Coordination between multiple jurisdictions also adds complexity**, potentially leading to regulatory overlap and delays. Conversely, successful pilot projects could pave the way for broader implementation, positioning the UK as a leader in sustainable fisheries management. Nevertheless, economic burdens on smaller operators and potential non-compliance could threaten the widespread adoption of new practices.

Marine Strategy Regulations 2010

The Marine Strategy Regulations (MSR) 2010 provide a structured approach to mitigating bycatch in UK marine waters, aligning with broader environmental governance frameworks.[4] These regulations were introduced to implement the EU's MSFD into domestic law. Since leaving the EU, the UK is not legally obliged to adhere to the MSFD but chooses to remain aligned to it through the MSR (2010). One of the key objectives is to achieve GES by ensuring that fish populations and ecosystems remain healthy and productive. By focusing on the reduction of bycatch, the regulations articulate clear goals aimed at minimising the ecological impact of fishing practices (Part 2). This direction is essential for setting measurable targets, which are **communicated to stakeholders, including fishermen, conservation groups, and policymakers, thereby fostering a collective responsibility for bycatch management and contributing to overall marine biodiversity** (Art 12).

Coordination among various stakeholders is crucial for effectively addressing the complex issue of bycatch within the Marine Strategy Regulations. The framework encourages collaboration among the competent authorities to create complementary strategies for bycatch reduction (Arts 7, 8). **This coordinated effort aims to ensure that bycatch mitigation measures are consistently implemented across different fishing sectors and geographic areas.**

The responsiveness of the Marine Strategy Regulations is particularly relevant in the context of bycatch management, as the framework includes robust monitoring and evaluation mechanisms (Art 6). These systems allow for ongoing assessment of bycatch levels and the effectiveness of mitigation strategies, enabling adaptive management that can respond to new scientific findings and changing ecological conditions. This adaptability not only enhances the resilience of marine ecosystems but also promotes innovative approaches to bycatch reduction, such as the development of selective fishing gear and techniques. Furthermore, the regulations appear to prioritise equity by ensuring that the voices of stakeholders are included in the decision-making processes surrounding bycatch management. **These qualities all point towards regulations that are effective, adaptive and robust, but there are opportunities for improvement.**

The Marine Strategy Regulations 2010 provides a comprehensive framework aimed at achieving GES in marine waters, which significantly impacts bycatch management. One of the main strengths of these regulations is their establishment of clear objectives that promote stakeholder collaboration, fostering a cooperative approach. This collaborative framework enhances awareness and encourages the adoption of best practices, ultimately contributing to marine biodiversity conservation. However, challenges in implementation exist, particularly concerning compliance monitoring and enforcement, which can vary among stakeholders. For example, smaller-scale fisheries may lack the resources for robust self-monitoring, while larger commercial operators might have better compliance structures but also face scrutiny over bycatch reporting accuracy. **The complexity of fisheries management and the diverse nature of marine ecosystems can also hinder the development of universally applicable bycatch reduction measures, limiting the regulations' overall effectiveness.** Nonetheless, the regulations present opportunities for innovation in fishing practices and gear technology, such as the adoption of more selective fishing methods. The focus on research and monitoring allows for adaptive management strategies that can respond to emerging data on bycatch levels and ecological impacts, leading to improved environmental outcomes. On the other hand, **external threats such as climate change and shifting fish populations may pose challenges to the regulations' effectiveness**. Additionally, competing interests within the fishing industry may obstruct the prioritisation of bycatch mitigation measures, potentially leading to conflicts among stakeholders.

The Conservation of Habitats and Species Regulations 2017

There are numerous environmental conservation regulations in the UK that may be applicable to bycatch, including the Wildlife and Countryside Act 1981,[39] Wildlife (Northern Ireland) Order 1985,[40] Conservation (Natural Habitats, etc.) Regulations 1994,[41] Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995,[42] Conservation of Offshore Marine Habitats and Species Regulations 2017,[43] and Conservation of Habitats and Species Regulations 2017.[44] These regulations make it an offence to deliberately capture, kill or disturb certain species.

In both England and Northern Ireland, the respective Conservation of Habitats and Species Regulations establish a clear directive for monitoring, thereby enhancing the capacity for data collection on bycatch rates and the associated risks for vulnerable species (Reg 52).[44] The emphasis on collaboration between the Secretary of State and devolved administrations promotes coordinated efforts in addressing bycatch issues, ensuring that local knowledge and regional variations in bycatch are adequately considered in management strategies (Reg 52(3)(a)). **The regulation's proactive approach in identifying risks associated with incidental capture and maintaining records allows for informed decision-making and targeted conservation actions,** thereby supporting the overarching goal of sustaining marine biodiversity (Reg 52(4)(b)).

Moreover, **the regulation's requirement for ongoing consultation and revision of monitoring arrangements demonstrates a commitment to adaptive management practices** (Reg 52(2)). By engaging various stakeholders, including nature conservation bodies and other competent authorities, the regulation fosters a participatory governance model that integrates diverse knowledge systems and experiences (Reg 52(6)). **This inclusivity is essential for developing effective bycatch mitigation measures tailored to specific contexts.**

The complexity of marine ecosystems and the variability of bycatch rates across different fisheries can complicate monitoring efforts, potentially leading to gaps in data and inadequate responses to emerging issues. Furthermore, the regulation's success depends on the commitment of all stakeholders to prioritise bycatch reduction and the willingness to adapt practices based on monitoring findings. Overall, this regulation offers a robust framework for addressing bycatch through a combination of proactive monitoring, stakeholder engagement, and adaptive management, but **its effectiveness hinges on overcoming implementation challenges and fostering a culture of accountability among all parties involved**. Opportunities exist for leveraging the regulation to develop innovative bycatch mitigation strategies and technologies. Enhanced monitoring can facilitate the identification of effective gear modifications and practices that minimise incidental capture while maintaining fishery productivity. Moreover, the regulation encourages public and stakeholder engagement, creating opportunities for education and awareness around bycatch issues, potentially leading to greater support for sustainable fishing practices.

Bycatch Policies and Instruments

The BMI is a strategy developed by the UK government to reduce and, where feasible, eliminate the bycatch of sensitive marine species in UK fisheries.[31] This policy framework aligns with the ecosystem objective outlined in the Fisheries Act 2020, **emphasizing the need to minimize incidental catches of species such as seabirds, marine mammals, and turtles.** The initiative aims to achieve its goals through several measures:

1. Improved Monitoring: Establishing enhanced bycatch monitoring systems, including REM with cameras, to identify and address bycatch hotspots. The initiative advocates using validated data collection methods to understand bycatch levels accurately.
2. Mitigation Strategies: Encouraging the development and adoption of gear modifications and alternative fishing techniques, such as switching from nets to hook-and-line methods, to reduce bycatch risks. The Clean Catch UK project is an example of ongoing innovation in this area.
3. Stakeholder Engagement: Incorporating input from fishers, conservation groups, and scientists to ensure practical and effective bycatch solutions.

4. Hotspot Management: Targeting areas with high bycatch risk for focused interventions, supported by spatial and temporal management measures, to protect vulnerable species and habitats.

The strengths of the BMI include its **evidence-based approach and emphasis on cutting-edge technologies, as well as its integration of diverse stakeholder perspectives.** Specific sections of the initiative, such as those addressing gear modifications and REM implementation, highlight these strengths (e.g., the proposed promotion of gear innovations like the seabird bycatch toolkits).

However, **weaknesses include potential enforcement challenges and the difficulty of balancing economic interests with conservation goals, especially for small-scale fishers.** Opportunities arise from the potential for the UK to lead globally in sustainable fisheries and the initiative's ability to foster innovation in bycatch mitigation techniques. Threats include resistance from the fishing industry due to potential economic costs and uncertainty in securing long-term compliance across diverse fisheries. **While the initiative contains guidelines that could be very beneficial for the management of bycatch, its status as a policy outline means success is dependent on the implementation of the proposals presented therein**.

The 25 Year Environment Plan[45] is for England only, and sets out the long-term approach to protecting and enhancing the natural environment (See
Box 5). One goal of the plan was to implement a sustainable fisheries policy upon the departure of the CFP. The plan commits to a framework that will '*account for, and seek to minimise, impacts on non-commercial species and the marine environment generally, including through technical conservation measures*' (p 107). As a policy framework, its success relies on integrating these principles into legally binding regulations and ensuring robust monitoring and enforcement to meet its long-term environmental goals. The Environmental Improvement Plan[46] is the first revision of the 25 Year Environment Plan. It has very similar objectives as the 25-year plan, although with an explicit commitment to enact the plans set forth in the Bycatch Mitigation Initiative, and to run trials of bycatch reduction technologies (p 59). The Environmental Improvement Plan is currently under review by the current government.

The third party initiatives outlined by Clean Catch UK,[47] the Marine Stewardship Council (MSC),[48] the WWF Global Seafood Charter,[49] and the Sustainable Seafood Coalition (SSC)[50] prioritise the reduction of bycatch as a fundamental objective. They provide guidelines aimed at improving the sustainability of fishing practices. These prioritise the reduction of bycatch as a fundamental objective, each bringing unique strengths to the broader sustainability agenda. Clean Catch UK serves as a collaborative hub, focusing on research and innovation in bycatch reduction. Its projects promote the use of advanced technologies and best practices to minimize incidental catches, particularly of sensitive species, by providing practical resources such as bycatch toolkits for fishers.

Box 5. Brief overview of the UK's 25-year Environment Plan including list of the plans ten themes.

The **25-Year Environment Plan**, published in 2018, sets out a comprehensive roadmap for improving England's natural environment within a generation. It outlines ambitious goals across ten key themes:

- Air
- Water
- Seas & Estuaries
- Wildlife
- Natural Resources
- Resilience
- Natural Beauty & engagement
- Biosecurity, Chemical & Noise
- Resources Use & Waste
- International

To track progress and measure environmental change, the plan introduced the Outcome indicator Framework. This framework consists of 66 indicators, categorized into pressures, asset conditions, and benefits, offering a systematic way to monitor the health of natural capital. These indicators are tied to the plan's goals, enabling policymakers to assess trends, identify gaps, and evaluate the effectiveness of interventions.

The framework supports evidence-based decision-making by providing data on critical environmental factors such as air and water quality, biodiversity, and climate resilience. It is also a key tool for reporting on progress toward international commitments, such as the Sustainable Development Goals, and domestic priorities established under the Environment Act. By integrating these indicators into regular reporting cycles, the framework plays a pivotal role in ensuring accountability and guiding future actions to achieve the 25-Year Plan's vision of a healthier, more sustainable environment.

The MSC sets standards for sustainable fishing including bycatch. The MSC Fisheries Standard requires fisheries to demonstrate minimal environmental impact, which includes reducing bycatch and ensuring effective monitoring and mitigation strategies. This certification not only provides market advantages but also raises consumer awareness of sustainable seafood practices. The WWF Global Seafood Charter emphasizes conservation-driven practices throughout the seafood supply chain, aiming to balance ecological health with industry viability. It encourages fisheries and retailers to adopt measures that mitigate bycatch while fostering transparency and accountability. Lastly, the SSC, a UK-based collaboration of retailers, suppliers, and foodservice companies, establishes voluntary Codes of Conduct that guide its members toward sustainable sourcing and responsible fishing practices. These codes help standardize expectations for reducing environmental impacts, including bycatch, while enhancing supply chain integrity.

Together, these organisations represent a coordinated and multifaceted effort to address bycatch. By aligning diverse stakeholders—fishers, retailers, conservation groups, and

consumers—they provide the tools, knowledge, and incentives necessary for effective bycatch management while fostering a collective commitment to sustainability. However, **there is no legal repercussion for not following the initiatives, and they require voluntary uptake.** Nonetheless, economic and market incentives, such as obtaining MSC certification, can drive participation by opening access to premium markets and providing the potential for securing partnerships with retailers and restaurants that prioritise sustainability. Additionally, aligning with these initiatives enhances reputational value, providing fishers and suppliers a competitive edge in increasingly eco-conscious markets.

A strength of these industry schemes is that they are built on robust principles that emphasise sustainability and environmental responsibility. They provide clear guidelines and standards that enhance the accountability of fisheries, facilitating effective monitoring and reporting of bycatch. Moreover, the incorporation of scientific research and data-driven approaches allows for continuous improvement and adaptation of methods to mitigate bycatch. **Weaknesses, however, include the variability in compliance among fisheries, which can lead to inconsistencies in bycatch reporting and management.** Some fisheries may lack the resources or motivation to fully implement these standards, leading to gaps in monitoring and enforcement. Additionally, **these frameworks may sometimes prioritise certified fisheries, potentially marginalising smaller or less-resourced operations that struggle to meet the required standards.**

Regarding opportunities, **there is significant potential for collaboration across these initiatives to create a unified approach to bycatch management**. Increased awareness and demand for sustainably sourced seafood among consumers present opportunities for these frameworks to expand their influence and reach. Moreover, the advancement of technology, such as remote electronic monitoring systems, can enhance data collection and transparency, facilitating better compliance and management of bycatch, helping fisheries meet the requirements for certification. These industry schemes may face pressures such as regulatory changes and market fluctuations that can undermine their effectiveness. Competition from unregulated fisheries may threaten those adhering to these sustainable practices, creating economic disincentives for compliance.

In summary, these industry schemes represent significant advancements in the governance of bycatch management, characterised by clear objectives, coordinated efforts, and a commitment to informed and adaptive decision-making. As the challenges of bycatch continue to evolve, these industry schemes will play a crucial role in guiding sustainable fishing practices and promoting environmental stewardship within the industry.

International Regulatory Frameworks

The UK is party to a number of international treaties that aim for the conservation of protected species including the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention),[51] The Convention on Migratory Species (CMS),[52] Agreement on the Conservation of Albatrosses and Petrels (ACAP),[53] The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA),[54] the International Convention for the Regulation of Whaling (ICRW),[55] and Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS).[56] These multilateral treaties demonstrate an international commitment to the protection of sensitive species. Under the responsibilities of a party to the OSPAR convention, the UK monitors indicators such as harbour porpoise bycatch, the population levels of marine birds, seals, sensitive fish species, and cetaceans, and is participating in a pilot assessment focused on marine bird bycatch. This monitoring and assessment are undertaken as part of OSPAR's Coordinated Environmental Monitoring Programme (CEMP).[57]

Furthermore, IWC has a Bycatch Mitigation Initiative[58] which includes a Standing Working Group to oversee the initiative, a multidisciplinary Expert Panel[59] to provide specialist advice, and a Bycatch Co-ordinator who brings technical expertise in the field of bycatch and leads the work programme. The main areas of focus for this initiative are:

- *improved assessment of bycatch to determine priorities and to measure success;*
- *innovation and testing of mitigation and management methods and approaches (no single solution exists to prevent cetacean bycatch);*
- *capacity building and transfer of expertise, technology and management measures between countries and fishing communities; and*
- *engagement and collaboration with other relevant international organisations focused on fisheries management and bycatch.*

Implementation of this plan is dependent on securing funding and developing strong collaborations between various stakeholders. **While there are proposed compliance measures such as incentivisation schemes, the plan heavily relies on the voluntary participation of stakeholders and does not have enforcement measures.**

In addition to international treaties, there are voluntary codes and guidelines that the UK could use (and has mentioned in the Bycatch Mitigation Initiative) to guide best practices for sustainable fisheries and bycatch mitigation. These include the FAO Code of Conduct for Responsible Fisheries,[60] the International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries,[61] the FAO Technical Guidelines for Responsible Fisheries: Guidelines to prevent and reduce bycatch of marine mammals in capture fisheries,[5] and the FAO Technical Guidelines for Responsible Fisheries: Best practices to reduce incidental catch of seabirds in capture fisheries.[62] The Code of Conduct contains guidance for sustainable management of fisheries resources. Bycatch is mentioned in the Fisheries Research section, where it is stated that '*states should collect reliable and accurate data which are required to*

assess the status of fisheries and ecosystems, including data on bycatch, discards and waste' (12.4). **The Code of Conduct also encourages states to take compliance and enforcement measures but does not specify what these measures should entail except to state that *'sanctions may, for serious violations, include provisions for the refusal, withdrawal or suspension of the authorization to fish'*** (7.7.2). All the voluntary guidelines encourage best practice but are intentionally left somewhat vague so that they have the flexibility to apply across different regions. As stated in the guidelines to reduce incidental catch of seabirds in capture fisheries, the guidelines and plans of action provided by the FAO are not full strategic plans, but rather prescribe a process whereby individual States, or States participating in multilateral arrangements can identify national, subregional and regional issues and then develop national and regional plans to address the issues.

The UK's involvement in numerous international treaties and voluntary codes highlights its commitment to protecting sensitive species from bycatch through collaborative efforts. Treaties such as the OSPAR Convention, CMS, and ASCOBANS, along with initiatives like the IWC's Bycatch Mitigation Initiative, reflect a collective approach to monitoring and reducing bycatch, particularly through monitoring assessments and the development of mitigation strategies. However, the success of these efforts often relies on voluntary participation and collaboration, with limited enforcement mechanisms in place. **While international guidelines, such as the FAO's Code of Conduct for Responsible Fisheries, provide valuable frameworks for sustainable practices, they leave compliance measures flexible, allowing individual nations to tailor their strategies. This approach enables adaptability but underscores the importance of robust national policies to ensure effective bycatch mitigation and long-term conservation of marine species.**

Commendable commitment but with numerous limitations

Based on Bennett and Satterfield's framework for effective environmental policy, **the UK's bycatch management approach shows a commendable commitment to sustainable practices through structured objectives, collaborative frameworks, and a willingness to innovate** (Table 5) (see also Annex 2 for examples of UK-funded bycatch research and monitoring efforts).

The Joint Fisheries Statement provides clear direction and legitimacy under the Fisheries Act 2020, ensuring alignment with sustainability goals and an ecosystem-based approach. However, it shows **limited inclusivity** for small-scale fishers and relies on existing institutional frameworks, which may constrain broader capacity-building and stakeholder engagement. The **JFS demonstrates adaptability and learning potential through Fisheries Management Plans (FMPs), positioning it as a cornerstone of UK fisheries governance**.

The EU-derived Regulations **uphold continuity in governance** and provide legitimacy through the EU's Common Fisheries Policy framework. However, the **lack of full UK-specific**

adaptation limits flexibility and fails to address post-Brexit challenges. While these regulations provide a solid foundation, there is a need for modernization to better reflect UK priorities and increase stakeholder participation.

The Marine Strategy Regulations are particularly **strong in providing accountability and adaptability through their GES targets**. They emphasize cross-sector coordination and evidence-based decision-making, creating a robust framework for aligning ecological and socio-economic goals. However, **enforcement capacity and stakeholder engagement remain areas for improvement**, particularly to ensure widespread adoption and compliance.

The Conservation of Habitats and Species Regulations **demonstrate a commitment to adaptive management practices** through ongoing consultation and revision of monitoring arrangements. While these regulations promote a participatory governance model that integrates stakeholder knowledge, their success is dependent on the willingness of stakeholders to prioritise bycatch management.

Table 5. Descriptions of how four key UK marine regulations / policy relate to the governance framework of Bennett and Satterfield (2018) [26].

Policy/ Regulation	Joint Fisheries Statement (JFS)	Retained EU Regulation	Marine Strategy Regulations	Conservation of Habitats and Species Regulations
Direction	Provides clear goals through Fisheries Objectives (e.g., sustainability, ecosystem approach).	Maintains the legal framework and objectives of the EU Common Fisheries Policy with clear and comprehensive aims.	Establishes legally binding direction through GES targets aligned with international commitments.	Provides strong direction through site-specific legal protections and conservation objectives.
Legitimacy	Supported by legal mandates under the Fisheries Act 2020, ensuring legitimacy in governance.	Retained EU law provides legitimacy but may lack full UK-specific adaptation.	Legitimacy derived from legal incorporation of the EU Marine Strategy Framework Directive (MSFD).	Legitimacy derived from its basis in EU Natura 2000 framework, adapted to UK law post-Brexit.
Accountability	Devolved administrations are accountable for implementing objectives through FMPs.	Accountability mechanisms carried over from the CFP but may have enforcement challenges in UK waters.	Regular assessments and reporting create accountability for meeting GES targets.	Mechanisms for accountability through legal enforcement of protections for designated habitats and species.
Fairness	Incorporates stakeholder views but may prioritize industrial fisheries over small-scale fishers.	Fairness is based on pre-Brexit EU agreements, which may not fully reflect post-Brexit UK priorities.	Promotes fairness by addressing broad ecological and socio-economic goals.	Fairness in protecting biodiversity, though integration with broader fisheries or marine policies is limited.
Coordination	Promotes collaboration across devolved administrations and stakeholders for cohesive policies.	Limited to existing structures with little flexibility for regional or sectoral coordination.	Coordination required across sectors (fisheries, conservation, pollution) and devolved administrations.	Coordination challenges exist between habitat-focused protections and broader marine or fisheries policies.
Learning	Encourages adaptive management through FMP reviews and periodic assessments.	Does not explicitly encourage learning beyond the EU framework.	Encourages learning through periodic GES reviews and updated action plans.	Promotes learning through site-level monitoring and conservation management plans.
Capacity	Provides resources for FMP development but relies on existing institutional frameworks.	Constrained by reliance on pre-existing EU frameworks without additional UK-specific resources.	Supports cross-sectoral action but may be limited by enforcement capacity in certain regions.	Focused on maintaining site-specific resources but lacks broader integration with fisheries management.
Informed	Informed by evidence-based scientific assessments and stakeholder contributions.	Relies heavily on EU-established science and processes, though evolving with UK-specific data integration.	Relies on evidence-based monitoring programs and scientific indicators to assess GES.	Informed by ecological data and monitoring but lacks integration with fisheries-specific data.
Adaptability	FMPs include mechanisms for adapting to changing ecological and economic conditions.	Lacks flexibility to fully address UK-specific challenges in discard management and other areas.	Targets are updated based on new evidence, reflecting adaptability.	Conservation plans can adapt to new ecological data, though broader integration is limited.
Participation	Engages stakeholders but requires greater inclusion of marginalized groups (e.g., small-scale fishers).	Limited stakeholder engagement, with less opportunity for UK-specific input post-Brexit.	Encourages inclusivity through multi-sector collaboration, though challenges remain in engaging all stakeholders.	Focuses on ecological inclusivity but requires better engagement with fishers and other marine stakeholders.

The policies encourage adaptive management, foster international collaboration, and engage industry stakeholders, making the UK a potentially influential player in global bycatch reduction efforts. However, **limitations such as restricted scope for pilot projects, potential non-compliance due to lack of enforcement mechanisms, and the economic pressures facing the fishing industry reveal weaknesses that may impact the long-term effectiveness of these policies.**

Moving forward, the UK has an **opportunity** to strengthen its bycatch management framework by **enhancing enforcement mechanisms, increasing support for smaller operators, and further investing in and implementing innovative monitoring technologies.** By leveraging its international partnerships and aligning more closely with the proactive elements of initiatives like the IWC's Bycatch Mitigation Initiative, the UK can promote greater accountability and resilience in its fisheries sector. These steps will be essential for allowing the UK to reinforce sustainable fisheries management and achieve the ambitious conservation goals outlined in its regulatory framework. Table 6 attempts to summarise this complexity in UK bycatch regulation as a SWOT analysis.

Table 6. SWOT analysis of UK's bycatch regulatory landscape.

Strengths	**Weaknesses**
1. Comprehensive regulatory framework with well-defined objectives across key policies (e.g., Fisheries Act 2020, Marine Strategy Regulations 2010) 2. Strong emphasis on adaptive management, monitoring, and data-driven approaches within regulations 3. International alignment through participation in treaties like the OSPAR Convention, CMS, and IWC initiatives, demonstrating commitment to bycatch reduction	1. Limited scope of innovative pilot projects, with restrictions such as the 5% vessel cap and a one-year timeframe in Regulation 2019/1241 2. Complexity in coordination across jurisdictions, potentially causing regulatory overlap and delays in implementation 3. Challenges in voluntary uptake of industry initiatives
Opportunities	**Threats**
1. Opportunity for the UK to establish itself as a global leader in sustainable bycatch management practices 2. Rising consumer demand for sustainably sourced seafood and certified products could encourage greater uptake of voluntary guidelines across the industry	1. Industry resistance due to economic concerns over compliance costs, which could hinder widespread adoption of new practices, particularly voluntary schemes

Over the past few decades, the UK's regulatory approach to bycatch has evolved significantly, shifting from basic conservation measures to a more nuanced, ecosystem-based management framework that aligns with international best practices. Historically, early bycatch policies focused primarily on the protection of specific species and habitats, often with limited stakeholder engagement or adaptive measures. However, as global awareness of bycatch impacts has grown, the UK has adapted its policies to incorporate scientific research, cross-jurisdictional cooperation, and more inclusive governance frameworks. This shift reflects a broader trend in international environmental governance, where conservation efforts are increasingly integrated with socio-economic objectives and aligned with global commitments to sustainable development. Despite these advancements, the UK's bycatch management exists within a competitive global market where sustainability standards vary widely. Fisheries face potential economic disadvantages with the presence of cheaper, less sustainable imports. This tension underscores the need for stronger international agreements that standardize bycatch management practices across jurisdictions, reducing disparities and promoting a level playing field for responsible fisheries worldwide.

In summary, the UK's approach to bycatch management reflects a blend of robust legislative frameworks, voluntary industry initiatives, and international commitments, positioning it as an advocate for sustainable fisheries management. Yet, **the overall effectiveness of these efforts is disadvantaged by regulatory limitation.** To strengthen its role on the global stage, the UK may need to explore policy mechanisms that further support economically vulnerable fisheries, bolster compliance incentives, and advocate for binding international standards that ensure equitable conservation practices across all nations. Such measures would enhance the UK's ability to sustain its fisheries sector while upholding its environmental objectives.

CHAPTER 4. UK Bycatch Monitoring

The previous chapter described and assessed the regulatory framework for bycatch management in the UK. This chapter examines how that framework addresses the monitoring of bycatch which is essential for the following reasons:

1. **Conservation of Non-Target Species:** Bycatch often includes endangered, threatened, or protected species, such as sea turtles, seabirds, and marine mammals. Monitoring helps to understand the impact of fishing activities on these vulnerable populations and implement protective measures.

2. **Ecosystem Health**: Bycatch affects the balance of marine ecosystems by unintentionally removing species that play essential roles in the ecosystem. Monitoring helps scientists assess ecosystem health and the broader impacts of fishing on biodiversity.

3. **Improving Fishery Efficiency**: By tracking bycatch, fisheries can work toward improving their gear and techniques to reduce non-target catches. This can increase efficiency, reduce waste, and support the sustainability of target stocks.

4. **Data-Driven Management**: Accurate bycatch data helps inform management decisions, including setting quotas, seasonal closures, or gear restrictions. This is essential for adapting fishing practices to changing conditions and mitigating environmental impact.

5. **Regulatory Compliance**: Many fisheries are subject to bycatch regulations to protect certain species. Monitoring ensures compliance with these regulations, avoiding fines, supporting responsible fishery certifications and evaluating the effectiveness of mitigation measures.

6. **Market Access**: Sustainable fisheries that monitor and reduce bycatch may gain access to eco-conscious markets and certifications, such as the Marine Stewardship Council, which often require stringent bycatch mitigation measures.

Tracking the effectiveness of bycatch measures is critical for adaptive management, enabling policy authorities to modify approaches as needed to achieve overarching conservation goals.

This chapter begins by outlining the policy landscape for bycatch monitoring, detailing the main initiatives and goals set out by the UK government, fisheries policy authorities, and international agreements. In addition to policy commitments, this chapter examines the practicalities of implementing bycatch monitoring systems across UK fisheries. By evaluating how monitoring is carried out, this section assesses whether these practices align with policy objectives.

Finally, the chapter concludes by reflecting on the alignment between policy goals and real-world practices in bycatch monitoring. This evaluation will consider how well current monitoring systems support the UK's commitments to sustainable fisheries management and

minimising bycatch, highlighting areas where further development and investment may be needed to bridge the gap between planned objectives and actual implementation outcomes.

Joint Fisheries Statement (JFS)

The JFS[28] contains provisions for bycatch monitoring requirements, but also relies on existing data sources, primarily from the International Council for the Exploration of the Sea (ICES).[63] The data from ICES, however, is primarily fish stock health and fishing fleet dynamics (3.6.1) and the JFS therefore tasks fisheries policy authorities with collaborating on plans for controlling fishing activity through traceability and robust monitoring, control, and surveillance (MCS) measures to discourage illegal discards and monitor sensitive species bycatch (4.2.7.3). Regarding compliance, fisheries authorities under JFS are tasked with:

- *working towards 'fully documented fisheries, to ensure all catches are recorded and accounted for'(4.2.8.1)*
- *collaborating with stakeholders to develop management measures aimed at reducing unwanted catches of quota species, minimising fish mortality, and discarding*
- *outlining approaches to bycatch reduction, with provisions for discard exemptions in specific cases, based on scientific evidence*
- *applying TAC deductions for any exemptions used by its fleets* (4.2.8).

As discussed in the previous chapter, the regulatory impacts of the JFS will be seen through the associated FMPs and their implementation which is ongoing. The Bass FMP emphasises improving monitoring, encouraging gear modifications, and engaging in schemes to reduce bycatch of sensitive species, particularly by promoting REM for better data collection on discards and sensitive species bycatch.[32] Similarly, the Channel Demersal FMP advocates for robust data collection,[33] with REM as a key tool, starting with an early adopter scheme for fly-seining vessels. The Crab and Lobster FMP[34] suggests incorporating REM for data collection, while also proposing a bycatch monitoring plan across all crab and lobster fisheries to assess risks to marine species. The King Scallop FMP's Stage 2 actions focus on developing a potential approach regarding how output (e.g. quota driven) or input (e.g. fishing effort controlled) controls could be applied to king scallop fisheries – including options for the method by which limits may be set, allocation method and criteria for fishing opportunities and monitoring required to measure effectiveness.[64] For the Whelk FMP, a comprehensive data collection program will be established to support evidence-based fisheries management.[35] This will include biological, spatial, environmental, and socio-economic data, with an emphasis on understanding bycatch and minimising interactions with sensitive species through a targeted bycatch monitoring plan.

The MMO and Welsh Government use a **blended enforcement model, which includes both physical inspections and desk-based monitoring** of fisheries activities, sales note data analytics, buyers information and a risk assessment tree to highlight the physical checks that

may be needed (see king scallop FMP).[64] This approach leverages data from Vessel Monitoring Systems (VMS) and quota tracking, enabling real-time and risk-based inspections at sea and in ports. For example, vessel inspections and monitoring of first-sale fisheries products by both the MMO and the Welsh Government ensure that fishing practices comply with regulations. **This proactive monitoring helps ensure that fishers remain within legal quotas and gear restrictions.**

A specific **example of how compliance measures are evolving is the introduction of inshore Vessel Monitoring Systems (I-VMS) for pot fisheries, which could help track the number of pots hauled by vessels.** Regulations limiting pot numbers may require the development of Catch Per Unit Effort (CPUE) reference points to be fully effective, which are not yet available for English whelk fisheries but are successful in other regions like Granville Bay (Northern France).

The JFS also makes mention of The UK BMI which focuses on reducing sensitive species bycatch through **targeted monitoring of high-risk areas**, promoting mitigation practices, advancing technologies, and supporting fishers. These efforts contribute to the ecosystem and scientific evidence objectives by enhancing bycatch-related data collection and informed management decisions (4.2.8.5).

EU-derived Regulation

The assimilated EU Regulation on the conservation of fisheries resources and the protection of marine ecosystems through technical measures outlines the use of **selectivity indicators, such as the "length of optimal selectivity" as tools to monitor progress** towards the Common Fisheries Policy (CFP) objective of minimising unwanted catches.[30] **These indicators are not binding targets** but serve as monitoring tools to inform decision-making at the regional level. They should be derived from appropriate scientific bodies, focusing on key indicator stocks, including demersal species managed through catch limits. The Regulation emphasises the importance of considering mixed fisheries, recruitment spikes, and the relevance of landings and discards for each sea basin when applying these indicators.

Marine Strategy Regulations 2010

The Marine Strategy Regulations mandated that by 2014, a monitoring programme for the environmental status of marine waters must be established and implemented.[4] These provisions require the Secretary of State, devolved policy authorities, and Northern Ireland bodies to ensure compliance with the Marine Strategy Directive by taking measures to achieve or maintain good environmental status of marine waters (Art 4). This programme was to follow guidelines in Annexes 3 and 5 and align with environmental targets set under regulation 12. The Secretary of State is responsible for developing a marine strategy aimed at protecting, preserving, and, where possible, restoring marine ecosystems, while preventing pollution that

could harm biodiversity, ecosystems, human health, or sea uses (Art 5). The strategy must apply an ecosystem-based approach that limits human activities to levels that do not compromise marine ecosystem health or resilience to human-induced changes (Art 5(2)). Additionally, the Secretary of State is granted the power to lay down standardised methods for monitoring and assessment of the status of the marine environment (Art 21).

In 2012, the UK government published the **UK Marine Strategy** Part One,[65] which set the foundation for implementation of the Strategy and was later updated in 2019. **Part Two**, published in 2014[66] and updated in 2022[66] sets out **the monitoring programmes used to assess the progress towards achieving GES.** One indicator is bycatch rate or risk for listed fish species, with a target of keeping incidental bycatch below levels which threaten long-term viability and recovery of fish populations (p 33). This is to be monitored through official catch and effort data including from vessel monitoring systems (VMS) and observer programmes. According to the updated assessment from 2019,[65] GES had been achieved for a number of species including grey seals, as well as coastal bottlenose dolphins, and minke whale in the Greater North Sea (p 6). The assessment does note that while targets for cetacean bycatch have been met for some species in certain areas, **there is not enough monitoring to have confidence in bycatch compliance across all UK waters** (p 48). This gap highlights the need for more consistent and extensive data collection to ensure that bycatch management measures are effective across all UK waters. Strengthening monitoring efforts will be crucial in securing the long-term sustainability of vulnerable species and ensuring the continued protection of marine biodiversity under the framework of the Marine Strategy Regulations.

The mortality of cetaceans and seals caused by fishing bycatch is monitored through existing programmes including the UK Bycatch Monitoring Programme (BMP),[67] Cetacean Strandings Investigation Programme (CSIP),[68] Department of Agriculture, Environment and Rural Affairs (DAERA) Marine Mammal Stranding Investigations (Northern Ireland),[69] OSPAR (reports on abundance and distribution of certain cetaceans, which is used as an indicator for cetacean bycatch calculations),[57] and Scottish Marine Animal Strandings Scheme (SMASS)[70] (p 17). Mortality of birds caused by fishing bycatch is monitored through BMP (p 27).

The Conservation of Habitats and Species Regulations 2017

The Conservation of Habitats and Species Regulations 2017[44] **require relevant administrations to establish and maintain systems for monitoring the incidental capture and killing of protected species** as per Annex IV(a) of the Habitats Directive (art 52(1)). This includes regular consultations between administrations, the sharing of information derived from monitoring efforts, and periodic reviews of the arrangements to assess and improve their effectiveness in protecting sensitive marine species. For the purposes of carrying out this regulation, monitoring may be carried out by:

(a) a nature conservation body;
(b) any other competent authority
(c) any person acting pursuant to, and in accordance with–
(i) an agreement with the appropriate authority or a nature conservation body; or
(ii) a condition of a licence or other authorisation granted by a competent authority (art 52(6)).

The nature conservation body must also keep a record of instances of incidental capture and killing and assess the extent to which monitoring incidental capture and killing of those species is necessary, conducting further research as required (Art 52(4)(c); Art 53). The purpose of this research is to ensure that there is not a significant negative impact on the species (Art 53(2)). These measures focus on establishing monitoring systems that promote compliance by providing clear data on incidental capture and informing strategies to mitigate risks to protected species. Authorities are required to evaluate bycatch impacts, maintain detailed records, and conduct targeted research when necessary, ensuring that proactive risk identification and ongoing data collection support effective conservation and compliance efforts.

Initiatives and Industry Schemes

The SSC encourages its members to prioritise responsible seafood sourcing by implementing bycatch mitigation measures and working toward reducing bycatch of endangered or vulnerable species.[50] Transparency and traceability are core principles of the SSC, requiring **members to disclose bycatch-related impacts and ensure responsible supply chains.** The SSC categorises fisheries as "medium risk" when they require improvements to mitigate environmental impact or manage stocks. These fisheries may show stable or improving stock status with adequate management and monitoring in place. This promotes the implementation of monitoring techniques to improve stock status for certification purposes. Notably, **the SSC promotes engagement with certification schemes like the Marine Stewardship Council (MSC) to drive improvements in fisheries management and sustainable practices.**

The MSC standard emphasises minimising environmental impacts under its Principle 2, requiring fisheries to actively reduce bycatch and mitigate impacts on non-target species, particularly those that are endangered, threatened, or protected.[48] Fisheries must demonstrate that their bycatch management practices do not harm the broader ecosystem and must implement effective strategies to address unintended catches.

To ensure high-quality evidence in fisheries assessments, the MSC introduced the Evidence Requirements Framework, which includes enhanced guidance for evaluating MCS systems to promote best practices. This framework addresses environmental impacts, shark finning

compliance, and management regulations. In July 2024, an external review of the framework was launched to incorporate stakeholder feedback and further refine its effectiveness.

International Frameworks

In addition to UK initiatives, there are international regulatory frameworks and voluntary guidelines for bycatch management. The CMS requires the establishment of appropriate machinery to monitor its effectiveness and report findings to the Conference of the Parties.[52] ACAP emphasises research and monitoring to assess interactions between albatrosses, petrels, and fisheries, encouraging the use of observers and other reliable data collection methods.[53] In 2021, ACAP published data collection guidelines for observer programmes to improve knowledge of fishery impacts on ACAP listed species, as well as complementary guidelines on fisheries electronic monitoring systems. The guidelines include key recommendations for observer programmes including:

- *All fisheries management bodies with fisheries that overlap with seabirds susceptible to bycatch should establish and implement Fishery Observer Programmes that explicitly include seabird bycatch monitoring objectives and standards.*
- *For regional bodies, such as RFMOs, centralised management of observer programmes is preferable to a nationally implemented and managed system.*
- *Ensure a coordinated approach across regional bodies to enable larger scale assessments of bycatch. This includes making use of data collection and reporting protocols that have already been set up in other bodies, and potentially making use of joint databases* (p 5).

ACAP also recommends critical data to be recorded by observers, including

- *Vessel characteristics, including name, registration and nationality.*
- *Fishing trip and event characteristics, including target fish species, trip number, event number, fishing method and gear used*
- *Total fishing effort*
- *Spatial and temporal information about the fishing operation*
- *Key trawl gear characteristics including the use and characteristics of net monitoring cables*
- *Mitigation measures used* (p 8).

ACAP provides further guidance on bycatch reporting, stating that to improve the monitoring and management of seabird bycatch in fisheries, explicit protocols for reporting seabird bycatch and associated data should be developed and implemented. These protocols must align with data collection requirements and support the overarching objective of accurately monitoring bycatch levels in fisheries. ACAP considers it essential that actual quantitative bycatch data, rather than qualitative summaries, be included in national reports to provide a more precise understanding of the issue (p 17).

AEWA mandates Parties to designate authorities to monitor activities affecting migratory waterbird conservation.[54]ASCOBANS focuses on facilitating the exchange of monitoring and

research information, organising meetings, and reporting on the implementation of agreements and activities related to cetacean conservation.[56] ASCOBANS published a report in 2021 on different methods of monitoring cetacean bycatch in commercial fishing operations. A cost-benefit analysis on a UK gillnet fishery was included and found that REM provides a cost-effective and high-quality monitoring coverage. These international agreements can strengthen global collaboration on bycatch management, encouraging consistent monitoring practices, data sharing, and targeted conservation actions to protect vulnerable species.

The FAO Technical Guidelines for Responsible Fisheries emphasise a cyclical framework of data collection, research, and monitoring to reduce seabird bycatch through adaptive management.[5] Similarly, guidelines for reducing marine mammal bycatch stress the need for monitoring to ensure bycatch is below levels that could prevent population viability. Key actions include providing baseline data on habitat use, fishing effort, and bycatch rates, and supporting monitoring through independent observers or electronic systems. The Code of Conduct for Responsible Fisheries (CCRF) advocates for effective fisheries monitoring, surveillance, and enforcement measures to ensure compliance with conservation and management actions.[60] States are encouraged to implement monitoring programs, including observer schemes and vessel monitoring systems, and cooperate within regional organisations to establish effective systems for control and enforcement in both national and international waters.

Practical Monitoring Efforts in the UK

There are numerous practical monitoring efforts past, present, and planned in the UK (Annex 2). The following section examines a selection of monitoring projects in the UK, chosen for their variety in targeted taxa and availability of information. By exploring these examples, this section aims to illustrate how different monitoring techniques are applied to address specific bycatch challenges, providing the groundwork to later assess both the successes and limitations of current practices.

As part of the UK's efforts to address fisheries bycatch, the government has invested money in a diverse portfolio of different research projects to better understand how to mitigate and reduce bycatch (Annex 2). When summarising these fundings over the last 18 years, some patterns emerge that may[4] highlight areas for improvement for the UK's investments into UK bycatch (Figure 6). For example, over the last 18 years it appears the **UK has injected money sporadically into bycatch research** and mitigation projects when considering total funding pots that spike heavily in 2011, 2019 and 2022 driven by Cetacean Bycatch Observer

[4] It should be noted that these patterns should be caveated for several reasons: 1) the portfolio of funding whilst comprehensive may not be exhaustive. 2) the projects identified may be biased regarding time because of internet searches possibly favouring more recent funding schemes like the FISP. 3) Some projects did not have funding or timing data available and therefore the dataset used herein is incomplete and may not represent the full picture of funding or project spans allocated.

Monitoring scheme, Clean Catch UK, and the Bycatch Monitoring Programme and the Insight 360 monitoring. When calculating the total investments in programs calculated as a per year equivalent, the data suggests that in fact although there have been these large sporadic investments, the **UK is increasing its investments overall**. When looking at these patterns specifically for fish versus PETS (Protected, Endangered, Threatened Species) **more money overall has been invested in PETS than in fish species bycatch research** both in terms of total costs (£4.28M vs £1.29M) and per year equivalent costs (£1.38M vs £1.22M) (see Figure 7). This disparity in funding could reflect a genuine increased interest and prioritisation of PETS conservation. However, it might also be a result of the relative ease of measuring bycatch for megafauna compared to mixed fish species, particularly in complex bycatch fishery scenarios. Given that much of UK management and legislation around bycatch is focused on measuring change, establishing indicators, and achieving GES, the emphasis on megafauna research could be driven more by the practicality of monitoring and designing compliance targets than by an inherently higher importance placed on these species.

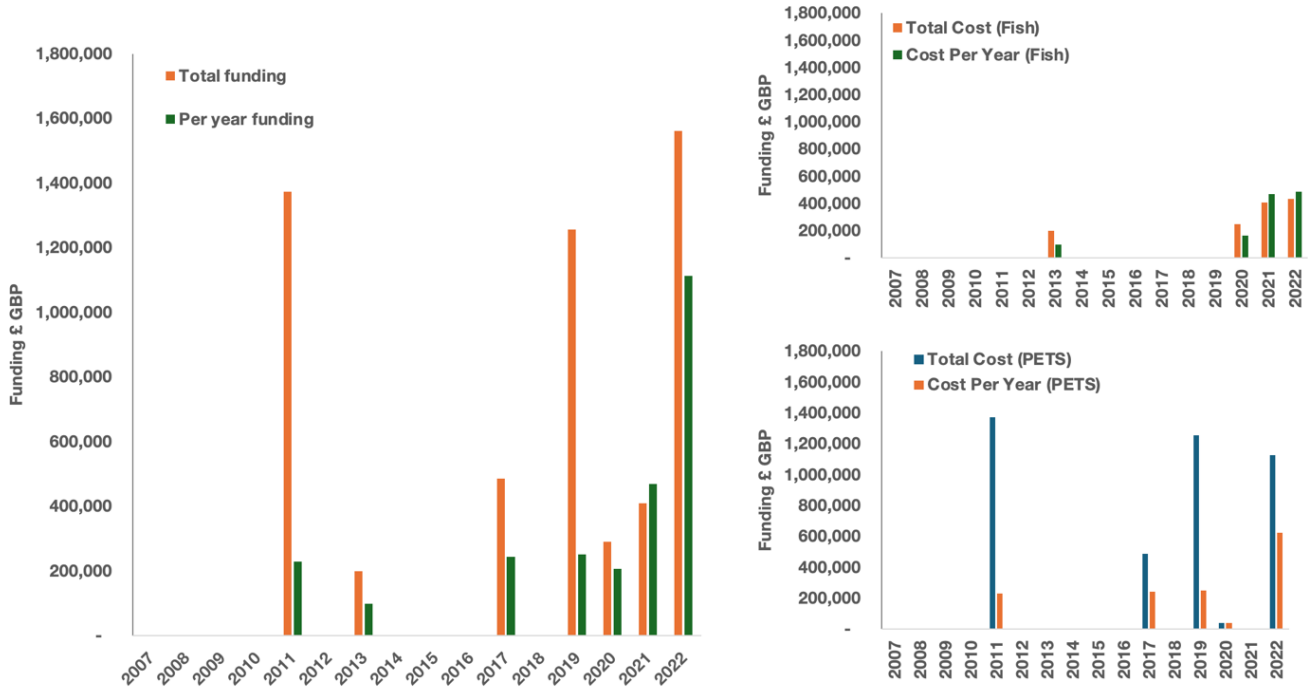

Figure 6. Panel figure showing total funding and funding per year of program (equivalent) along with the same divided into those programs focusing on fish versus PETS (Protected, Endangered, Threatened Species (which usually correlate to megafauna)).

Interestingly, when looking at the length of different bycatch research programs, the **overall time investment appears to be increasing** with a total of 150 months of research effort invested in 2022 (Figure 8). However, this may be caused by the UK's large investment in the Seafood Innovation Funding as well as the Fisheries Industry Science Partnership Schemes, the former having already ended and the later ending in 2025. These appear to have been a large-scale push from the UK government pushed by Brexit and based on discussion with

regulators[5], renewals of such generous funding packets are not at present in UK government funding plans.

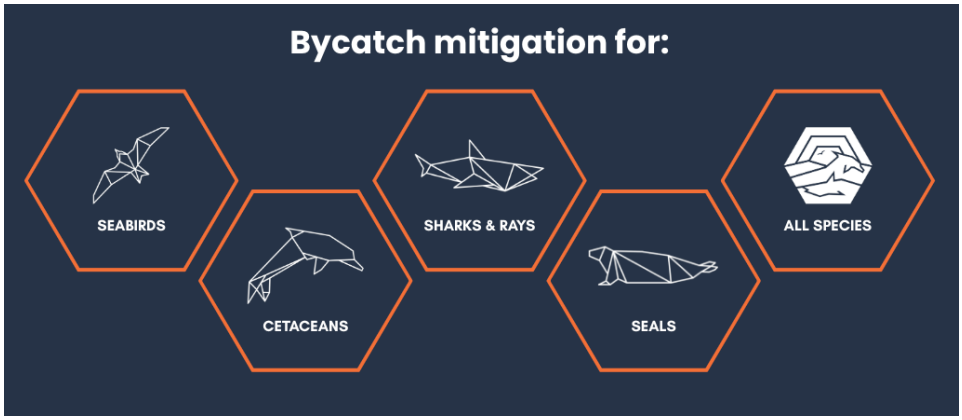

Figure 7. Image from the CleanCatch UK website that highlights the common focus on large megafauna and places fish species bycatch as a potentially secondary concern.

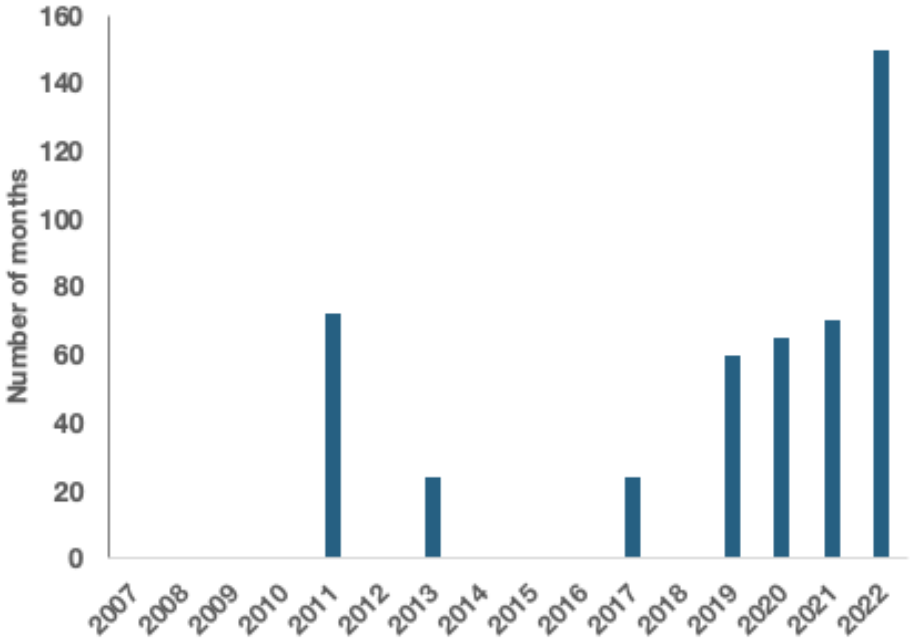

Figure 8. Total length (months) of UK bycatch programs from those uncovered in the review.

The UK's approach to bycatch monitoring and mitigation has demonstrated a clear commitment to addressing bycatch through several innovative research programs and increasing investments. However, the sporadic nature of funding and a **lack of (publicly available) future commitments to large-scale initiatives may pose challenges to maintaining momentum.** While significant progress has been made, particularly in protecting

[5] This is based on MFE's communications with different administrations and should be treated as hearsay as it is difficult to prove no future funding.

PETS, a **more consistent and sustainable funding strategy** will be crucial for ensuring long-term success in reducing bycatch and safeguarding marine biodiversity.

Large-scale bycatch monitoring efforts - Examples

The Working group on bycatch of protected species (WGBYC), is an ongoing monitoring programme established in 2007 through ICES, collects and analyses data from the Northeast Atlantic and adjacent sea areas related to the bycatch of PETS, including marine mammals, seabirds, turtles and sensitive fish species in commercial fishing operations.[71] The 2023 annual report provides an overview of collected data from 2022 including reported monitoring data and bycatch records that ICES countries submitted to the WGBYC database. Monitoring data is primarily collected by at-sea observations, which WGBYC considers the most reliable source of data for bycatch calculation (annual report p 23). Electronic monitoring is considered reliable, and vessel crew observer data is considered moderately reliable, given it can be validated against independent monitoring data (e.g. electronic monitoring) from the same fishery. WGBYC considers data from logbooks and port observers to be unreliable for purposes of bycatch calculation but may have value if there are no other monitoring techniques available for that fishery. Other monitoring methods such as interviews with fishers are considered by WGBYC to be generally unsuitable for the calculation of bycatch rates due to underlying biases which may be difficult to account for.

The Cetacean Bycatch Observation Scheme (2017 - 2019)[72] is a continuation of the Cetacean Bycatch Observer Monitoring System which was a similar project running from 2011 to 2017. This project combines on-board fishery observations with records of the fleet fishing effort to estimate total bycatch of marine mammals and other protected species in UK fisheries. Since the project began before the UK's official exit from the EU, independent observers were placed on a representative selection of vessels using specific gear types and in particular regions that are either required under EU law or in which the bycatch of protected or vulnerable species could be having the greatest conservation impacts. The 2020 bycatch report includes observer data from ICES divisions 6a (West of Scotland), 7c (Porcupine Bank (West of Ireland)), 7d (Eastern Channel), and 7e (Western Channel). Observer data is from gillnet, tangle net, trammel net, and longline vessels, and includes bycatch information on mammals, seabirds, sharks, and skates (BMP Annual Report 2020). Annual reports from each year of the programme provide information on fishing effort by key fishery and by region, summaries of bycatch observations and associated estimates of protected species annual bycatch.

BMP is a continuation of the Cetacean Bycatch Observation Scheme.[73] Beginning in 2022, this project is currently ongoing, with a 2025 end date. BMP aims to pilot ways to expand and diversify monitoring techniques to provide better bycatch estimates by bringing together a wide range of sources, including monitoring through the Clean Catch UK project, the existing Fisheries Observer Programme, self-reporting by fishers and any REM trials. Additionally, this project expands monitoring to include all marine mammals, seabirds, sensitive elasmobranchs and fish, and turtles. The BMP annual report reports on acoustic deterrent devices (ADD)

compliance. Fishing vessel compliance with ADD requirements are carried out by the MMO in English and Welsh waters and by Marine Scotland (MS) in Scottish waters (BMP 2020 report p 20). These compliance checks were conducted by at-sea inspections, during which two offences were detected in Scottish waters during the boardings for suspected breaches of the Landing Obligation (p 21). Due to the report being from 2020, covid restrictions led to lower-than-normal inspection rates.

Small-scale bycatch monitoring efforts - Examples

Devon and Severn Inshore Fisheries and Conservation Authority (IFCA) trialled a low-cost REM solution from 2022 – 2023 that could provide the necessary level of monitoring and evidence to deter illegal fishing within MPAs and afford protection to these sites. Although this project does not specifically monitor bycatch as a primary objective, monitoring and control plans in the MPA include analysing IVMS data, engagement with fishers and questionnaires to obtain bycatch information. In September 2022, Officers reported positive outcomes from D&S IFCA's REM project. The project demonstrated that D&S IFCA could adopt a new management approach that benefits fishers and enables a fully automated system for monitoring compliance with Marine Protected Area restrictions. The governance working group was tasked with reviewing D&S IFCA's Compliance and Enforcement strategy, but at the time of publication of the report, this review had still not started (p 10). Some industry stakeholders have, however, noted that the scheme being "voluntary" was a misnomer as a lack of participation restricted their access to certain grounds and technical problems with the VMS terminals hampered comprehensive data collection during the trials.

Another project includes the assessment of bycatch of non-target species in Welsh static net fisheries. As bycatch of non-target species in this fishery is not well understood, this project has been funded through the Fisheries Industry Science Partnerships (FISP) scheme.[74] Estimates of bycatch in this fishery come from UK-level observer programmes which are then extrapolated across each fishing area. This project aims to create better understanding of bycatch rates in Welsh fisheries in a more targeted manner, to inform better management in future fisheries policies. This project is currently ongoing, and reports are not yet available.

The final project considered in this review is another FISP funded project, regarding above-water deterrents (AWDs) and mitigating seabird bycatch in set net fisheries. This project is currently ongoing, and while it does not have monitoring as a primary objective, monitoring efforts are required for the success of the project. Pilot studies have been conducted in the Baltic Sea and showed reduction in seabirds near AWDs, but this project aims to understand if these results will translate into reduced bycatch in operational fisheries. To do so, vessels are being equipped with onboard cameras to increase understanding on seabird bycatch and evaluate the potential of new technologies on fisheries impacts.

Program Evaluation for Accuracy and Reliability

The bycatch monitoring initiatives in the UK incorporate a variety of methods to assess and mitigate bycatch. Despite the **wide-ranging scope of these programs, there remain challenges in evaluating their accuracy and reliability as tools for fisheries management.** The methodologies employed, from traditional observer programs to REM, highlight both opportunities and gaps in the UK's approach to bycatch data collection and application.

Accuracy of Monitoring Efforts

The accuracy of bycatch monitoring is vital for informing effective fisheries management, yet challenges remain in ensuring data reliability. Programs like the BMP have made strides in diversifying monitoring techniques, incorporating Fisheries Observer Programmes, REM technologies, and self-reported data from fishers to generate more accurate bycatch estimates. Each method, however, has its limitations. **Observer programs, while well-regarded, often lack sufficient spatial and temporal coverage, and the presence of observers can inadvertently alter fisher behaviour, potentially skewing the data.**

Low-cost REM technologies, as demonstrated by the Devon and Severn IFCA EM project, **offer consistent and automated monitoring solutions. These systems are particularly effective for specific objectives, such as compliance with MPA restrictions, yet they may fall short in capturing incidental bycatch events.** Similarly, self-reported data from fishers helps to fill critical data gaps but can be prone to bias—whether intentional or unintentional—reducing its reliability.

Despite these challenges, the integration of multiple data sources shows significant promise for improving the accuracy and comprehensiveness of bycatch monitoring. **By combining observer data, REM outputs, and fisher-reported data, monitoring programs can develop a more holistic understanding of bycatch trends,** ultimately enhancing efforts to mitigate its impacts and contribute to sustainable fisheries management.

Evaluating Data Reliability

The reliability of bycatch data requires consistent protocols, comprehensive sampling, and the incorporation of emerging technologies. However, the lack of formal program evaluations makes it difficult to judge how reliable many of these monitoring initiatives are. The disparity in objectives, methodologies, and reporting standards across projects may hinder cross-program comparability and the integration and harmonisation of data. While programs like BMP expand coverage across multiple species[6] groups, differences in implementation can impede their

[6] Note previous calls (supported by 10 NGOs) for the elimination of cross-taxa bycatch in UK fisheries – *"Gearing up to eliminating cross-taxa bycatch in UK fisheries" A Wildlife and Countryside Link (WCL) technical briefing.* (This call was largely focused on UK megafauna, not fish).

overall reliability. External factors, such as COVID-19 restrictions that reduced at-sea inspections, underscore the vulnerability of data collection efforts to unforeseen disruptions. Such gaps in coverage create increased uncertainties when evaluating long-term trends.

A key limitation identified in the UK's bycatch monitoring landscape is the lack of transparency in summarising program outcomes and lessons learned. **Few programs offer comprehensive evaluations at their conclusion** or clearly articulate how findings are translated into practical fisheries management or legislative changes. This opacity undermines the ability to refine methodologies or scale up effective practices.

Projects funded through initiatives like the FISP emphasize pilot studies and innovation but **often stop short of broad, formal evaluations with a clear path towards informing policy and regulation**. For instance, the Welsh static net bycatch project and the above-water deterrent studies provide preliminary insights, but their potential for informing future policy remains unclear without robust final assessments accessible to interested parties. **Greater efforts to consolidate findings and systematically review program effectiveness would enhance the utility of these initiatives.**

Gaps and Limitations in Bycatch monitoring

An overarching concern with the UK's approach to bycatch monitoring is the **disconnect between data collection and its application to management and legislation**, as the pathway from monitoring outcomes to practical fisheries policies remains opaque. Addressing this issue requires a **more explicit framework for integrating monitoring results into decision-making processes, alongside prioritizing funding and resources for programs that include mechanisms for evaluation and public dissemination of outcomes to ensure accountability and transparency**. Additionally, the bycatch monitoring landscape in the UK faces several gaps and limitations, such as uneven allocation of funding, inadequate program evaluation, and limited species coverage, which constrain its overall effectiveness. A summary table below identifies these key gaps, providing concise descriptors, detailed explanations, and applicable references.

Table 7. Key gaps and limitations in bycatch monitoring in the UK.

Gap / Limitation	Full Description	In Relation to GES
Lack of program evaluation	Whilst there are many programs, few appear to have formal final reviews or monitoring, evaluation, and learning processes that assess program success. Without these evaluations, it is challenging to determine effectiveness or lessons learned.	Without program evaluations, it is difficult to assess the effectiveness of bycatch mitigation measures, which are critical for achieving GES.
Difficulty tracking program outputs	Projects often generate academic papers or interim reports, but it is difficult to link these outputs to specific programs. This lack of transparency hinders a systematic evaluation of knowledge gains from individual efforts.	The inability to track outputs reduces transparency and hinders the development of evidence-based strategies to mitigate bycatch and progress toward GES.
Imbalance in funding allocation	While funding is available for monitoring megafauna (e.g., cetaceans, seabirds), limited resources are allocated for taxa such as fish. This imbalance creates significant data gaps in less-studied bycatch species groups.	The imbalance in funding creates gaps in data for species, leaving critical ecological impacts unaddressed, hindering GES progress.
Data gaps for small-scale fisheries	Small-scale and artisanal fisheries are underrepresented in most bycatch monitoring efforts. Limited funding and logistical challenges mean these fisheries lack adequate coverage, contributing to gaps in bycatch data for specific gear types and regions.	Underrepresentation of small-scale fisheries in monitoring efforts leaves key sectors unassessed, undermining GES objectives for comprehensive bycatch management.
Inconsistent application of REM technologies	While REM has proven effective in some projects (e.g., D&S IFCA trials), its adoption remains limited and there is variability in implementation standards across regions and fisheries.	Inconsistent application of REM technologies limits the ability to standardize and scale effective monitoring solutions, impeding GES progress.
Limited geographic coverage	Monitoring efforts tend to concentrate in regions with higher fishing effort, potentially overlooking areas with lower effort but potentially significant bycatch.	Focusing on high-effort regions neglects areas with potentially significant ecological impacts, creating blind spots in achieving GES for bycatch reduction.
Focus on gear-specific solutions	Bycatch reduction strategies often focus on single gear types (e.g., set nets), neglecting the potential for mixed solution approaches to work together. Within the same fishery context. This may limit their scalability and overall impact on reducing bycatch.	Gear-specific solutions fail to address the potential of mixed-solution bycatch reduction / mitigation comprehensively, likely reducing the overall impact of mitigation strategies on achieving GES.
Unclear pathways to policy integration	Monitoring results are not systematically linked to practical fisheries policies or regulatory changes. This lack of integration reduces the overall impact of monitoring programs on sustainable fisheries management.	The lack of integration between monitoring and policy weakens the feedback loop needed to implement adaptive measures required for GES.
Gaps in self-reporting mechanisms	Fisher-reported bycatch data remains underutilized due to concerns over accuracy, compliance, and trust. There is little focus on improving these mechanisms or integrating them effectively with other data sources.	Inaccurate or underutilized fisher-reported data hampers reliable assessments of bycatch, undermining transparency and the ability to measure progress with GES indicators.
Limited long-term monitoring	Many programs focus on short-term trials and pilots without ensuring continuity. This short-term focus leads to limited datasets for assessing trends and understanding long-term impacts.	The short-term nature of monitoring programs fails to capture long-term trends, making it difficult to assess and achieve sustained improvements for GES.

Best Practices and Lessons Learned

The following discussion considers other practices from within and outside the UK, and opportunities for improved bycatch monitoring and examples of 'best' / 'good' practice. The leading authority in fisheries science within Europe is arguably ICES. The organisation has several different working groups that are specialized teams of scientists and experts who collaborate on marine science and fisheries issues. These groups are essential components of ICES' work, functioning to provide scientific advice and promote sustainable management of marine ecosystems and resources. Fisheries bycatch features heavily in ICES work and as such ICES has two dedicated working groups on the subject: the Working Group on Bycatch of Protected Species (WGBYC) and the Working Group on Fisheries Bycatch (WGFBycatch). As such, ICES is an important place to look for examples of project success as well as lessons learned. The bycatch projects ICES have invested in are diverse and highlight the nature of the bycatch problem which often requires a multi-pronged approach using different methods to understand the extent of the problem as well as case specifics designed to satisfy the nuances of the issues being tackled (Table 8).

Table 8. Examples of monitoring and technical measures from the ICES working group on fisheries bycatch (WGFBycatch).Note the prevalence of megafauna in the summarised studies that ICES and other organisations often report.

Country	Monitoring or Technical Measures	Description	Organism group
Spain	Monitoring	On-board	Marine Mammals and Protected, Endangered, Threatened Species
Spain	Technical Measures	Pingers, exclusion devices	Cetaceans
France	Monitoring	REM	Marine mammals
Portugal	Monitoring	Observers, fisher logbooks, and harbour surveys	Cetacean and bird
Canada	Technical Measures	Gear projects (breakaway designs, ropeless systems)	Cetaceans
USA	Monitoring	EM	Fish
USA	Technical Measures	Turtle Excluder Devices (TEDs)	Turtles

The project examples from ICES (Table 8) illustrate how different countries are adopting innovative approaches to address bycatch, combining monitoring and technical solutions tailored to local contexts. Monitoring efforts, such as on-board observers in Spain and Portugal or REM in France and the USA, show the value of diverse data collection methods. Combining human observations with technologies like REM provides comprehensive insights into bycatch events, enhancing compliance and supporting adaptive management. Multimodal strategies, like Portugal's integration of logbooks, harbour surveys, and observer programs, demonstrate the benefits of a holistic approach to data gathering.

Technical measures being tested also highlight promising innovation (see also Box 6). Turtle Excluder Devices (TEDs) in the USA are a proven, scalable solution for reducing turtle bycatch in trawl fisheries, while Canada's gear projects, such as breakaway designs and ropeless systems, offer targeted solutions for minimizing cetacean entanglements in high-risk fisheries. Spain's use of pingers and exclusion devices showcases how acoustic and physical deterrents can effectively protect cetaceans. However, the success of these measures still depends on their adaptability to local fisheries and the species they aim to protect.

Box 6. Summary from: Evaluating Success of Bycatch Mitigation Measures (O'Keefe et al.) ICES CM 2012/C:17.

Effective bycatch mitigation is critical to achieving sustainable fisheries while minimizing ecological impacts. The paper reviewed various bycatch mitigation strategies and evaluated their effectiveness in reducing the unintended capture of non-target species across fisheries. Key approaches examined included gear modifications, spatial and temporal closures, bycatch quotas, and fleet communication systems. Each method has been implemented with varying degrees of success, influenced by species-specific dynamics, fishery characteristics, and compliance levels.

The findings reveal that gear modifications, such as the use of bycatch reduction devices (BRDs) and turtle excluder devices (TEDs), are among the most effective tools, particularly in addressing specific bycatch species such as marine mammals and sea turtles. Spatial and temporal closures, while useful for protecting vulnerable habitats and species, can lead to displacement of fishing effort, potentially creating bycatch issues elsewhere. Fleet communication programs, which rely on real-time data sharing between vessels, have shown promise in dynamically avoiding bycatch hotspots but require robust monitoring systems and high levels of industry collaboration to succeed.

The evaluation emphasizes the importance of adaptive management in bycatch mitigation. Strategies tailored to the biological characteristics of target and non-target species, combined with industry participation and enforcement, yield the best results. However, the paper also highlights trade-offs, such as economic challenges for fishers and the risk of unintended ecological consequences. A multi-faceted, ecosystem-based approach, integrating real-time data, stakeholder input, and ongoing monitoring, is therefore essential to refining bycatch management and achieving long-term sustainability in fisheries.

Another of the key challenges identified in bycatch monitoring programs is the lack of formal program evaluation (as aforementioned). Many projects and initiatives exist, but **few appear to have undergone comprehensive evaluations or developed and implemented monitoring and evaluation frameworks.** This makes it difficult to assess their effectiveness in reducing bycatch or enhancing species conservation. To address this, a robust evaluation system should be incorporated from the start of any significant bycatch mitigation initiatives / methods / tests. For example, the North American Sea Turtle bycatch monitoring program

integrates annual evaluations that assess both quantitative results, such as bycatch rates, and qualitative outcomes, such as community engagement and policy impact.[75] Incorporating formal MEL indicators frameworks like these into UK programs would allow for clearer measurement of success and highlight more clearly areas that require further improvement.

In terms of monitoring and compliance, there is noticeable variability in the effectiveness of monitoring programs across regions and fisheries. **Inconsistent adherence to bycatch mitigation measures creates challenges for enforcement**. Establishing more standardized monitoring systems, adaptable to local contexts, could be an effective solution. The Commonwealth Fisheries project in Australia offers a useful model, utilizing both observer programs and automated electronic monitoring systems (EMS).[76] These have proven successful in improving bycatch data collection and compliance rates in diverse fishery contexts. This kind of system could be implemented across UK fisheries to ensure consistent monitoring and compliance.

Bycatch in small-scale fisheries remains a less-understood issue, often overshadowed by the focus on industrial-scale operations. Many small fisheries lack robust monitoring systems, resulting in limited data on bycatch levels. Addressing this gap requires increased engagement with small-scale fishers and the deployment of cost-effective, adaptable technologies such as low-cost REM solutions or collaborative data collection methods. For instance, the Devon & Severn IFCA trialled such a system to enhance compliance monitoring and improve data on fisheries impacts. This model provides an important opportunity for small-scale fisheries to engage with monitoring while ensuring their financial and operational viability. Since inception the project has also been expanded to encompass more vessels in the IFCA's membership.[77]

A related issue is the **lack of clear pathways from data to legislative change**. Even though bycatch data is being collected, the relationship between research outputs and tangible policy adjustments remains unclear. Bycatch management in Canada serves as a strong example of this approach, where researchers work directly with policy-makers to integrate monitoring findings into regulatory frameworks.[78] The UK can learn from this collaborative model by **establishing strong partnerships between researchers, fisheries managers, and lawmakers to ensure that monitoring results are used effectively in the development of practicable policy**.

Another significant issue is the difficulty tracking outputs from projects. Even though numerous projects collect valuable data, it is often unclear which specific datasets are contributing to knowledge gains, making it hard to evaluate the cumulative impact of these efforts. Clear data documentation and centralized repositories are crucial for improving accessibility and usability. The UK has made significant efforts to centralize marine data collection and management to support sustainable ocean governance and research. The Marine Environmental Data and Information Network (MEDIN) serves as a cornerstone in these efforts, providing a centralized portal with access to over 17,000 marine datasets from various organizations. There are also

complementary platforms to MEDIN such as the British Oceanographic Data Centre (BODC), and the ADMIRALTY Marine Data Portal. All these initiatives collectively aim to make marine data Findable, Accessible, Interoperable, and Reusable (FAIR), enhancing the UK's capacity to monitor and manage its marine resources effectively.

While such centralized platforms provide invaluable tools for managing marine data, challenges remain in addressing the sensitivity of certain datasets, particularly those related to bycatch. Bycatch data often contains sensitive information, such as vessel tracking details, which could raise privacy or commercial concerns. This sensitivity may hinder the widespread sharing and accessibility of bycatch data, even within well-structured platforms. As a result, while these systems enhance data management and accessibility, they may not fully resolve issues related to data sharing and transparency, necessitating additional measures to balance data utility with the protection of sensitive information.

Limited geographic and species coverage

The UK's bycatch monitoring strategy, encompassing frameworks such as the JFS, the BMI, and the Marine Strategy Regulations, aims to reduce bycatch and conserve sensitive species. Initiatives like the Cetacean Bycatch Observation Scheme and the Bycatch Monitoring Programme employ both traditional observer methods and innovative tools like REM. **Despite these efforts, challenges persist, including limited geographic and species coverage, inconsistent application of REM technologies, inadequate evaluation frameworks, and unclear pathways for integrating monitoring data into legislative changes.**

International examples underscore **the importance of collaboration and stakeholder engagement**. Voluntary programs, such as REM pilots foster trust but must be complemented by mandatory measures for broader adoption. Additionally, financial incentives and training can help overcome barriers for smaller operators, ensuring equitable participation in bycatch reduction efforts. These practices highlight the value of combining technology, policy, and fisher involvement to create effective and sustainable solutions for mitigating bycatch across regions.

A more inclusive approach to species monitoring is needed, as specifically funded UK bycatch data collection tends to focus on megafauna (e.g., cetaceans and seabirds), while fish species and other marine organisms remain underrepresented. While the life history characteristics of marine megafauna clearly make them vulnerable to fisheries bycatch, from an economic and wider marine community sustainability perspective, the bycatch of fish species needs better representation in efforts, particularly considering the JFS push to reduce UK bycatch. **The UK should invest in broader monitoring efforts that encompass a wider range of marine species, adopting a more holistic approach that includes proactive data collection as standard practice, as well as case-specific responsive efforts for specific bycatch cases of concern.**

While the UK's current bycatch monitoring programs are a step in the right direction, there are several areas where improvements can be made. By drawing from international best practices, such as integrated species monitoring, and rigorous evaluation processes, the UK can refine its approach to bycatch reduction**. It is important that monitoring programs are designed to produce actionable data that can influence legislative changes, leading to more effective conservation outcomes and reduced bycatch**. These efforts should also be adaptable, accommodating the evolving needs of fisheries and the dynamics of marine ecosystems.

CHAPTER 5. UK Bycatch Enforcement and Compliance

Effective enforcement of bycatch regulations is important to sustainable fisheries management and the protection of marine ecosystems[7]. This chapter examines the state of bycatch enforcement and compliance measures in the UK, focusing on the powers and strategies of the Marine Management Organisation, the role of policy frameworks such as the Joint Fisheries Statement and Fisheries Management Plans, and the impact of broader legislative and international agreements.

While the UK boasts a robust legal foundation and ambitious commitments to reducing bycatch, enforcement remains a challenging area, with gaps in implementation and resource allocation. This chapter seeks to assess whether the UK's current enforcement landscape is equipped to ensure compliance and deliver on its goals of sustainable fisheries and biodiversity conservation.

Marine Management Organisation (MMO)

The Marine and Coastal Access Act 2009 established the MMO[79] transferring functions from the Sea Fish Conservation Act (1967)[80] through the Marine and Coastal Access Act. The MMO's primary goal is to oversee licensing, regulation, and marine planning for activities in England's seas and to ensure these activities are conducted sustainably.

The MMO is also granted enforcement powers to ensure compliance with marine conservation laws. Specifically regarding export of seafood products to the USA, there is a mandatory requirement[81] (based around the USA's MMPA - marine mammal protection act) under fishing vessel licence conditions to report any marine mammal bycatch to the MMO within 48 hours of the end of the fishing trip. This is interesting as it is an example of a non-UK jurisdiction's rules / legislation applying to UK fisheries (and aquaculture). This may seem somewhat surprising, particularly because enforcement and compliance of the MMPA rules within the UK is considered good (Pers. Comm. Industry and management authorities). However, the driving force behind this is a strong economic one based on the trade of seafood rather than just a UK drive for better environmental conservation. In some ways, this perhaps indicates that economics is an important lever in industry-wide behavioural change and compliance. It should, however, be noted that the MMPA does not at present impact UK fisheries because no UK fisheries products are exported to the US market. The impact of the MMPA, for now is largely focused on aquaculture produced salmon that has issues with seal predation and avoidance measures that have previously been flagged in MMPA audits. Therefore, until UK fisheries catched have a more established US market, the MMPA will remain inconsequential for UK fisheries and only be impactful for UK finfish aquaculture which does have a US market.

[7] It is important to note that this is not the only thing that is necessary for marine protection and conservation. Marine conservation is a multi-faceted problem that involves various factors within the UK fishing fleet and additional factors extraneous to fisheries like land run-off, windfarm development, aggregate extraction etc.

The Landing Obligation (LO) applies to all fishing vessels, including those under 10 metres in length. MMO enforces compliance with the LO through various measures. The Fully Documented Fishery (FDF) scheme incentivises fishermen to avoid discards by promoting accountability for all catches, including unmarketable fish. Fishermen must record discards exceeding 50 kg per trip in logbooks, specifying the estimated weight of each species. The MMO also investigates discrepancies in data, which may indicate breaches of assimilated EU legislation, with enforcement actions ranging from verbal warnings to prosecution of vessel owners or masters. A risk-based enforcement process is employed when other tools fail to resolve compliance issues, ensuring a fair and proportionate approach to enforcement.

MMO's Compliance and Enforcement Strategy was updated in 2020 *'to ensure that the environment, public health, and legitimate uses of the sea is properly protected.'*[82] Enforcement powers available to the MMO include:

- Seizure and disposal of offending goods and fish – certain provisions provide for seizure and disposal of goods and fish e.g. of illegal fishing net attachments or undersized fish.
- Imposition of conditions on operating –such as a condition applied to a licence.
- Carrying out of remediation in default of action by the recipient and recovering costs.
- Variations of a licence or permit – e.g. in relation to activity licensed e.g. port development.
- Revocation of licence or permit – e.g. for fishing.

While bycatch is not mentioned explicitly in the Compliance and Enforcement Strategy or the other Acts that give the MMO enforcement powers, these regulations create the possibility for MMO to enforce bycatch policies that are implemented.

Joint Fisheries Statement (JFS) and FMPs

The JFS, reflects policies to be implemented in order to meet bycatch management objectives.[28] Section 4.2.6 of the JFS provides for monitoring and enforcement actions to be taken by fisheries authorities. These policies are adaptable to various fisheries across the UK, tasking each national fisheries authority with regulating and enforcing fisheries using methods that are appropriate and proportionate to their respective waters and fisheries (4.2.6.3). Additionally, fisheries enforcement authorities are to work together to ensure enforcement meets the requirements of the legislation in place, ensuring a consistency in approach where feasible (4.2.6.4). Enforcement actions will be dependent on the actual policies implemented, but the FMPs have yet to be implemented, so specific enforcement legislation is not yet defined.

The bass FMP does not provide specific enforcement policies, but states the goal of ensuring full compliance with bass regulations can be achieved through improved collaboration between regulators on targeted enforcement and clarity of approach to ensure consistency in how regulators enforce bass regulations (Goal 4).[32] The FMP for channel demersal non-quota species does not specify any enforcement actions.[33] The lobster and crab FMP does provide

for enforcement policies to ensure fishers' compliance with Minimum Conservation Reference Size (MCRS) by harmonising standards for lobster and crawfish.[34] These regulations protect spawning stock biomass and promote sustainability, but they need to be implemented carefully to mitigate socio-economic impacts on fishers, such as by providing longer lead-in times or incremental changes to regulations. **Consistent enforcement across jurisdictions is another key goal, ensuring that fishers operating in different regions are subject to the same rules, particularly in areas where they might land catches in different regulatory zones.** A stakeholder engagement report for the king scallop FMP[64] found that there was a perceived risk that the FMP could make the management landscape more complex and make enforcement more difficult (p 7). The FMP for North Sea and Eastern Channel mixed flatfish does not identify any need for changes to current monitoring and enforcement strategies, but notes that changes may be required in the future.[83]

Additionally, innovative approaches to monitoring, such as the research project aimed at defining "soft brown crab" based on objective measures like durometer testing, are part of ongoing efforts to improve enforcement and monitoring (lobster and crab FMP).[34] This project, funded through the FISP scheme,[74] could resolve current enforcement challenges related to subjective classifications of crab shell condition, aiding in the regulation of crab landings for bait use. English Channel crabbing vessels, however, are already voluntarily undertaking such measures which highlights that industry buy-in has a much quicker impact than waiting for legislative change to enforce behavioural changes.

In summary, the FMPs employ a mix of monitoring, collaborative enforcement strategies, and adaptive regulation to ensure compliance, protect stocks, and support sustainable fisheries. Through these measures, the plans aim to balance enforcement with industry needs, fostering sustainable practices while minimising negative socio-economic impacts. However, these have yet to be implemented meaning compliance is not able to be evaluated currently in these fisheries, and any updates to enforcement practices have not yet been applied.

Marine Strategy Regulations

The Marine Strategy Regulations 2010 provide a framework for the UK to assess and monitor the status of its waters and to put in place the necessary measures to achieve or maintain GES.[4] There are no enforcement measures in the Marine Strategy Regulations, but the relevant authorities are directed to '*exercise their functions, so far as they are relevant functions, so as to secure compliance with the requirements of the Directive*' (art 4(1)). While the required monitoring programmes discussed in the previous chapter promote compliance, the lack of enforcement policies may undermine the effectiveness of the regulations.

The Conservation of Habitats and Species Regulations 2017

Part 7 of The Conservation of Habitats and Species Regulations 2017 pertains to enforcement.[44] Under these regulations, if a constable (any sworn police officer irrespective of rank) has reasonable cause to suspect that an offence has been or is being committed, they may enter premises (excluding dwellings) to exercise enforcement powers or make an arrest under section 24 of the Police and Criminal Evidence Act 1984. Constables are also permitted to bring necessary equipment or personnel to assist with enforcement activities. Additionally, if a justice of the peace is satisfied, based on sworn information, that there are reasonable grounds to suspect an offence and that evidence may be found on specific premises, they can issue a warrant authorising the constable to enter and search those premises. The offences covered by these provisions include species offences, introducing new species from ships, making false statements to obtain a licence, and breaches under regulation 122(1) or (2). These measures provide robust enforcement mechanisms for environmental protections. As the regulations do call for the monitoring of the incidental capture and killing of certain species, there is the possibility that amendments to the regulations could expand those enforcement powers to bycatch as well.

The 25 Year Environment Plan

The 25 Year Environment Plan sets out long-term conservation plans for England.[45] One goal of the plan was to implement a sustainable fisheries policy upon the departure of the CFP. **Due to its nature as a policy plan, there are no compliance and enforcement measures that are directly implemented from the plan.** The State of Nature 2023 provides information and guidance regarding bycatch, but is a summary report that does not grant any powers for compliance and enforcement related to these activities.[84]

The Environmental Improvement Plan (EIP), published in 2023, builds upon the 25 Year Environment Plan as the government's long-term strategy for environmental recovery in England. The EIP sets out updated targets and actions, including those related to sustainable fisheries management. While it reinforces commitments to reducing bycatch and improving monitoring, it remains a high-level policy framework rather than a regulatory tool with direct enforcement measures. The EIP is intended to be a dynamic document, subject to periodic review and revision, ensuring that environmental policy evolves in response to emerging challenges and scientific developments. It is currently being revised by the new government.

Initiatives and Industry Schemes

There are also industry / third party and retailer schemes such as Clean Catch UK,[47] MSC Fisheries Standard,[48] WWF Global Seafood Charter,[49] and Sustainable Seafood Coalition[50] that contain bycatch mitigation goals. Clean Catch UK includes a Bycatch Mitigation Hub, an interactive resource to explore global bycatch reduction techniques. It outlines key principles and actions that businesses can implement to help conserve marine ecosystems and ensure

the long-term viability of fish populations. **While these various schemes and initiatives have the potential to be very effective with full compliance, they lack enforcement measures, so success is ultimately reliant on industry willingness[8] and to some extent, consumer demand.**

International Frameworks

ACAP provides a framework for the protection of these species but does not include specific enforcement regulations.[53] Instead, it requires each Party to designate an authority or authorities responsible for supervising, applying, and enforcing the agreement. This is outlined in Article 7(1)(a), which emphasises the importance of a structured approach to monitoring and control to ensure compliance with the agreement's provisions.

Similarly, the AEWA includes limited enforcement-related provisions.[54] It primarily focuses on the enforcement of pollution controls, as specified in Article 4.3.9. While this provision underscores the need to address pollution's impact on migratory waterbirds, it does not delve into broader enforcement mechanisms or provide detailed guidance on implementing compliance measures that could be applied to bycatch.

In contrast, ASCOBANS delegates the responsibility for establishing enforcement regulations to the national level.[56] As stated in its Annex, Parties are expected to develop and implement their own enforcement measures in alignment with the agreement's objectives. This approach allows for flexibility but also places a significant burden on individual countries to ensure that national regulations are sufficient to meet the agreement's conservation goals.

Overall, these international agreements highlight a range of approaches to enforcement, from general guidance on designation of authorities (ACAP) to targeted provisions on pollution control (AEWA) and reliance on national frameworks for enforcement measures (ASCOBANS). This variability reflects differences in the scope and focus of each agreement, as well as the challenges of coordinating international efforts to protect migratory species and marine life.

Enforcement and Compliance – fragmented implementation

The enforcement of bycatch regulations in the UK presents a complex and evolving landscape characterised by robust legislative frameworks, emerging strategies, and significant gaps in practical implementation. **While institutions like the MMO and initiatives under the Fisheries Act provide a foundation for enforcement, including powers to regulate,**

[8] It is important to note that many changes driven by MSC have not been met favourably by UK fishing fleets who have had new rules / regulations enforced on them by their producer organisations (POs). Therefore, whilst MSC certification may, in some cases, help with market access for UK seafood products, it may be argued that the relationship between MSC, POs and their fisher members.

monitor, and penalise non-compliance, the system struggles with fragmented implementation, limited resources, and reliance on voluntary industry schemes.

Policy measures, such as the JFS and various FMPs, showcase a commitment to sustainable fisheries, but their enforcement potential is hindered by delayed implementation and the absence of clear mechanisms for compliance monitoring. T**he lack of integration between tools like REM and enforceable frameworks further limits the impact of these measures.** Moreover, while international frameworks and industry-led initiatives set aspirational goals for bycatch mitigation, their effectiveness is undermined by a lack of enforceable provisions and dependence on voluntary compliance.

Despite these challenges, the UK demonstrates potential for bycatch management by advancing its existing frameworks. Enhancing inter-agency coordination and integrating mandatory technologies like REM would benefit enforcement. However, **without swift action to bridge the gap between policy intent and operational enforcement, the UK risks undermining its commitments to sustainable fisheries management.** This underscores the urgency of a cohesive, well-resourced enforcement strategy that aligns regulatory measures with practical capabilities.

CHAPTER 6. UK Bycatch – Final Appraisal

The management of bycatch in UK marine waters can play a pivotal role in achieving GES. The 2019 GES assessment indicated that the GES for commercial fish and shellfish[9] was not yet achieved (see Table 9) and the expected results of the delayed 2024 assessment are predicted to show poor progress towards GES for all species groups and habitats (Table 10). Therefore, there is still considerable work to be undertaken before GES and bycatch related impacts in the UK are close to being "achieved".

This section critically appraises the strengths and weaknesses in the current monitoring and regulatory landscape for UK bycatch, highlighting opportunities for improvement and challenges posed by future pressures. It also addresses key questions related to necessary changes in regulation and monitoring structures, mechanisms for successful policy implementation, conflicts within current frameworks, and anticipated impacts from future pressures. For each section a bullet point summary is also provided.

Table 9. 2016 status of UKMS human activity pressure descriptors. Red = GES was not achieved, orange = GES was partially achieved, green = GES achieved. Take from the October 2019 assessment.

Non-Indigenous Species (D2)	Commercial fish and shellfish (D3)	Eutrophication (D5)	Hydrographical Conditions (D7)	Contaminants (D8)	Contaminants in Seafood (D9)	Litter (D10)	Underwater Noise (D11)

Table 10. 2019 Marine Strategy UK descriptors (taken from OEP' UKMS data-driven review report). The 2024 status review is late and likely delayed to 2025.

UKMS Descriptors	2019 UKMS Status
Birds	Did not achieve GES
Seals	Partially achieved GES
Cetaceans	Partially achieved GES
Fish	Did not achieve GES
Pelagic Habitats	Partially achieved GES
Benthic Habitats	Did not achieve GES
Food Webs	Partially achieved GES
Non-indigenous Species	Did not achieve GES
Commercial Fish and Shellfish	Did not achieve GES
Eutrophication	GES achieved
Hydrographical Conditions	GES achieved
Contaminants	GES achieved
Contaminants in Seafood	GES achieved
Litter	Did not achieve GES
Underwater noise	Partially achieved GES

[9] the descriptor most related to bycatch impacts

Strengths in Monitoring and Regulation

The UK has developed a legislative framework to address bycatch, considering the Fisheries Act 2020, the Joint Fisheries Statement the Bycatch Mitigation Initiative and the ongoing development of the FMPs. These all emphasize reducing bycatch and approximately align UK practices with international commitments like the OSPAR Convention and the MSFD (and therefore the objective of reaching GES). The UK has shown its commitment to the MSFD by incorporating GES into the Marine Strategy Regulations and continuing to aim for these goals post-Brexit. The JFS and FMPs specifically provide a clear path and potential mechanisms[10] for coordination across the UK's devolved administrations. Monitoring efforts, including Remote Electronic Monitoring and observer programs, have demonstrated effectiveness in specific fisheries and regions. Additionally, multi-stakeholder initiatives such as Clean Catch UK have enhanced awareness and helped promote improved practices. Collaboration among government bodies, NGOs, and industry stakeholders has been instrumental in driving innovation through pilot projects and advancing bycatch mitigation technologies. Recent consultations on discard reform, the broader implementation of REM and ongoing FMP development indicate a governmental commitment to refining regulatory frameworks in fisheries, guided by stakeholder input and technological advancements.

Legislative Frameworks:

- The Fisheries Act 2020, JFS, BMI, and the development of FMPs emphasize reducing bycatch.
- These frameworks align UK practices with international commitments such as the OSPAR Convention and the MSFD, aiming to achieve GES.

Coordination Mechanisms:

- The JFS and FMPs provide a clear path and potential mechanisms for coordination across the UK's devolved administrations.

Monitoring Efforts:

- REM and observer programs have demonstrated effectiveness in managing bycatch in specific fisheries and regions.

Multi-Stakeholder Initiatives:

- Initiatives like Clean Catch UK have enhanced awareness and promoted improved bycatch practices.

Collaborative Innovation:

- Collaboration among government bodies, NGOs, and industry stakeholders has driven innovation through pilot projects and advanced bycatch mitigation technologies.

Regulatory Refinement:

- Recent consultations on discard reform, the broader implementation of REM, and ongoing FMP development reflect a governmental commitment to refining fisheries regulatory frameworks.

[10] It should be noted that every FMP id different and many are in different stages of development, therefore this comment does not necessarily hold true for every extant FMP.

- These efforts are guided by stakeholder input and advancements in technology.

Weaknesses in Monitoring and Regulation

Despite the UK's established frameworks, significant weaknesses and gaps still hinder the effectiveness of bycatch management. Regulatory limitations include a lack of binding commitments and enforceable timelines in key initiatives like the BMI, as well as fragmented governance and overlapping mandates across regional, national, and international frameworks, likely leading to inefficiencies. Monitoring efforts face challenges such as limited geographic and species-specific coverage, particularly for vulnerable marine megafauna and benthic ecosystems with a lack of focus on more generic large-scale fisheries (fish species) bycatch. Additionally, issues with data reliability, transparency, and accessibility likely impede effective decision-making and enforcement. Implementation gaps further exacerbate these challenges. While policies like the Fisheries Act and Joint Fisheries Statement set ambitious objectives, inconsistent operationalization delays progress in achieving outcomes. The coexistence of voluntary and mandatory schemes may also be creating confusion, potentially undermining compliance and adding pressure to an already stressed relationship between UK fisheries, markets and governments. Furthermore, resistance from fishers regarding mitigation technology uptake, especially small-scale operators, stems from the perceived financial and logistical burdens as well as privacy associated with adopting new technologies such as Remote Electronic Monitoring. These gaps highlight the need for targeted improvements in governance, monitoring, and stakeholder engagement.

Regulatory Limitations:

- Lack of binding commitments and enforceable timelines in key initiatives such as the BMI.
- Fragmented governance and overlapping mandates across regional, national, and international frameworks lead to inefficiencies.

Monitoring Challenges:

- Limited geographic and species-specific coverage, particularly for vulnerable marine megafauna and benthic ecosystems.
- Insufficient focus on large-scale fisheries bycatch (e.g., fish species).
- Issues with data reliability, transparency, and accessibility impede effective decision-making and enforcement.

Implementation Gaps:

- Inconsistent operationalization of ambitious objectives in policies like the Fisheries Act and Joint Fisheries Statement may hinder progress.
- Coexistence of voluntary and mandatory schemes creates confusion, potentially undermining compliance.
- Strained relationships between UK fisheries, markets, and governments due to unclear policy implementation.

Stakeholder Resistance:

- Resistance from fishers, particularly small-scale operators, to adopt mitigation technologies like REM.
- Concerns over financial and logistical burdens, as well as privacy, further hinder uptake of new technologies.

Need for Improvement:

- Highlights the necessity of targeted improvements in governance, monitoring, and stakeholder engagement to address these gaps effectively.

What changes need to occur in regulation and monitoring structures in the UK, if bycatch is to be effectively managed to the extent necessary to achieve GES?

To effectively manage bycatch and achieve GES, the UK must implement clearer, measurable and enforceable targets with binding timelines for reducing bycatch across all fisheries. These need to be designed alongside the more generic GES indicators. They must also span and encompass monitoring, enforcement, compliance and real reductions in bycatch rates for key fisheries in which bycatch is a significant problem. Regulatory oversight should be expanded to include under-monitored regions and species. Whilst the historical focus on UK megafauna is important, it may be argued that larger scale change can happen if fish species bycatch is more heavily addressed due to is almost ubiquitous nature across the UK fishing fleet. This in turn will have positive consequences for food web dynamics and benthic habitats in marine ecosystems and therefore contribute to ecosystem based fisheries management. Existing policies should be harmonized with international commitments such as the MSFD and OSPAR agreements to ensure consistency and accountability. This integration will help address fragmentation and enhance the UK's ability to monitor progress towards clear, measurable goals and enforce regulations comprehensively, creating a more streamlined and effective governance framework.

Clearer and Enforceable Targets:

- Implement measurable and enforceable targets with binding timelines for reducing bycatch across all fisheries.
- Targets should span monitoring, enforcement, compliance, and actual reductions in bycatch rates.
- Complement generic GES indicators with specific bycatch-focused metrics specific to fisheries.

Expanded Regulatory Oversight:

- Include under-monitored regions and species in regulatory frameworks and / or measurable goal setting.
- Expand focus from primarily UK megafauna to include fish species bycatch more prominently.

- Addressing fish species bycatch will positively impact food web dynamics and benthic habitats.

Policy Harmonization:

- Align existing policies with international commitments like the MSFD and OSPAR agreements.
- Ensure consistency and accountability across national and international frameworks.

Streamlined Governance:

- Integrate fragmented policies to create a unified, effective governance framework.
- Enable comprehensive monitoring, measurable progress tracking, and enforcement of regulations.

What are the mechanisms required for any regulation/ policy/ delivery frameworks to be successful in terms of the uptake of effective bycatch management and monitoring practices in UK marine waters?

Effective implementation of bycatch management frameworks in the UK requires robust stakeholder engagement, capacity building, and well-designed policy mechanisms. Partnerships with industry must be fostered by providing financial incentives to encourage the adoption of best practices, such as the use of selective fishing gear and Remote Electronic Monitoring. Integrating voluntary industry initiatives into formal regulatory frameworks could further ensure consistency and compliance. Capacity building is essential, involving enhanced training and resources for fishers and monitoring personnel, as well as increased funding for enforcement bodies like the MMO and for research and development activities to test and corroborate new designs that can help the UK reduce bycatch. Finally, policy mechanisms could mandate the landing of bycatch under specific conditions to improve data collection while enforcing penalties for unauthorized catches to deter non-compliance. Together, these measures will help enhance uptake and effectiveness of bycatch management practices.

Stakeholder Engagement:

- Foster partnerships with industry by providing financial incentives for adopting best practices, such as selective fishing gear and Remote Electronic Monitoring.
- Integrate voluntary industry initiatives into formal regulatory frameworks to enhance consistency and compliance.

Capacity Building:

- Provide enhanced training and resources for fishers and monitoring personnel.
- Increase funding for enforcement bodies, such as the Marine Management Organisation.
- Support research and development to test and validate new bycatch reduction designs.

Policy Mechanisms:

- Mandate the landing of bycatch under specific conditions to improve data collection.

- Enforce penalties for unauthorized catches to deter non-compliance.

Are there any conflicts between the different government and non-government schemes/initiatives in relation to the management of bycatch?

Conflicts within the UK's bycatch management landscape may arise from overlapping mandates and inconsistencies between voluntary and mandatory schemes. These overlaps can lead to inefficiencies and confusion among stakeholders, complicating compliance and enforcement. For instance, government-mandated regulations sometimes conflict with voluntary initiatives such as Clean Catch UK, creating fragmented implementation and diverging priorities. Similarly, market-based incentives like eco-certifications may place different constraints on fishing operations compared to legislation. If such pressures are both directed at reductions in effort for example, they can lead to inefficiencies in fishing operations as well as frustration for industry who become increasingly restrained trying to keep up with. Addressing these issues requires the creation of a unified governance structure to streamline decision-making and ensure alignment between all initiatives. Harmonizing voluntary and mandatory schemes can help reduce redundancies, while clearly defining roles and responsibilities across stakeholders will improve coherence and accountability in bycatch management.

Overlapping Mandates and Inconsistencies:

- Conflicts arise due to overlaps between voluntary and mandatory schemes, leading to inefficiencies and stakeholder confusion.
- Government regulations sometimes conflict with voluntary initiatives like Clean Catch UK, resulting in fragmented implementation and diverging priorities.

Market-Based Incentives vs. Legislation:

- Eco-certifications and market-based incentives often impose constraints on fishing operations that may differ from legislative requirements.
- Conflicting pressures, such as simultaneous reductions in fishing effort, can create inefficiencies and frustration for the fishing industry.

Impact on Compliance and Enforcement:

- These overlaps complicate compliance and enforcement, further hindering effective bycatch management.

Recommendations for Improvement:

- Create a unified governance structure to streamline decision-making and align all initiatives.
- Clearly define roles and responsibilities across stakeholders to improve coherence and accountability.

How will future pressures impact on the regulatory framework for the effective management of bycatch in UK marine waters?

Future pressures such as climate change, industrial expansion, and technological needs will significantly challenge the existing regulatory framework for bycatch management. Climate change will alter species distributions and behaviours, necessitating dynamic, data-driven updates to regulations to ensure continued protection of vulnerable species as well as fish bycatch and habitats adversely impacted because of UK bycatch. Industrial expansion, particularly the growth of offshore energy projects, will exacerbate spatial conflicts by displacing fishing activities, potentially into ecologically sensitive areas or areas not yet exposed to significant fishing pressures. This will potentially increase the risk of bycatch as fishers are moved to less productive grounds that require more fishing effort (and potentially therefore bycatch) to meet quota allocations. To address these challenges, future frameworks must incorporate advanced monitoring technologies while building resilience to adapt to evolving environmental and industrial conditions. Proactive planning and adaptive management will be essential to mitigate these pressures and maintain effective bycatch management.

Climate Change:

- Alters species distributions and behaviours, necessitating dynamic, data-driven updates to regulations.
- Impacts fish bycatch and habitats adversely affected by UK bycatch.

Industrial Expansion:

- Growth of offshore energy projects exacerbates spatial conflicts by displacing fishing activities.
- Displacement into ecologically sensitive or previously unfished areas increases the risk of bycatch.

Technological Needs:

- Advanced monitoring technologies must be incorporated into future frameworks to address evolving challenges.

Adaptive Management:

- Proactive planning and adaptive regulatory mechanisms are essential to mitigate pressures and maintain effective bycatch management.

How much change is needed to achieve GES?

Whilst the UK's drive to achieve GES is commendable and sensible, it could be argued that the lack of quantifiable goals within the GES framework will make it hard to accurately assess if GES has been achieved. Bycatch by its nature is multi-faceted due to multiples species, multiple geographies, multiple fisheries and multiple regulatory jurisdictions all coming into play on the subject. In addition, the levels of may be considered "acceptable" or within GES will vary over time and based on these multivariate factors that also have a multitude of different

impacts that correlate to varied portfolios of the GES indicators. This leaves the evaluation of bycatch in the lens of GES somewhat of a conundrum that in many ways is unanswerable. At least based on the current known (2019) and predicted (2024 / 2025) GES assessment, the UK has a long way to go to achieving GES related when considering bycatch because it overlaps with those indicators that to date have scored poorly in assessments. The magnitude of change needed is unknown but can be posited to be significant base on the fact that moving from a red to a green in the GES framework is assumed to be no small leap. Whether the government's current plans will be sufficient to achieve GES is largely an unknown but in terms of bycatch will likely be based on the successful design and implementation (and then compliance) with the new FMPs.

Challenges in GES Framework:

- The lack of quantifiable goals within the GES framework makes it difficult to accurately assess whether GES has been achieved.
- Bycatch is inherently multi-faceted, involving multiple species, geographies, fisheries, and regulatory jurisdictions, adding complexity to its evaluation.

Dynamic Nature of Bycatch:

- Levels of acceptable bycatch or alignment with GES vary over time and depend on multivariate factors.
- Bycatch impacts correlate with varied portfolios of GES indicators, creating a complex and somewhat unanswerable conundrum under the current framework.

UK's Progress Toward GES:

- Current and predicted GES assessments (2019–2025) indicate that the UK needs to make significant progress in achieving GES related to bycatch.
- Bycatch overlaps with GES indicators that have historically scored poorly in assessments, highlighting the need for considerable change.

Magnitude of Change:

- The scale of improvement required to move from a failing (red) to a successful (green) score in the GES framework is substantial and likely a significant challenge.

Improvements for UK bycatch management

To improve bycatch management in UK marine waters, several key recommendations should be implemented. Regulatory frameworks need to be strengthened with enforceable timelines and clear metrics for success, while governance structures should be simplified to streamline decision-making and eliminate any potential redundancies. Monitoring efforts must also be enhanced. This can be undertaken by scaling up the adoption of Remote Electronic Monitoring, increasing observer coverage, mandating industry-driven data collection from fishing fleets and / or enforcing landing of bycatch species in subsets of fisheries to address existing data gaps. Standardizing data collection and data sharing mechanisms will further improve transparency and accountability. Stakeholder collaboration is essential, with the development of cost-sharing models to reduce financial burdens on fishers and encourage the wider adoption of bycatch mitigation technologies. This includes increased flexibility when it

comes to technical measures that may often hinder fishers from reducing bycatch[11] as well as funding to formally test innovations that can be dynamically spliced into existing regulations as and when needed to ensure bycatch mitigation and reduction can follow spatial and temporal patterns in fishing and species abundance. Finally, policies must incorporate adaptive mechanisms to address emerging challenges such as climate change and industrial expansion, ensuring resilience and flexibility in the face of future pressures.

Regulatory Enhancements:

- Strengthen commitments in key policies with enforceable timelines and metrics for success.
- Simplify governance structures to streamline decision-making and reduce redundancy.

Monitoring Innovations:

- Scale up REM adoption and enhance observer coverage to address data gaps.
- Standardize data collection and sharing mechanisms for greater transparency.

Stakeholder Collaboration:

- Develop cost-sharing models to alleviate financial burdens on fishers and promote wider adoption of mitigation technologies.

Adaptive Management:

- Incorporate flexible mechanisms into policies to address emerging challenges like climate change and industry expansion.

Future Trajectories in UK Bycatch

The future of bycatch management in UK marine waters is inextricably linked to the dual pressures of climate change and the current trajectory of bycatch practices. Without significant mitigation efforts, bycatch will continue to exert profound impacts on marine ecosystems, likely with consequences for biodiversity, fisheries sustainability, and ecosystem services. The following points are somewhat speculative but provided to allow evaluation of future consequences with varying scenarios of bycatch mitigation effort and success.

If current bycatch pressures persist:

Biodiversity decline: Vulnerable species, including marine megafauna and benthic organisms, will experience continued population declines, particularly in heavily fished areas. This is likely to exacerbate the current challenges of achieving GES.

Ecosystem Instability: Disruptions in food webs caused by the removal of key species will lead to imbalances in predator-prey dynamics, reducing ecosystem resilience and productivity.

[11] Note from the authors: we work with many skippers who know very well how to remove or reduce bycatch of undersized fish but rigid gear tech regulations prohibit them from using different gear designs flexibly.

Habitat Degradation: Increased bycatch of benthic species could result in long-term damage to seafloor habitats, further compromising biodiversity and ecosystem functioning.

Impacts of climate change on bycatch management:

Species range shifts: Rising ocean temperatures and shifting currents are driving species to new habitats, often beyond their traditional ranges. These shifts increase the likelihood of bycatch as fishers target new areas which may not have experienced such fishing pressures previously.

Behavioural changes: Changes in migratory patterns, spawning seasons, and feeding behaviours in response to warming waters and ocean acidification will complicate efforts to predict and manage target catches and therefore bycatch.

Ecosystem interactions: Climate-driven alterations in primary productivity, predator-prey relationships, and habitat availability may create unforeseen ecological consequences, making traditional bycatch management approaches less effective.

Adaptations required to address bycatch in a changing climate:

To effectively manage bycatch in this evolving context, a combination of proactive and adaptive strategies is essential:

Dynamic Management Approaches: Policies must incorporate real-time data on species distribution and behaviour, allowing for flexible management measures such as dynamic closures or temporal fishing restrictions. This also includes dynamic quota allocation and licencing of vessels to allow flexibility and changes to be made in line with spatio-temporal fisheries productivity.

Improved monitoring and prediction: Enhanced use of technologies like REM, coupled with predictive modelling, will enable better anticipation of bycatch hotspots and emerging risks.

Ecosystem-Based Management: Integrating bycatch mitigation into broader ecosystem-based management frameworks will ensure that the cumulative impacts of climate change and bycatch are addressed cohesively.

Stakeholder Engagement and innovation: Collaboration with fishers, scientists, and policymakers to develop and test adaptive gear technologies that can reduce bycatch under shifting environmental conditions.

Not just climate change

Future pressures such as climate change, industrial expansion, and technological needs will significantly challenge the existing regulatory framework for bycatch management. Climate change will alter species distributions and behaviours, necessitating dynamic, data-driven updates to regulations to ensure continued protection of vulnerable species. Industrial expansion, particularly the growth of offshore energy projects, will exacerbate spatial conflicts by displacing fishing activities into ecologically sensitive areas, increasing the risk of bycatch. To address these challenges, future frameworks must incorporate advanced monitoring technologies, such as AI-driven bycatch detection systems, while building resilience to adapt to evolving environmental and industrial conditions. Proactive planning and adaptive management will be essential to mitigate these pressures and maintain effective bycatch management.

Conclusion

Bycatch remains a critical challenge in the journey toward sustainable marine ecosystems and achieving GES in UK waters. Its multifaceted nature—spanning species, geographies, and fisheries—makes it a complex issue that impacts biodiversity, food webs, and benthic habitats. Addressing bycatch requires dynamic, data-driven solutions, robust monitoring systems, and policies that integrate stakeholder collaboration and technological innovation.

As a central pressure on marine health, bycatch underscores the need for adaptive management approaches that balance ecological sustainability with the economic realities of fishing communities. Prioritizing species-wide and habitat-scale interventions, harmonizing regulatory frameworks, and embedding flexibility to respond to climate change and industry expansion will be critical. By treating bycatch as both a challenge and an opportunity, the UK can establish itself as a leader in sustainable fisheries management, ensuring resilient ecosystems and livelihoods for future generations.

Acknowledgements

MarFishEco extends its sincere gratitude to the two external experts who contributed their insights in evaluating the most relevant GES descriptors and indicators for UK bycatch. We also appreciate the invaluable support of the two external peer reviewers, whose feedback helped ensure that the literature reviewed was as current as possible and that the messages conveyed remained objective. Additionally, we thank the experts who were consulted to corroborate findings and clarify aspects that were ambiguous in published materials.

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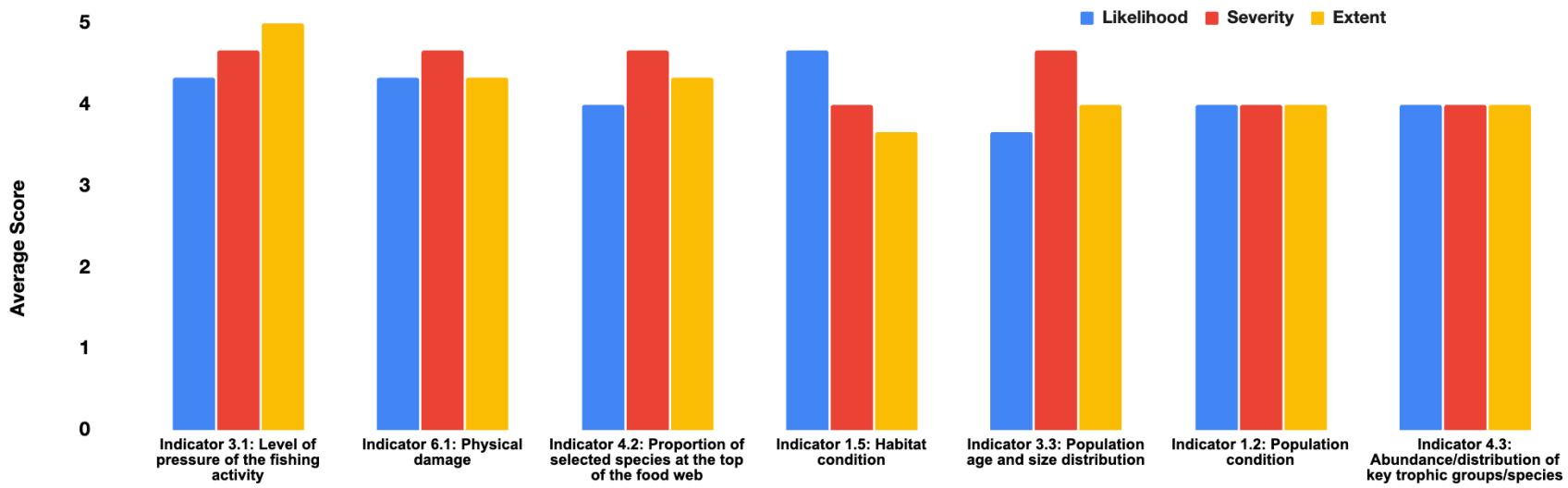
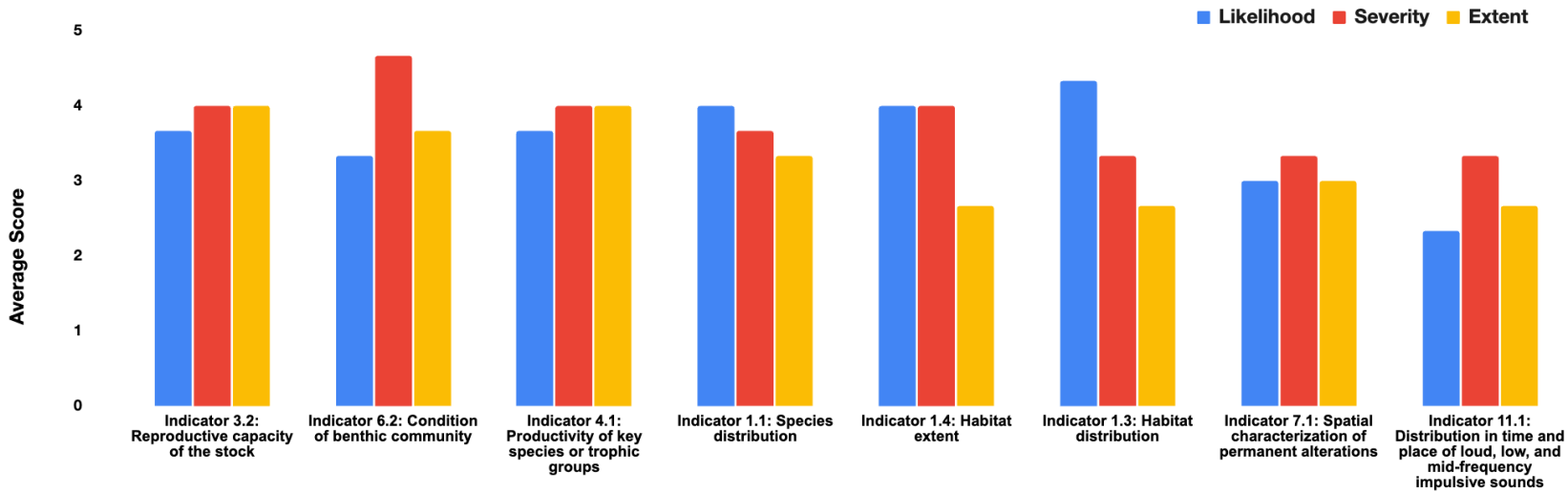
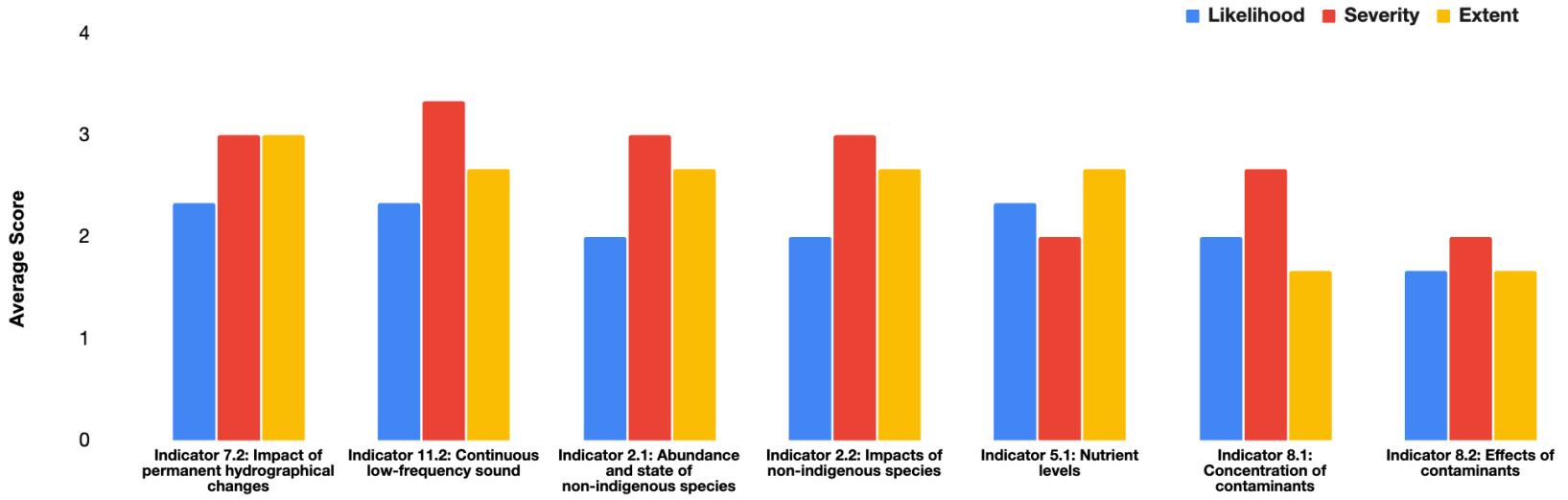
Annex

Annex 1. Likelihood, Severity and Extent scores for each GES indicator. Panels separated into highest, medium and lowest importance scores (n = 7,8,7) – e.g. Indicator 3.1 (Level of pressure of the fishing activity) scored the highest, whilst Indicator 8.2 (Effects of contaminants) score the lowest.




Likelihood
Severity
Extent
Average Score
5
4
3
2
1
0
Indicator 3.2: Reproductive capacity of the stock
Indicator 6.2: Condition of benthic community
Indicator 4.1: Productivity of key species or trophic groups
Indicator 1.1: Species distribution
Indicator 1.4: Habitat extent
Indicator 1.3: Habitat distribution
Indicator 7.1: Spatial characterization of permanent alterations
Indicator 11.1: Distribution in time and place of loud, low, and mid-frequency impulsive sounds


Likelihood
Severity
Extent
Average Score
4
3
2
1
0
Indicator 7.2: Impact of permanent hydrographical changes
Indicator 11.2: Continuous low-frequency sound
Indicator 2.1: Abundance and state of non-indigenous species
Indicator 2.2: Impacts of non-indigenous species
Indicator 5.1: Nutrient levels
Indicator 8.1: Concentration of contaminants
Indicator 8.2: Effects of contaminants

Annex 2. Examples of UK bycatch research and monitoring efforts (collated from multiple sources).

Title of Project	Start year	End year	Description	Approaches	Organism group	Organism group category	Cost Per Year (equivalent)	Length of program (months)	Total Cost
Working group on bycatch of protected species (WGBYC 2023)	2007	ongoing	Analyses to improve understanding of bycatch impacts on sensitive species across the Northeast Atlantic and adjacent seas.	Data collection & collation, analysis, risk-based approaches, reviewing current mitigation strategies	PETS	PETS	unknown	ongoing?	unknown
Cetacean Bycatch Observer Monitoring System (Continued as ME6004) - MB5203	2011	2017	Addressed monitoring and quantifying cetacean bycatch to improve data quality and support mitigation efforts.	Observer monitoring and acoustic deterrents	Cetaceans	PETS	£228,842	72	£1,373,052
Common Fisheries Policy reform implementation: aligning zero quota species and improving fisheries management – a spurdog case study. - MB0125	2013	2015	Align spurdog management under a zero-quota policy exploring evidence-based bycatch allowances and management measures in the Northeast Atlantic.	Species reclassification, biological research, stakeholder engagement.	Single species (elasmobranch)	Fish	£99,790	24	£199,580
Cetacean Bycatch Observation Scheme (continuation of MB5203) - ME6004	2017	2019	Addressed monitoring and quantifying cetacean bycatch to improve data quality and support mitigation efforts.	Observer monitoring and acoustic deterrents	Marine mammal focus, also sharks and birds	PETS	£243,523	24	£487,046
Clean Catch UK - ME6023	2019	2024	Collaborative research program that aims to reduce the accidental capture of wildlife by commercial fishing vessels.	Data collection, hotspot identification, barrier identification, knowledge sharing	PETS	PETS	£251,169	60	£1,255,845
EM Scottish demersal fisheries	2020	2022	Long-term engagement implementing electronic monitoring (EM) systems to measure the discarding practices of small cod across the Scottish demersal fishing fleet.	Electronic Monitoring (EM), compliance monitoring	Single species (North Sea cod)	Fish	unknown	ongoing?	unknown

Above-water deterrents: mitigating seabird bycatch in set net fisheries	2020	2022	Brings together diverse stakeholders to discuss the efficacy of above-water deterrents to understand if initial findings could translate into reduced bycatch in an operational fishery.	Data collection on technology implementation	Seabirds	PETS	£163,068.85	22	£298,416
Plastic Free Fishing	2020	2022	Tests the viability of plastic-free potting gear for shellfish by assessing its ecological, social, and economic impacts, while raising awareness about ghost fishing and lost fishing gear through education and outreach.	Gear innovation, data collection, behavioural analysis, LCA, education and outreach.	Fish	Fish	£60,087.43	22	£109,960
Low Impact Scallop Innovation Gear	2020	2023	The project aims to develop economically viable gear which reduces bycatch and environmental impacts associated with the UK scallop fishery to catch king scallops.	Gear innovation, data collection and analysis, stakeholder engagement	Fish	Fish	£166,604	18	£249,906
Developing a Floated Demersal Longline Design that Minimises Seabird Bycatch	2020	2020	This project looked at the key driver of accidental seabird captures in a floated demersal longline fishery – the availability of baited hooks to seabirds as the line is being set. Using this information, we identified potential gear adaptations to reduce the risk posed to seabirds.	Gear innovation, data collection and analysis, stakeholder engagement	Seabirds	PETS	£40,128	3	£40,128
Devon and Severn IFCA REM Trials	2021	2022	Equipping scallop vessels with onboard cameras and sensors to monitor fishing activities, aiming to enhance compliance and inform sustainable fisheries management.	Remote Electronic Monitoring (REM)	Fish	Fish	unknown	ongoing?	unknown
Addressing specific challenges facing the Celtic Sea demersal trawl mixed fisheries	2021	2022	Brings together key fishing industry actors with fisheries scientists to identify priority industry-science actions which address challenges facing Celtic Sea demersal trawl mixed fisheries.	Quota-focused analyses, uncertainty estimation, spatial analyses, evaluation of mitigation methods	Fish	Fish	£45,600	5	£19,000
Assessing bycatch of non-target species in Welsh static net fisheries	2021	2023	Characterising the Welsh static net fishery, assessing its interaction with different non-target species, and quantifying and characterising the level of bycatch.	Mapping, spatio-temporal modelling, species risk maps	Fish	Fish	£198,999.45	22	£364,169

Data gathering to inform the Nephrops fleet on choke species in Western Scotland	2021	2023	Addresses data deficiencies for ling, a choke species in mixed demersal fisheries.	Biological and fishing data collection, piloting electronic reporting tools and analyzing historical exploitation patterns.	Fish	Fish	£161,026.23	22	£294,678
Smartrawl: a solution to discards and bycatch in trawl fisheries	2021	2022	Development of in-water sorting device for use with trawl gear which is expected to enable fishers to eliminate bycatch of unwanted fish, improving fishing efficiency and sustainability.	Gear innovation, data collection, stakeholder engagement	Fish	Fish	£243,273	18	£364,909
Scallop Potting	2021	2022	This project will investigate the potential to establish a new, commercially viable fishery that harvests king scallops using illuminated traps.	Gear innovation, data collection, stakeholder engagement	Fish	Fish	£181,208	3	£45,302
Bycatch Monitoring Programme (BMP) - ME6063	2022	2025	A comprehensive program to monitor and reduce bycatch of marine mammals, sharks, and seabirds across UK fisheries.	Observer monitoring	Marine mammal focus, also sharks and birds	PETS	£375,948	36	£1,127,845
Insight 360 monitoring	2022	2027	Insight360 is an innovative tool to transform how bycatch events are documented aboard fishing vessels, offering a 360-degree view of fishing activity, cetacean sightings, and bycatch events.	High tech data collection (voice recognition, speech-to-text, machine learning)	Cetaceans	PETS	£250,000	60	£1,000,000 approx.
BATmap (By-catch Avoidance Tool)	2020	ongoing	An app to reduce bycatch in the West of Scotland by enabling real-time sharing of catch information, allowing fishers to avoid areas with high concentrations of unwanted or protected species.	Phone application, real-time monitoring	Fish	Fish	unknown	ongoing	unknown
Gear Trial Partnership Project (GTPP)	2022	2025	Gear Tech project focused on the UK Nephrops trawl fleet.	Gear testing, data collection, stakeholder engagement.	Fish	Fish	£456,679.24	22	£835,723

Sustainable Recovery of Shellfish Using Remote Technology	2022	2022	Explore the feasibility of using Remotely Operated Vehicle technology for the recovery of scallops from the seafloor in an environmentally sustainable manner.	Gear innovation, ROV technology, stakeholder engagement	Fish	Fish	£149,028	4	£49,676
Scallop Potting	2022	2023	This project aims to provide a method to coastal fishers wishing to augment their crustacean catches with high-value, low-impact scallops.	Gear innovation, data collection, stakeholder engagement	Fish	Fish	£153,652	16	£199,748
Sustainable recovery of shellfish using remote technology	2022	2023	This project will deliver a working prototype Remotely Operated Vehicle technology for the recovery of scallops from the seafloor in an environmentally sustainable manner.	Gear innovation, ROV technology, stakeholder engagement	Fish	Fish	£184,776	12	£184,776