

Nature Conservation Advice from NatureScot and JNCC: Pelagic FMPs

Executive Summary

This advice forms part of a commission from the Marine Directorate (MD) to NatureScot and JNCC to provide nature conservation advice to support the development of UK Fisheries Management Plans (FMPs). The advice provides information on the risks arising from the Scottish fisheries contained within the Atlanto-Scandian Herring FMP, the North Sea Greater Silver Smelt FMP, the North Sea Herring FMP, the North Sea Horse Mackerel FMP, the Northern Shelf Blue Whiting FMP, the Northern Shelf Mackerel FMP, the West Coast of Scotland (and Clyde) Herring FMP, and the West of Scotland Greater Silver Smelt FMP, hereafter referred to as **the Pelagic FMPs**, to:

- The designated features of Marine Protected Areas (MPAs) in Scottish waters
- Priority Marine Features (PMFs)
- UK Marine Strategy (UK MS) descriptors

This advice sets out our approach and a brief assessment of risks to MPA features, PMFs and UK MS descriptors in Scottish waters from the pelagic fisheries covered in the Pelagic FMPs. Although the underlying impact pathways are similar (e.g. bycatch is a risk in all three assessments), there are also important differences. The UK MS and PMFs list cover a much broader range of species than those protected by MPA designations, especially for cetaceans and fish. Also, the underlying objectives are different and therefore there may be subtle but important differences to the assessment of risk and precaution. Therefore, our advice is presented separately for MPA features, PMFs and UK MS descriptors.

This advice has scoped in pelagic trawls and purse seines as being the most relevant gear types for consideration. Drift nets have also been included in the assessment. However, as this gear is not widely used in the Scottish pelagic fisheries covered by the FMP, the assessment of risk has been refined to account for this. Jigging, a fishing method used in the Scottish mackerel fishery, is the most common handline gear used in the Scottish pelagic fisheries. Other handline gears, such as trolling, may be used in Scotland and elsewhere in UK waters targeting pelagic fish, but it is currently unclear to what extent these fisheries are to be included in the Scottish Pelagic FMPs. All handline gears are considered to be very selective, with low risk of bycatch. These gears have therefore been scoped out of this assessment in relation to bycatch risk, but this gear group has been considered in the broader assessment of the impacts of prey species removal. More specific information on gear types, location and fishing effort will improve the ability to assess environmental risks associated with each FMP and may alter some of the risk-ratings presented. However, the primary aim of this advice is to provide a pragmatic steer on where the greatest concerns lie for interactions between relevant fishing gear types and the designated features of MPAs, PMFs, and UK MS descriptors. Further SNCB advice will be required to support the Habitats

Regulations Appraisal of any management measures stemming from the FMP and their potential effects on designated sites and features.

Risks relating to the designated features of MPAs in Scottish Waters

Fisheries contained in the Pelagic FMPs have the potential to impact the designated features of MPAs in 2 primary ways;

- (i) through the **bycatch** of designated features of MPAs, and
- (ii) the direct (targeted) and indirect (bycatch) **removal of prey species** on which designated species depend.

These impacts can potentially occur both inside and outside MPA site boundaries. Pelagic gears are considered to pose negligible risk to benthic habitats (Rosen et al., 2012) in the context of physical impact, and impacts that do occur would be mitigated by the existing MPA management process. **This impact pathway has therefore been screened out of this advice.**

Assessments of the impact of fishing activity occurring within MPAs in Scottish waters has been carried out by the Marine Directorate of the Scottish Government. Management measures for relevant fishing activities within MPAs have been implemented or are in development, to ensure any fishing within MPAs is compatible with the MPA's conservation objectives. Therefore, the existing assessment and management pathways mitigate risks arising from fishing activity within Scottish MPAs, and **no additional action is suggested for the Pelagic FMPs within Scottish MPA site boundaries at this time.** However, potential risks to designated mobile features remain when they move outside of the MPA.

The results of an initial consideration of the available evidence and expert opinion based assessment of the main risks arising from the Pelagic FMPs to the designated features of Scottish MPAs are summarised below.

Risk Summary:

Evidence suggests that pelagic trawl and purse seine fisheries pose a relatively low risk to the MPA designated marine mammal and fish species features in terms of bycatch, with limited records of bycatch of harbour porpoise, grey seals, basking shark and 'common' skate. However, due to low sampling effort, improved evidence is needed to support a low risk rating for these species. Several MPA designated bird species features are considered sensitive to bycatch in these fisheries; guillemot, razorbill and cormorant have all been recorded as bycatch in pelagic trawls.

While mobile species are typically considered sensitive to bycatch in static and drift net fisheries, there is insufficient resolution to determine the impact of pelagic drift net fisheries specifically. Although the use of pelagic drift nets in the regions covered by the Pelagic FMPs is limited, based on the potential sensitivity to bycatch, expert advice suggests the risk ought to be classed as moderate. This aligns with the assessment from French et al. (2022).

Owing to significant gaps in the available evidence, **the risk rating for bycatch in pelagic fisheries is considered moderate**. Addressing evidence gaps through ongoing monitoring and research or, where necessary, through enhanced data collection will improve confidence in the assessment of bycatch risks.

All the fish species managed through the pelagic FMPs are considered prey species for a broad range of predators and as such, are an important part of the marine ecosystem around Scotland. There is good evidence to demonstrate that many of the pelagic species covered in the pelagic FMPs are key prey for many of the designated fish, marine mammal, and seabird features in Scottish MPAs. However, the extent to which features rely on specific pelagic prey species is less clear. As such, **the risk rating for pelagic fisheries in Scottish waters regarding removal of important prey species that designated species depend on is considered moderate**. Work done by the Pelagic FMPs to ensure fisheries meet the precautionary and stock sustainability objectives of the Fisheries Act will help to ensure that exploited stocks are fished sustainably, but additional consideration of predator needs is recommended.

Risks relating to Priority Marine Features

Priority Marine Features (PMFs) in Scotland represent a selection of habitats and species identified for their conservation importance. These eighty-one features are acknowledged for their national significance and the role they play in supporting marine biodiversity. The list includes highly mobile marine mammals and fish (but not seabirds), as well as habitats and benthic species of conservation interest. The purpose behind identifying PMFs is to focus conservation efforts, guide management actions, and ensure the protection and enhancement of marine biodiversity within Scottish waters.

The primary impact pathways for PMFs are the same as those listed above for MPA features: (i) bycatch, (ii) prey reduction. As with the MPA risk assessment, physical impacts have been screened out as pelagic gears are considered low risk with respect to this impact pathway.

The results of an initial consideration of the main risks to PMFs also echo the assessment for MPA features, albeit covering an additional suite of features. The results of our assessment are summarised here.

Risk Summary:

There is a moderate risk of bycatch for PMFs (marine mammal and fish) from pelagic fisheries in Scottish waters. As discussed above for MPA features, pelagic fisheries are not expected to pose a substantial risk of bycatch; however, evidence gaps remain resulting in a precautionary rating. Addressing evidence gaps through ongoing monitoring and research or, where necessary, through enhanced data collection will improve confidence in the assessment of bycatch risks.

Several marine mammal and fish PMFs, in addition to those species designated as MPA features, are likely to utilise pelagic species at various life stages as a prey resource. Though they exhibit a variety of foraging strategies, many killer whale groups, including those that visit Scottish waters, are fish-eating specialists, feeding almost exclusively on schooling pelagic fish species such as herring and mackerel. Fin whale feed on small schooling fish species such as herring and sprat. Herring and mackerel are also important prey species for adult porbeagle. Though substantial evidence gaps exist, many of the species targeted by fisheries listed under the Pelagic FMPs are important prey species for a variety of cetaceans and fishes, including species of conservation interest which are not listed as PMFs, such as the humpback whale; thus, **a moderate risk to PMFs (fish, marine mammals) through removal of key prey species in pelagic fisheries is concluded.**

Work done by the FMP to ensure fisheries eventually meet the precautionary and sustainability objectives of the Fisheries Act will help to ensure the stocks are fished sustainably, but additional consideration of predator needs is recommended. For forage fish stocks, additional steps should be considered so that stocks are managed in such a way as to enable them to perform their key role in marine food webs and ecosystems. This would be an important step in implementing an Ecosystem Based Approach to Fisheries Management.

Risks relating to UK Marine Strategy Descriptors

The UK Marine Strategy Regulations 2010 (SI 2010/1627) provide the policy framework for delivering marine environmental policy at the UK level and set out how the vision of clean, healthy, safe, productive, and biologically diverse oceans and seas will be achieved. The Regulations require authorities to define the characteristics of Good Environmental Status and in turn develop an associated Programme of Measures to deliver this. Good Environmental Status (GES) establishes a 'benchmark' for our seas which seeks to *'protect the marine environment, preventing its deterioration and restoring it where practical, while allowing sustainable use of marine resources.'* For each descriptor there are a number of practical targets and indicators that facilitate assessment of our delivery against each descriptor.

The UK Marine Strategy Regulations require management action to be taken to achieve or maintain GES. The Fisheries Act (2020) enables regulators to deliver on this ambition through the Ecosystem Objective, which states that fish and aquaculture activities should be managed using an ecosystem-based approach, which is, in-part, defined in the Act by the achievement of GES. Equally, the Joint Fisheries Statement (2022) lays out the ambition across UK administrations to take action to achieve or maintain GES in all UK waters (Joint Fisheries Statement, 2022).

This advice focuses only on the most relevant descriptors in terms of risks posed by commercial and recreational fisheries: D1 biodiversity, D3 commercial fish and shellfish, D4 foodwebs, D6 seafloor integrity and D10 marine litter. In the UK MS, these descriptors are assessed using indicators for each of their constituent 'ecosystem components.' This is carried through to this advice resulting in advice on risks to eight descriptor-ecosystem

component combinations: D1, D4 cetaceans; D1, D4 seals; D1, D4 seabirds; D1, D4 fish; D4 foodwebs; D1, D6 seafloor integrity and D10 Marine Litter.

The results of an initial consideration of the available evidence and expert opinion of the main risks arising from the fisheries covered by the Pelagic FMPs to UK MS Descriptors are summarised below.

Risk Summary:

There is a *moderate* risk to achieving GES for the biological diversity of cetaceans, seals, and birds, due to impacts from Pelagic fishing activities. Bycatch is likely to impact some species populations to the extent that it is contributing to the failure to achieve GES. However, though mobile species are typically considered sensitive to bycatch in static and drift net fisheries, there is insufficient resolution to determine the impact of pelagic drift net fisheries specifically. Although use of pelagic drift nets in the regions covered by the Pelagic FMPs is likely to be limited, the lack of evidence to provide a confident assessment of bycatch risk suggests the risk is likely to be moderate. It is thought that *pelagic gears* are contributing relatively little to the failure of this indicator in relation to bycatch. However, owing to the importance of pelagic stocks within the Scottish marine ecosystem, the potential to impact prey availability needs further consideration for pelagic fisheries. The Fisheries Management Plan (FMP) process presents an opportunity to further strengthen the ecosystem-based approach to fisheries management. This can help deliver the Ecosystem and Sustainability Objectives, maintaining target fish populations in a favourable condition while also contributing to the achievement of Good Environmental Status.

There is a *moderate* risk to marine litter. More robust estimates of abandoned, lost, or discarded fishing gear from pelagic fisheries are required.

Recommendations

The advice herein also makes *recommendations* for the Pelagic FMPs to reduce associated risks to the designated features of MPAs in Scottish waters (arising from fishing activity outside site boundaries), PMFs, and achievement of GES (UK MS); these include:

- A recommendation to continue and where required undertake additional targeted evidence collection to improve estimates of bycatch of marine mammals, seabirds, and designated fish for pelagic gear types, utilising remote electronic monitoring where appropriate. [
- A recommendation to explore enhanced ecosystem-based approaches for the management of pelagic fish stocks that:
 - 1) Utilise ecosystem information and models to manage stocks of important pelagic prey species in a way that accounts for their key roles in the broader marine food web and ecosystem processes.
 - 2) Evaluate whether current management frameworks adequately account for needs of dependent predators like fish, marine mammals, and seabirds.
 - 3) Assess potential ecosystem impacts of alternate management strategies on predator productivity and resilience.

- 4) Engage stakeholders early to develop pragmatic, interdisciplinary solutions that balance ecological, social, and cultural objectives through evaluating potential trade-offs.

This enhanced ecosystem approach aims to contribute to achieving GES across multiple descriptors, while reflecting the requirement for continued human use and the importance of healthy marine ecosystems.

Contents

Executive Summary	1
Contents	7
1 Scope and purpose of SNCB advice	8
2 Approach to assessing risk	9
2.1 Indicative risk ratings	9
3 Risks relating to the designated features of MPAs in Scottish waters	10
3.1 Impacts to designated features outside MPA boundaries.....	11
3.1.1 Risk of bycatch to mobile MPA features from pelagic fishing	11
3.1.2 Risk of prey depletion of important prey species to mobile MPA features from pelagic fishing.....	14
4 Risks relating to PMFs in Scottish waters	18
4.1.1 Risks of catch and bycatch to mobile PMFs from pelagic fishing.....	19
4.1.2 Risks of prey depletion to mobile PMFs from pelagic fishing	20
5 Risks to UK Marine Strategy Descriptors	21
5.1 The UK Marine Strategy and FMPs	21
5.2 Assessing risk to UK MS Descriptors.....	22
5.3 Risks to UK MS Descriptors.....	23
5.3.1 UK MS Descriptor D1, D4 biological diversity of cetaceans.....	30
5.3.2 UK MS Descriptor D1, D4 biological diversity of seals	32
5.3.3 UK MS Descriptor D1, D4 biological diversity of birds	34
5.3.4 UK MS Descriptor D1, D4 biological diversity of fish	35
5.3.5 UK MS Descriptor D4 foodwebs.....	36
5.3.6 UK MS Descriptor D1, D6 seafloor integrity	36
5.3.7 UK MS D10 marine litter	37
6 Conclusion and recommendations	37
References	39
Annex 1.....	44
Annex 2.....	46

1 Scope and purpose of SNCB advice

This document provides Statutory Nature Conservation Bodies (SNCB) advice to inform the development of the Pelagic Fisheries Management Plans (FMPs), focusing on the fisheries contained within these FMPs and their potential risks to:

- The designated features of Marine Protected Areas (MPAs) in Scottish waters
- Priority Marine Features (PMFs)
- UK Marine Strategy (UK MS) descriptors

The advice is premised on the ecosystem-based approach mandated by the Fisheries Act (2020), ensuring fisheries activities within the FMPs contribute to the achievement of Good Environmental Status (GES), as defined by the UK Marine Strategy Regulations 2010.

Herein, we set out our approach and a brief assessment of risks to MPA features, PMFs and UK MS descriptors in Scottish waters from pelagic fisheries covered by the Pelagic FMPs. Although the underlying impact pathways are similar (e.g. bycatch is a risk in all three assessments), there are also important differences. The UK MS and PMFs list cover a much broader range of species than those protected by MPA designations, especially for cetaceans and fish. Also, the underlying objectives differ for each and therefore there may be subtle but important differences to the assessment of risk and precaution. Therefore, our advice is presented separately for MPA features, PMFs and UK MS descriptors.

The advice has scoped in pelagic trawls and purse seines as the most relevant gear types for consideration within the pelagic fisheries. Drift nets and handlines are also considered and discussed within the advice. More specific information on gear types, location and fishing effort will improve the ability to assess environmental risks associated with each FMP and may alter some of the risk-ratings presented. We have made the assumption that these FMPs will adopt the Precautionary Objective in the Fisheries Act, and thus that actions will be put in place to fish the target stock at Maximum Sustainable Yield (MSY) or its equivalent; this advice therefore relates mainly to impacts beyond those to the stocks themselves. However, where we have identified risks to mobile species through prey reduction, management of these stocks may need to consider options which go beyond the current MSY approach.

The primary aim of this advice is to provide a pragmatic steer on where the greatest concerns lie for interactions between relevant pelagic fishing activities and the designated features of MPAs, PMFs, and UK MS descriptors. It intends to guide the FMP's development process, focusing on where to best allocate resources to mitigate wider environmental impacts of the fisheries. Further SNCB advice will be required to support the Habitats Regulations Appraisal of any management measures stemming from the FMPs and their potential effects on designated sites and features.

2 Approach to assessing risk

2.1 Indicative risk ratings

In contrast to the SNCBs routine advice around environmental sensitivity, the ‘indicative risk ratings’ developed for this advice consider the scale of risk associated with the different components of the pelagic fisheries in Scottish waters to help identify where the greatest impacts are likely to occur. For example, the risk rating associated with a gear-feature/descriptor interaction may be lowered if the higher-risk activity only makes up a small proportion of the fishing activity covered by the FMP and thus there is low exposure of the feature/descriptor to the higher-risk activity.

Low Risk: An impact pathway exists, but evidence or expert opinion suggests that impacts are minimal or unlikely. This applies in the MPA context where a theoretical impact is either absent or the scale of impact is minimal. For PMFs, the fishery may have defined impact pathways, but it would be considered low risk where there is either no empirical evidence of significant adverse effects on the national status of PMFs or the impacts are negligible across relevant spatial and temporal scales. This rating is appropriate when interaction with PMFs is minimal or when existing mitigation measures effectively negate potential harm. For UK MS, impacts were rated low risk where fisheries were considered unlikely to adversely impact the achievement of GES.

Moderate Risk: Interactions rated as moderate risk typically have an evidenced impact or expert judgment indicates a genuine risk. For MPAs, this risk rating would be appropriate where the overall impact level might be ambiguous, possibly due to, limited spatial overlap between relevant gears and protected features, significant variation in impact over space and time, or differences between fisheries covered in the FMP and those from which the evidence base was derived. For PMFs, moderate risk was deemed appropriate where there is a clear linkage between the fishery's activities and potential adverse effects on the national status of PMFs, albeit mitigated by factors like limited spatial overlap, existing management measures, or the resilience of PMFs. It also covers scenarios where potential impact pathway is identified although more evidence is required to enhance assessment confidence. For UKMS, moderate risk refers to instances where a clear impact pathway exists between the relevant fishing gears and the achievement of GES. However, further evidence might be needed, or other activities also significantly influence the current indicator status.

Such a precautionary approach to risk assessment is aimed at managing identified risks proactively while acknowledging gaps in current understanding. It is recommended that FMPs consider enhanced data collection or mitigation options if a moderate risk is identified, taking a proactive approach towards minimising impacts.

High Risk: Interactions identified as high risk are those where available evidence or expert opinion suggests there is an impact at such a scale as is likely to require mitigation. In the MPA context, this rating would be assigned where the scale of impact is likely to have an adverse effect or hinder the achievement of an MPAs' conservation objectives, and the fishing activities managed by the FMP are believed to significantly contribute to these risks. For PMFs, the rating applies where activities or conditions within the fishery have well-

documented, significant negative impacts on PMFs, threatening their national conservation status through direct harm or habitat degradation. High-risk scenarios are those where the intensity, scale, or nature of the impact could lead to a decline in PMF populations/extent or degradation of critical habitat, which would affect the national conservation status of that PMF in the absence of substantial mitigation measures. This rating would be given for UKMS where a well-evidenced link exists between the fishery and the failure to attain GES based on current indicators, with fishing activities covered by the FMP being assessed as contributing significantly to that failure.

3 Risks relating to the designated features of MPAs in Scottish waters

Marine Protected Areas (MPAs) in Scottish waters include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) which are protected under the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017, collectively referred to as the Habitats Regulations. Additionally, Nature Conservation Marine Protected Areas (NCMPAs) are designated and protected by the Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009. Impacts of activities are assessed against the conservation objectives of MPAs and activities should not have an adverse effect on the integrity of SACs or SPAs and should not hinder the conservation objectives of NCMPAs.

Fisheries within the Pelagic FMPs can potentially impact MPA designated features in 2 main ways:

- (iii) through the **bycatch** of designated features of MPAs
- (iv) the direct (targeted) and indirect (bycatch) **removal of prey species** on which designated species depend, and

These impacts can affect the designated features of MPAs both inside and outside the boundaries of MPAs.

Assessment of the impact of fishing activity occurring within MPAs in Scottish waters has been carried out by the Marine Directorate of the Scottish Government. Management measures for relevant fishing activities within MPAs have been implemented or are in development, to ensure any fishing within MPAs is compatible with the MPA's conservation objectives. Therefore, the existing assessment and management pathways mitigate risks arising from fishing activity within Scottish MPAs, **and no additional action is suggested for the Pelagic FMPs within Scottish MPA site boundaries at this time.** Pressures occurring within MPAs have therefore been screened out of this advice.

In addition, pelagic gears are considered to pose little risk to benthic habitats (Rosen et al., 2012) in the context of physical impact, and any physical impact would likely be mitigated by the existing MPA management pathway. **This impact has therefore been screened out of this advice.**

However, potential risks to designated mobile species from bycatch and removal of prey species may remain when they move outside of the MPA. This advice therefore focusses on

risks to mobile MPA features from pelagic fishing activities occurring outside MPA boundaries.

3.1 Impacts to designated features outside MPA boundaries

The potential for fishing activities outside of MPAs to impact designated features, particularly mobile species that move beyond the protections of MPA boundaries, necessitates broader management consideration.

3.1.1 Risk of bycatch to mobile MPA features from pelagic fishing

Much of the evidence presented below comes from the UK bycatch monitoring programme (BMP). The BMP monitors the levels of bycatch in certain fisheries, gear types and areas and extrapolates the data where appropriate to give an indication of the scale of overall bycatch levels (Kingston et al., 2021). The fisheries monitored are nets, pelagic trawls, longlines, and ring nets, as these are currently considered to present the greatest risk.

In general, the findings from the BMP should be considered alongside the caveats of the programme, for example current bycatch estimates will likely underestimate bycatch from larger offshore vessels yet overestimate it for smaller inshore vessels (Kingston et al., 2021).

3.1.1.1 Risk to marine mammals

There are seven marine mammal species that have been designated in Scottish MPAs: harbour porpoise, bottlenose dolphin, Risso's dolphin, minke whale, grey seal, common seal, and otters. Otters, primarily associated with terrestrial SACs and coastal habitats, are excluded from this advice due to their minimal interaction with the relevant pelagic gears.

Pelagic trawls and purse seines

Evidence from the UK BMP indicates that pelagic trawls pose a relatively low risk to marine mammals. Specifically, the data show minimal seal bycatch associated with pelagic trawls, with most incidents linked to static nets or the North Sea sandeel fishery.

Given the episodic nature of bycatch and the current low sampling effort, the risk to marine mammals from pelagic trawls is considered moderate. This assessment does not imply a specific known threat but instead reflects limitations in bycatch data collection/coverage for this fishery and the need for increased monitoring to improve the confidence in these estimates.

Drift nets

Harbour porpoise have been recorded as bycatch in drift net fisheries for small pelagic fish (Kingston et al., 2021). The BMP makes annual estimates for mortality from static nets including drift nets. The point estimate for harbour porpoise bycatch across UK waters in 2019, assuming full compliance (with acoustic deterrent regulations) by the over 12m fleet is 833 individuals or 1,061 individuals assuming no acoustic deterrent use. Only 18 of these occurrences were estimated to be caused by pelagic drift nets, which equates to less than 2% of the total bycatch mortality. For harbour porpoise, bycatch rates in the greater North

Sea ecoregion are below the precautionary threshold of 1% of the best population estimate, but estimates for the Celtic Seas Ecoregion, which includes the Scottish west coast, indicate that bycatch in the region exceeds this threshold. This suggests that the risk to the conservation status of individual MPAs is limited, but that localised impacts cannot be entirely dismissed.

There were no bycatch records of other marine mammal MPA features in pelagic drift nets from 2017-2019.

3.1.1.2 Risk to seabirds

Pelagic trawls and purse seines

In a study of bycatch risk to seabirds, Bradbury et al. (2017) identified gannets, fulmars, guillemots, razorbills, black guillemots, puffins, shags, and great northern divers as being the most sensitive species to bycatch in pelagic fisheries. The study showed that bycatch risk was generally lower and more localised in pelagic trawls when compared to static gears, and areas of highest risk shift seasonally in response to seabird distribution (Bradbury et al., 2017).

Three species have been recorded as bycatch in pelagic trawls in the BMP; guillemot, razorbill, and cormorant, with guillemot accounting for 85% of individuals recorded (Northridge et al., 2020). Again, this dataset shows strong seasonal and area-specific trends. All seabird bycatch observations came from midwater trawl fisheries targeting bass (this fishery is now closed) and coastal sprat fisheries in the English Channel.

There is little direct information on seabird bycatch in the UK-registered purse-seine fleet, which is relatively limited in extent and effort. Species such as gannets, various gulls, and auks are thought to be most vulnerable to these gears. Birds are believed to be caught during hauling when the fish aggregate in a smaller area. The UK purse-seine fishery already has a voluntary 'code of conduct' that includes rescuing water-logged birds, drying them on deck and releasing them once they are recovered. Anecdotal observer data indicates this is happening (Anderson et al., 2022).

Typical annual sampling coverage under the BMP has been roughly 5% of midwater trawl effort (compared to <1% of total static net effort and 1-2% of longline effort) and so it is likely that sampling under the BMP will not have covered some specific metiers where seabird bycatch occurs at relatively higher rates than in the metiers we report on here. However, it is unlikely that those metiers have a wide geographical distribution and/or are large scale in terms of total effort. More probably, there are specific fisheries operating at small spatial scales that have not been sampled, where seabirds are caught at relatively higher (or lower) rates than observed in the general sampling efforts. Therefore, although the findings of Northridge et al. (2020) are heavily caveated, preliminary estimates suggest that bycatch from the pelagic fishing gears sampled are unlikely to be having population level effects for bird species that are also features of Scottish SPAs. The findings of the BMP in relation to pelagic trawls should be assumed only to apply to smaller, inshore vessels. Additional sampling is required on larger pelagic vessels, as described in Northridge et al. (2020), to properly assess the risks posed by those gears.

Drift nets

Drift nets were not specifically distinguished in the analysis of seabird bycatch by Northridge et al. (2020) but were included as a component of the overall 'static net' bycatch assessment. A total of 365 seabirds were recorded as bycatch in static nets between 1996 and 2018, with at least 8 species identified, including guillemots, cormorants, gannets, razorbills, fulmars, shags, herring gulls and a single record of great northern diver. French et al. (2022) and expert advice suggest the risk of seabird bycatch in drift nets is likely to be moderate.

3.1.1.3 Risk to fish

There are 12 species of fish that are designated features of SACs and NCMPAs. 6 of these are deep-water species (blue ling, Leafscale gulper/gulper shark, orange roughy, Portuguese dogfish, and round-nose grenadier) which are unlikely to interact with most pelagic fishing operations. The remaining species spend part of their lifecycle in coastal and marine waters (flapper skate, basking shark, sandeel, Atlantic salmon, river lamprey and sea lamprey) and may interact with pelagic fishing gears.

Pelagic trawls and purse seines

There were no records in the BMP of bycatch of designated fish in pelagic trawls between 2017 and 2020. However, a study by Trancart et al. (2014) used a large dataset (2003 – 2010; >9,000 trawls, 43 different gear types, 6–320mm mesh size range) of onboard observations from fishery fleets (from the *ObsMer* program) and found that 15% of bycatch incidences were from midwater trawls (compared to 20% in Trammel-nets, 19% fixed gill nets and 16% benthic bottom trawls). The fishery targeting blue whiting on the west coast of Scotland operates in deeper waters along the continental shelf; this fishery may overlap with the preferred habitats of deep-water fish species, indicating a bycatch risk, but data on bycatch within this fishery is lacking. Addressing evidence gaps through ongoing monitoring and research or, where necessary, through enhanced data collection will improve confidence in the assessment of bycatch risks in Scottish pelagic fisheries.

Drift nets

Reports of a single basking shark and 12 common skate were recorded as bycatch in the gillnet fisheries sampled through the BMP over the 2017-2019 period. However, it is unclear whether these bycatch incidents can be specifically attributed to pelagic drift nets. Addressing evidence gaps through ongoing monitoring and research or, where necessary, through enhanced data collection will improve confidence in the assessment of bycatch risks in Scottish pelagic fisheries.

3.1.1.4 Conclusions and recommendations relating to bycatch risk

There is a *moderate* risk of bycatch of mobile species (marine mammals, birds, and fish) that are designated features of MPAs from pelagic fisheries in Scottish waters. As stated above, this risk assessment applies to bycatch risk for MPA species features when they move outside of their designated MPAs.

Whilst these gears are associated with occasional bycatch of designated mobile species, results from the BMP suggest that risks are much lower for pelagic trawls than for static nets. However, due to the episodic nature of bycatch incidences and the relatively low sampling efforts, risk will vary greatly over space and time. Improved evidence would increase confidence in the assessment.

In the short-term, improvements to achieve greater certainty in bycatch estimates would result from a more systematic approach to data collection, particularly large offshore pelagic fisheries. This approach would also generate better understanding of the temporal and spatial patterns of bycatch estimates, and demographic information about which individuals are bycaught. This information could then be used to highlight species and areas most at risk and enable possible pilot area(s) for more focussed development of mitigation trials and monitoring to be identified with stakeholders.

Ongoing work focusing on understanding and mitigating the impact of bycatch on the wider population is being progressed through initiatives such as the UK wildlife bycatch mitigation initiative (BMI) and also the Clean Catch UK programme. This work is crucial to helping mitigate bycatch risks and evidence gaps identified in this advice, however an action plan to deliver the BMI has not yet been published. Building the evidence base through self-reporting of bycatch events may help support future iterations of this assessment. However, the implementation of Remote Electronic Monitoring (REM), prioritised by risk (e.g. French et al., 2022) would vastly improve our knowledge of, and ability to mitigate, designated species bycatch.

3.1.2 Risk of prey depletion of important prey species to mobile MPA features from pelagic fishing

3.1.2.1 Risks to marine mammal features from prey depletion

Small schooling fish, such as herring and sprat act as an important source of food for several marine mammal species, including whales, dolphins, seals and porpoise (Similä, 1997; Engelhard et al., 2014).

The diet of minke whales around Scotland primarily consists of sandeel and pelagic species targeted by the fisheries listed under the Pelagic FMPs, including clupeids, such as herring and sprat (Pierce et al., 2004; Robinson et al., 2023). Further research indicates that the distribution and foraging behaviour of minke whales are influenced by seasonal changes in prey availability (Anderwald et al., 2012; Robinson et al., 2023).

Harbour porpoise are generalist foragers, feeding primarily on small fish from both demersal and pelagic habitats (Santos & Pierce, 2003; IAMMWG, 2015). Prey is variable both spatially and seasonally and porpoise switch between species in response to changes in prey availability (Fryxell & Lundberg, 1994). Recorded prey species include sandeels, gobies, various gadoids (whiting, pout, cod), clupeids (herring and sprat), and scad/horse mackerel (Santos & Pierce, 2003; Santos, 2004; De Pierrepont, 2005; Ransijn, 2019). Harbour porpoise are also known to take cephalopods and crustaceans (IAMMWG, 2015). While prey choice might vary through the year, harbour porpoise are thought to focus on two to four small energy rich prey species at any given time in a region (Santos & Pierce, 2003;

Fontaine, 2007). It is unclear what drives harbour porpoise preferences and foraging behaviours and how these change between seasons. Calorific mapping of prey and analysis of functional responses of harbour porpoise in the southern North Sea suggests that sandeel are a particularly important prey species year-round, followed by whiting (particularly in winter), sprat (particularly in winter), herring (particularly in summer) and cod (Ransijn, 2019; Ransijn, 2021). Studies have shown that harbour porpoise do feed on mackerel in Northern Shelf waters, though there is substantial evidence to suggest that mackerel do not make up a vital part of harbour porpoise diet and that they prefer feeding on other species such as herring and sandeel (Santos & Pierce, 2003; Sveegaard et al., 2012).

The diet of Risso's dolphins (*Grampus griseus*) around Scotland, as well as in other regions, is predominantly composed of cephalopods, particularly oceanic squid families associated with deep-sea environments, suggesting a preference for mesopelagic and bathypelagic prey, rather than small pelagic fish species (Blanco et al., 2006; Praca & Gannier, 2008). Given the specialised feeding habits of Risso's dolphins and their preference for squid over fish, it is likely that species targets of the Pelagic FMPs do not constitute a major part of their diet around Scotland or in other parts of their range. However, specific studies on the diet of Risso's dolphins in Scottish waters would be required to fully understand their dietary preferences in this region.

The diet of bottlenose dolphins around Scotland is diverse and includes a variety of fish species. A study on the stomach contents of ten bottlenose dolphins stranded and by-caught around Scotland between 1990 and 1999 found that cod, saithe, and whiting were the main prey, along with other fish species including salmon and haddock, and cephalopods (Santos et al., 2001). This indicates that bottlenose dolphins in Scottish waters have a varied diet with no specific emphasis on any of the target pelagic species listed in the Pelagic FMP as key components of their diet.

The diet of seals around Scotland, including both grey and harbour seals, shows considerable variation, largely depending on the season and the geographical location within Scotland. These diets encompass a wide range of fish species, with some studies highlighting the importance of gadoids (such as whiting and cod), sandeels, pelagic fish, like herring, and cephalopods. Studies highlight a broad dietary range that suggests flexibility and opportunistic feeding behaviours by seals, likely driven by the availability of prey species in their respective habitats. Wilson and Hammond (2019) highlights that the proportion of sandeel in the diet has increased for both harbour and grey seals in the southern North Sea, where populations of both seal species are on the rise. This aligns with observations from previous studies (e.g. Furness, 2002, Engelhard et al., 2014, and Kuhn et al., 2014), emphasising the dynamic nature of seal diets and the influence of changing prey populations. Given the observed dietary flexibility and the significant regional and seasonal variation in seal diets, it is likely that small pelagic fish species may contribute to the diet of seals in Scotland to some extent, particularly in areas and seasons where they are abundant. However, the significance of pelagics relative to other prey items, such as gadoids and sandeels, would require more focused research to ascertain.

3.1.2.2 Risk to seabird features from prey depletion

Small pelagics form a significant part of the diet of a number of seabirds that are designated features of Scottish MPAs. There is clear evidence that many protected species regularly feed on herring and that the North Sea stock is becoming more and more important each year to seabird populations.

Herring form a significant part of the diet of a number of designated seabirds, including:

- Common terns
- Arctic terns
- Common guillemot (murre)
- Razorbills
- Cormorants
- Atlantic puffins
- Gull species

Although sandeel make up the bulk of tern diet in Scottish waters, both common and arctic terns have been observed to regularly feed on North Sea herring and sprat, which make significant contributions to their diet. Common terns in the Firth of Forth are particularly dependant on clupeids, with sprat considered their main prey, and breeding success for these birds has been strongly linked to fluctuations in local sprat stocks (Jennings et al., 2012). Breeding success in terns has been strongly linked to availability of their preferred prey (Green, 2017) and these species are considered sensitive to fluctuations in key prey stocks.

In recent years, fluctuations in sandeel abundance in the North Sea has been linked to a greater reliance on herring and sprat in seabird diet. Razorbill diet is largely restricted to sprat and herring in the North Sea (Torda, 2003), sandwich tern have been found to be 'highly reliant' on sprat (Stienen, 2006), and sprat and herring contribution to the diet of North Sea guillemot and puffin populations has increased, most likely due to reductions in the productivity of North Sea sandeel stocks (Wanless et al., 2018).

Studies have found that the chicks of razorbill, herring gull, and great black-backed gulls are often fed mackerel caught at sea by their parents (Harris & Wanless, 1986; Steenweg et al., 2011). These studies have found that these species also feed their chicks various other fish species, so it is likely that the adult birds feed opportunistically for prey and that they are not wholly dependent on mackerel stocks.

Northern gannets have been found to feed on mackerel more regularly than most seabird species, with some studies showing that in some areas of the Atlantic, northern gannets will feed on mackerel almost exclusively (Hamer et al., 2000; Garthe et al., 2014). This suggests that northern gannets are likely to be more susceptible to drops in mackerel stocks than other species, although this is likely to be complex and vary from region to region depending on the availability of alternative food sources, such as herring.

The sensitivity of designated bird species to blue whiting abundance is currently poorly understood. As blue whiting tends to be found in relatively deep waters (down to 600 metres)

compared to other pelagic fish species, they are likely to be less important to seabirds in comparison to other species such as herring and sprat. However, juvenile blue whiting tend to be found in shallower water, so may be more available to seabirds.

Studies have shown that some species of seabird, such as gannet and shearwater spp., feed on horse mackerel, and their distributions may be influenced by horse mackerel abundance (Certain et al., 2011; Ramos et al., 2022).

At present, there is no evidence to suggest that the greater silver smelt acts as an important food source for protected bird species. This is most likely due to the depths that silver smelt are found at relative to the feeding depths of seabirds.

3.1.2.3 Risk to fish features from prey depletion

The sensitivity to reductions in pelagic fish availability varies among fish species, largely influenced by their distinct dietary habits. Species such as the common skate, basking sharks, and sandeels, which primarily feed on bottom-dwelling organisms or zooplankton, face minimal direct risk of prey depletion from changes in the population dynamics of the target species listed under the pelagic FMPs. These species' diets are composed of food sources distinct from these pelagic fish species, with common skate focusing on demersal fish and invertebrates, while basking sharks and sandeels feed on zooplankton, rendering the small pelagics as outside their typical prey size range. Given the ecological roles and feeding strategies of these species, the risk from the Scottish pelagic fisheries primarily concerns potential indirect effects on the broader marine food web rather than direct prey depletion.

River and Sea Lampreys, with their parasitic feeding habits on the blood and body fluids of other fish, could potentially include pelagic fish species in their diet if they are an available and appropriately sized target, though they typically prefer larger hosts.

Atlantic salmon, known for their varied diet that can include smaller fish during their marine phase, are likely to feed on pelagics considering their presence and nutritional value in Scottish waters. Studies have shown that in some areas of the Northeast Atlantic, juvenile blue whiting act as an important food source for young Atlantic salmon (Haugland et al., 2006). In these areas, blue whiting was often consumed more than any other species (by weight) by juvenile salmon while they drift offshore from UK coastal spawning areas. Blue whiting is also present, though much less important, in the diet of adult salmon, who are thought to feed on blue whiting opportunistically, but are thought to prefer other species such as capelin and sandeel (Jacobsen & Hansen, 2001; Rikardsen & Dempson, 2011). As large predatory fish, salmon are well-documented as predators of juvenile herring. Herring larvae have been found to be present in the diets of most salmon populations throughout the Northeast Atlantic, suggesting they are a major source of food to salmon stocks, and that salmon may rely on herring populations to thrive (Rikardsen & Dempson, 2011; Utne et al., 2022).

The sensitivity of designated fish to reductions in mackerel are not well understood. Currently there is little evidence to suggest that designated fish species are reliant on

mackerel as a regular food source, though it is likely that due to their size and abundance, salmon may feed on smaller/juvenile mackerel opportunistically in the wild.

At present, there is little to no evidence suggesting that either horse mackerel or the greater silver smelt acts as an important food source for protected fish species.

3.1.2.4 Conclusions and recommendations relating to prey depletion risk

There is a *moderate* risk of prey depletion of important prey species that designated species depend on from pelagic fisheries in Scottish waters.

Work done by the FMP to ensure fisheries eventually meet the precautionary and sustainability objectives of the Fisheries Act will help to ensure the stock is fished sustainably, but additional consideration of predator needs is recommended. Although the majority of MPA protected species discussed here exhibit some flexibility in their diets, they will still rely on the availability of suitable alternatives. Where one or more stocks fail to achieve MSY, the risk to marine predators from this pressure will be more acute.

All the fish species managed through the pelagic FMPs are considered as “forage fish” and as such, are an important part of the marine ecosystems around Scotland. They are major predators of zooplankton, exhibit inter-species competition, and are key prey for piscivorous fish, marine mammals, and seabirds. Ensuring the sustainable exploitation of these species by commercial fisheries in this region is therefore important for the health of the marine ecosystem and the wider fisheries sector in the UK. It is advisable that the pelagic FMPs evaluate where actions to strengthen an ecosystem-based approach to fisheries management (EBAFM) could be implemented to improve current management. As part of this, it is important to evaluate:

- if management enhanced with ecosystem information could improve the long-term viability of the stock and fishery
- the current and proposed advice framework can maintain stocks at a level which satisfies the needs of dependent predators, and
- how alternate management strategies could impact predator productivity and ecosystem resilience

The exploitation of these prey fish species, and the wider ecosystem impacts thereof, should be used to guide a risk-based ecosystem approach that reflects the multiple social, cultural, and ecological objectives and the trade-offs between human use and the need for a healthy marine ecosystem. This approach necessitates early engagement with stakeholders, decision-makers, ICES, and SNCBs, as well as the development of interdisciplinary and pragmatic solutions which promote the application of ecosystem information and models.

4 Risks relating to PMFs in Scottish waters

Priority Marine Features (PMFs) in Scotland represent a selection of habitats and species identified for their conservation importance. These 81 features are acknowledged for their national significance and the role they play in supporting marine biodiversity. The list includes highly mobile marine mammals and fish, as well as a number of habitats and low

mobility/sessile benthic species. The purpose behind identifying PMFs is to focus conservation efforts, guide management actions, and ensure the protection and enhancement of marine biodiversity within Scottish waters.

Fisheries covered by the Pelagic FMPs can potentially impact PMFs in 2 main ways:

- (i) through the **catch** and **bycatch** of mobile PMFs
- (ii) the direct (targeted) and indirect (bycatch) **removal of prey species** on which PMF species depend

Pelagic gears are considered to pose little risk to benthic habitat PMFs and low mobility/sessile PMFs (Rosen et al. 2012) due to the lack of physical interaction/impact of gears on the seabed. **This impact has therefore been screened out of this advice.**

4.1.1 Risks of catch and bycatch to mobile PMFs from pelagic fishing

4.1.1.1 Risk to marine mammals

The Scottish PMF list includes 16 marine mammals - the majority of the UK's resident species.

Pelagic trawls and purse seines

As mentioned in Section 3.1.1.1, pelagic trawls pose a relatively low risk to marine mammals. There was no recorded bycatch of marine mammals in pelagic trawls or purse seines over the 2017-2019 period.

Drift nets

Risks for harbour porpoise have been outlined in Section 3.1.1.1 above. There were no bycatch records of other marine mammal PMFs in pelagic drift nets from 2017-2019.

4.1.1.2 Risk to fish and crustaceans

The PMF list includes 31 fish species and one crustacean (spiny lobster), many of which are targeted commercially. Atlantic herring, Atlantic mackerel, blue whiting, and horse mackerel are PMF species which are directly targeted by the Pelagic FMPs. Risks to commercial species should be somewhat mitigated through stock management, and work done by the FMPs to ensure fisheries eventually meet the precautionary and sustainability objectives of the Fisheries Act will help to ensure these stocks are fished sustainably.

Pelagic trawls and purse seines

UK BMP held no records of PMF fish/crustacean bycatch in pelagic trawls (see Section 3.1.1.3) between 2017-2019. However, many of the species listed as PMFs are not recorded through the BMP so this evidence is limited. Whilst there is potential for the bycatch of demersal PMF fish species, likely incidents in the pelagic trawl and purse seine fisheries are not thought to be at a scale which risk PMF status. For the pelagic PMF species which are also assessed under the Pelagic FMPs (Atlantic herring, Atlantic mackerel, horse mackerel

and blue whiting), it is assumed that the management strategy adopted will support an MSY approach and should ensure that these species are maintained at a level which would ensure there is no significant adverse effects on the national status of these PMFs. Norway pout is frequently targeted alongside blue whiting in the North Sea. As a PMF species, stock management should seek to ensure the national status is maintained.

Drift nets

In addition to the species listed in Section 3.1.1.3, there were a small number of records of porbeagle shark bycatch in gillnets. However, it is unclear whether these bycatch incidents can be specifically attributed to pelagic drift nets. Addressing evidence gaps through ongoing monitoring and research or, where necessary, through enhanced data collection will improve confidence in the assessment of bycatch risks in Scottish pelagic fisheries.

4.1.1.3 Conclusions and recommendations relating to catch/bycatch risk

There is a *moderate* risk of catch/bycatch for PMFs (marine mammal and fish) from Pelagic fisheries in Scottish waters.

Pelagic fisheries are not expected to pose a substantial risk of bycatch; however, evidence gaps remain (see Section 3.1.1.4) resulting in a precautionary rating. Addressing evidence gaps through ongoing monitoring and research or, where necessary, through enhanced data collection will improve confidence in the assessment of bycatch risks. Improvements could include collaborative action through BMI and appropriate use of REM.

4.1.2 Risks of prey depletion to mobile PMFs from pelagic fishing

See section 3.1.2.3. A number of marine mammal and fish PMFs, in addition to species designated as MPA features, are likely to utilise pelagic species at various life stages as prey resource. Though they exhibit a variety of foraging strategies, many killer whale groups are fish-eating specialists, feeding almost exclusively on schooling pelagic fish species such as herring and mackerel (Luque et al., 2005; Samarra & Foote, 2015). Fin whale feed on small schooling fish species such as herring and sprat (Sigurjónsson, 1995). Herring and mackerel are also important prey species for adult porbeagle (Gauld, 1989; Priede, 2019). Small pelagics also contribute to the diet of other PMF fish species such as cod, ling and sea trout (Daan, 1989), however, their relative importance is not well understood. Cod, ling and sea trout are opportunistic foragers, and the risk from the Scottish pelagic fisheries primarily concerns potential indirect effects on the broader marine food web rather than direct prey depletion for these PMF fish species.

4.1.2.1 Conclusions and recommendations relating to prey depletion risk

There is a *moderate* risk of depletion of important prey species that PMF listed species depend on.

Though substantial evidence gaps exist, many of the species listed under the Pelagic FMPs are important prey species for a variety of cetaceans and fishes (see Section 3.1.2.4 and 4.1.2) resulting in a precautionary rating. Work done by the FMP to ensure fisheries eventually meet the precautionary and sustainability objectives of the Fisheries Act will help

to ensure the stock is fished sustainably, but additional consideration of predator needs is recommended.

Although the majority of PMF species discussed here exhibit some flexibility in their diets, they will still rely on the availability of suitable alternatives. Where one or more stocks fail to achieve MSY, the risk to marine predators from this pressure will be more acute. For forage fish stocks, additional steps should be considered so that stocks are managed in such a way as to enable them to perform their key role in marine food webs and ecosystems. This would be an important step in implementing an Ecosystem Based Approach to Fisheries Management.

5 Risks to UK Marine Strategy Descriptors

5.1 The UK Marine Strategy and FMPs

The UK Marine Strategy Regulations 2010 (SI 2010/1627) provide the policy framework for delivering marine environmental policy at the UK level and set out how the vision of clean, healthy, safe, productive, and biologically diverse oceans and seas will be achieved. The Regulations place a number of duties on the Marine Directorate Secretary of State, including the need to define the characteristics of Good Environmental Status (GES) and in turn develop an associated Programme of Measures required to deliver GES. Good Environmental Status (GES) establishes a 'benchmark' for our seas which seeks to *'protect the marine environment, preventing its deterioration and restoring it where practical, while allowing sustainable use of marine resources'*. For each Descriptor there are a number of practical targets and indicators that facilitate assessment of our delivery against each descriptor.

The UK Secretary of State sets the characteristics of GES every 6 years via a suite of 'Descriptors' that collectively indicate the health of our seas. More information about the UK Marine Strategy can be found via the Marine Online Assessment Tool (MOAT) portal, hosted by Cefas: [Introduction to UK Marine Strategy - Marine online assessment tool \(cefascas.co.uk\)](https://cefascas.co.uk/moat/). The UK Marine Strategy GES Descriptors are assessed as part of a 6-yearly assessment cycle; an updated assessment of our seas will be presented in 2024.

The UK Marine Strategy Regulations require management action to be taken to achieve or maintain GES. The Strategy applies an ecosystem-based approach to the management of all relevant human activities. In doing so, it seeks to keep the collective pressure of human activities within levels compatible with the achievement of GES and does not compromise the capacity of marine ecosystems to respond to human-induced changes. The Fisheries Act (2020) enables regulators to deliver on this ambition through the Ecosystem Objective, which states that fish and aquaculture activities should be managed using an ecosystem-based approach, which is, in-part, defined in the Act by the achievement of GES. Equally, the recently published Joint Fisheries Statement (2022) lays out the ambition across UK administrations to take action to achieve or maintain Good Environmental Status (GES) in all UK waters (Joint Fisheries Statement, 2022).

The full list of UK MS descriptors can be seen in Annex 1. This advice focuses only on the most relevant descriptors in terms of risks posed by commercial and recreational fisheries: D1 biodiversity, D4 foodwebs, D6 seafloor integrity and D10 marine litter. Additional consideration of screened-out descriptors may be required in the future if evidence emerges of those descriptors being vulnerable to pressures generated by pelagic fisheries. Furthermore, the status of many of the current indicators is currently 'uncertain' or 'unassessed' (see Annex 2). As the evidence base develops, or the suite of indicators associated with a specific descriptor evolves (e.g., after review in 2024), the advice pertinent to those descriptors will need to be updated.

UK Marine Strategy Descriptor D3 (commercial fish and shellfish) focuses on achieving maximum sustainable yield (MSY) for commercially exploited stocks. The indicators prioritise maintaining reproductive capacity and fishing mortality rates that support MSY. As the primary objective of this Fisheries Management Plan is establishing sustainable exploitation of the target stocks, following the precautionary and sustainability principles outlined in the UK Fisheries Act, significant progress should be made toward meeting Good Environmental Status for D3. While risks exist due to current exploitation levels and data limitations, the emphasis in the pelagic plans on long-term stock viability provides a pathway for reducing these risks. We therefore do not present detailed advice for D3 here. However, it is noted that achieving D3 targets alone may not fully support GES for associated descriptors, like D1 (biodiversity) and D4 (food webs), that require wider ecosystem considerations beyond single-stock MSY.

In the UK MS, these descriptors are assessed using indicators for each of their constituent 'ecosystem components.' This is carried through to this advice resulting in advice on risks to seven descriptor-ecosystem component combinations: D1, D4 cetaceans; D1, D4 seals; D1, D4 seabirds; D1, D4 fish; D4 foodwebs; D1, D6 seafloor integrity and D10 Marine Litter.

5.2 Assessing risk to UK MS Descriptors

This section provides an overview of the main risks posed to UK MS Descriptors by gear types likely to be covered by the Pelagic FMPs.

The advice draws upon an existing risk analysis by French et al. (2022), conducted for Natural England as part of a REM prioritisation exercise, which evaluated the impact of various fishing gears on GES descriptors. This study has provided a good foundation for the risk assessment conducted here; although the work focused on fishing interactions relevant to English inshore waters, a broad approach was undertaken in screening-in métiers, and while we acknowledge that there may be gaps from a Scottish perspective, these are not anticipated to significantly alter the risk ratings.

This advice considers the 'overall risk scores' from French et al. (2022), using or adapting these based on additional relevant evidence (e.g., specific to the FMP) and/or expert opinion. The risk rating assigned isn't merely an assessment of gear-feature interaction but also gauges the overall risk in the FMP's context. For instance, a high-risk activity constituting a minor portion of the fishing activity under the FMP might have its risk rating downgraded. The risk ratings aim to provide a pragmatic direction on the significant concerns regarding interactions between fishing gear types and UK MS descriptors for this

FMP. A description of how these risk ratings were derived is given in section 2.1 above. It should be noted that the work undertaken by French et al. (2022) used a slightly different grouping of UK MS descriptors to those used in this advice - see Objective 1 in their paper for the full methodology and associated literature reviews.

Our assessment specifically highlights pelagic trawls, purse seines, drift nets and handlines as the gears of relevance to the Pelagic FMP. These gears are actively employed across the UK in pelagic fisheries for the species listed. Should the Marine Directorate or FMP delivery partners require more information on gear types not covered in this advice, NatureScot and the Joint Nature Conservation Committee (JNCC) can offer advice or suggest suitable proxies.

5.3 Risks to UK MS Descriptors

The risks to UK MS descriptors are detailed in Tables 1 and 2 below. Sections 3.3.1- 3.3.7 elaborate on the justifications for these risk ratings.

Table 1 Risks to UK MS descriptors from pelagic trawls

UK MS Descriptor	FMP Risk rating	Additional comments on risk	Recommendations
D1, D4 Cetaceans	Moderate	The bycatch risk in this fishery is thought to be low/moderate but this assessment has a degree of precaution as substantial data gaps exist. Prey depletion is assessed as a moderate risk, as the FMP target species are important prey for many mobile species. Further work is needed to establish their importance in the wider marine food web. Further evidence collection and analysis will strengthen robustness and confidence in assessment.	Continue to improve the evidence base to understand the scale of the pressure and improve this risk assessment. This could focus on improving collaborative bycatch data collection for sensitive species, through enhanced reporting and remote electronic monitoring. Continue to develop and consider an enhanced Ecosystem Based Approach to Fisheries Management for forage fish species to improve current management and align with the UKs objectives to achieve Good Environmental Status i.e as an important prey species for cetaceans.
D1, D4 Seals	Moderate	The bycatch risk in this fishery is thought to be low/moderate but this assessment has a degree of precaution as substantial data gaps exist. Prey depletion is assessed as a moderate risk, as the FMP target species are important prey for many mobile species. Further work is needed to establish their importance in the wider marine food web. Further evidence collection and analysis will strengthen robustness and confidence in assessment.	Continue to improve the evidence base to understand the scale of the pressure and improve this risk assessment. This could focus on improving collaborative bycatch data collection for sensitive species, through enhanced reporting and remote electronic monitoring. Continue to develop and consider an enhanced Ecosystem Based Approach to Fisheries Management for forage fish species to improve current management and align with the UKs objectives to achieve Good Environmental Status.

UK MS Descriptor	FMP Risk rating	Additional comments on risk	Recommendations
D1, D4 Seabirds	Moderate	The bycatch risk in this fishery is thought to be moderate but this assessment has a degree of precaution as substantial data gaps exist. Prey depletion is assessed as a moderate risk, as the FMP target species are important prey for many mobile species. Further work is needed to establish their importance in the wider marine food web. Further evidence collection and analysis will strengthen robustness and confidence in assessment.	Continue to improve the evidence base to understand the scale of the pressure and improve this risk assessment. This could focus on improving collaborative bycatch data collection for sensitive species, through enhanced reporting and remote electronic monitoring. Continue to develop and consider an enhanced Ecosystem Based Approach to Fisheries Management for forage fish species to improve current management and align with the UKs objectives to achieve Good Environmental Status i.e. as an important prey species for seabirds.
D1, D4 Fish		Further work is required by Marine Directorate and SNCBs to understand the indicator and identify appropriate fisheries management advice.	No immediate additional action currently thought to be required for this FMP. Further partnership work required to better understand the status and vulnerability of the many species included in assessments for this descriptor before detailed advice can be provided. In the long-term some species may require targeted evidence collection (e.g., enhanced reporting requirements/ remote electronic monitoring) and consideration of mitigation.
D4 Foodwebs		Focus of FMPs on sustainability and precautionary objectives of the Fisheries Act and policies developed to support delivery of the bycatch objective of the Fisheries Act should contribute to the achievement of GES for this descriptor.	No immediate additional action currently thought to be required for this FMP. However, the extent to which stocks reaching MSY contributes to changes in fish community/ size structure is not yet clear. Further work may be required in the future.

UK MS Descriptor	FMP Risk rating	Additional comments on risk	Recommendations
D1, D6 Seafloor integrity	Low	Although-pelagic gears may make contact with the seafloor at times, it is not currently thought that this will produce pressures on a scale that is contributing to failure to reach GES for this descriptor	No action currently thought to be required for this gear-descriptor combination.
D10 Marine Litter	Moderate	The risk of losing static fishing gear (e.g., gillnets, pots, and fish traps) is significantly greater than the risk of losing mobile fishing gear. Equally, the design of the gear makes it less likely to pose a ghost-fishing risk. Some residual entanglement risk with netting and rigging but limited evidence on the scale of the risk.	More robust estimates of ALDFG rates are needed for all gear types. Gear-specific estimates have low certainty due to small numbers of studies and sample sizes. Polyethylene, polypropylene and nylon nets and ropes contribute to non-biodegradable marine litter when lost or discarded at sea. However, MCS beach litter data suggests fishing contributes <10% of total. Thus, actions targeting fishing litter alone are unlikely to achieve GES. D10 mitigation actions could include improved onshore fishing waste disposal facilities

Table 2 Risks to UK MS descriptors from drift nets

UK MS Descriptor	FMP Risk Rating	Additional comments on risk	Recommendation
D1, D4 Cetaceans	Moderate	The bycatch and prey reduction risk in these fisheries is thought to be moderate but this assessment has a degree of precaution as substantial data gaps exist. Further evidence collection and analysis will strengthen robustness and confidence in assessment.	Continue to improve the evidence base to understanding the scale of the pressure and improve this risk assessment. This could focus on improving collaborative bycatch data collection for sensitive species, through enhanced reporting and remote electronic monitoring. Continue to develop and consider an enhanced Ecosystem Based Approach to Fisheries Management for forage fish species to improve current management and align with the UKs objectives to achieve Good Environmental Status i.e as an important prey species for cetaceans.
D1, D4 Seals	Moderate	The bycatch and prey reduction risk in these fisheries is thought to be moderate but this assessment has a degree of precaution as substantial data gaps exist. Further evidence collection and analysis will strengthen robustness and confidence in assessment.	Continue to improve the evidence base to understanding the scale of the pressure and improve this risk assessment. This could focus on improving collaborative bycatch data collection for sensitive species, through enhanced reporting and remote electronic monitoring. Continue to develop and consider an enhanced Ecosystem Based Approach to Fisheries Management (EBAFM) for forage fish species to improve current management and align with the UKs objectives to achieve Good Environmental Status
D1, D4 Seabirds	Moderate	The bycatch and prey reduction risk in these fisheries is thought to be moderate but this assessment has a degree of precaution as substantial data gaps exist. Further evidence collection and analysis will strengthen robustness and confidence in assessment.	Continue to improve the evidence base to understanding the scale of the pressure and improve this risk assessment. This could focus on improving collaborative bycatch data collection for sensitive species, through enhanced reporting and remote electronic monitoring. Continue to develop and consider an enhanced Ecosystem Based Approach to Fisheries Management for forage fish species to improve current management

UK MS Descriptor	FMP Risk Rating	Additional comments on risk	Recommendation
			and align with the UKs objectives to achieve Good Environmental Status i.e. as an important prey species for seabirds.
D1, D4 Fish		Further work is required by Defra and ALBs to understand the indicator and identify appropriate fisheries management advice.	No immediate additional action currently thought to be required for these FMPs. Further partnership work required to better understand the status and vulnerability of the many species included in assessments for this descriptor before detailed advice can be provided. In the long-term some species may require targeted evidence collection (e.g., enhanced reporting requirements/ remote electronic monitoring) and consideration of mitigation
D4 Foodwebs		Focus of FMPs on sustainability & precautionary objectives of the Fisheries Act and policies developed to support delivery of the bycatch objective of the Fisheries Act should contribute to the achievement of GES for this descriptor. Contribute to the achievement of GES for this descriptor.	No action currently thought to be required for these FMPs. However, the extent to which stocks reaching MSY contributes to changes in fish community/ size structure is not yet clear. Further work may be required in the future.
D1, D6 Seafloor integrity	Low	Pelagic drift nets are not currently thought to produce pressures at a scale that is contributing to failure to reach GES for this descriptor.	No action currently thought to be required for this gear-descriptor combination.

UK MS Descriptor	FMP Risk Rating	Additional comments on risk	Recommendation
D10 Marine Litter	Moderate	Risk from abandoned lost discarded nets will be a factor of scale of loss and catching efficiency of the gear. Greatest risk associated with static gears. Significant spatial variation in the extent of ecological impact, being dependent on the species present, their abundance and vulnerability	Fishing litter is likely to be a relatively small component of overall marine litter and fishing measures on their own are unlikely to contribute significantly to achievement of GES. Greatest harm is likely to be associated with entanglement and ghost fishing from ALDFG. Action required to better record and map ALDFG. Adopt appropriate technical measures to minimise ghost fishing (e.g., net droppers). Spatial avoidance measures e.g., nets and VMEs.

5.3.1 UK MS Descriptor D1, D4 biological diversity of cetaceans

The current targets and indicators for the Descriptor 'D1, D4 Biological diversity of cetaceans' are set out in Table A2 (Annex 2). A summary of the risks and actions for this descriptor are found in Table 1 for pelagic trawls and Table 2 for pelagic drift nets. Additional evidence for purse seines and handlines has been included in this section where available. Potential risks to this UK MS descriptor arising from the fisheries contained in the Pelagic FMPs arise primarily from bycatch of descriptors and from reductions in available prey to descriptors.

5.3.1.1 Risks to cetaceans from bycatch

To be compatible with UKMS GES targets, fisheries must not result in a situation where the long-term viability of a cetacean population is threatened by incidental bycatch. In addition, there should be no significant decrease in abundance caused by human activities and the population range should not be significantly lower than the favourable reference value for the species.

Pelagic trawls and purse seines

For harbour porpoise, the bycatch target is deemed to being achieved if estimated bycatch is below a threshold of 1% of the best population estimate. Current estimates suggest that bycatch levels are probably at or below this level in the North Sea and Celtic Sea (Kingston et al., 2021). However, as previously discussed, the vast majority of this bycatch is from static gears, with existing evidence suggesting that pelagic gears contribute relatively little to harbour porpoise bycatch.

Common dolphin is regularly reported as bycatch within the UK Bycatch Monitoring Programme. In 2019, the common dolphin bycatch point estimate was 278 (Kingston et al., 2021). Spatially, bycatch of common dolphin is concentrated in ICES Divisions 7e-g (Kingston et al., 2021). However, the vast majority of this bycatch was in static net fisheries with large mesh sizes. Pelagic pair trawl fisheries have been associated with short-beaked common dolphin (*Delphinus delphis*) bycatch in southwest England (de Boer et al., 2012) but these fisheries were targeting bass, not herring and have since been banned.

Bottlenose dolphins are not regularly reported via the UK Bycatch Monitoring Programme and therefore estimates of total bycatch have not been made. However, bottlenose dolphin is listed as one of the three species where bycatch presents the highest conservation threat in south-west UK waters by Clean Catch UK (alongside harbour porpoise and common dolphin). The reason for this disparity is unclear but may be due to the highly localised nature of the risk to coastal populations of bottlenose dolphins that is not adequately represented within the ongoing monitoring programme.

Abundance trends for bottlenose dolphin are available (Pinn et al., 2018). For the four groups of coastal bottlenose dolphins in UK waters, the target of 'no statistically significant

decrease in abundance' was met for the greater North Sea and the largest group in the Celtic seas found off Wales. However, there is insufficient monitoring data to establish trends in abundance for bottlenose dolphins off the west coast of Scotland and for the population found in the coastal south-west of England.

Drift nets

Annual bycatch estimates from the BMP for harbour porpoise and common dolphin in pelagic drift nets were 18 and 0 individuals, respectively. Pelagic drift nets therefore appear to contribute relatively little to cetacean bycatch. However, coverage of the BMP means there is still a large degree of uncertainty in bycatch estimates.

5.3.1.2 Risks to cetaceans from reductions in prey

Studies across UK waters have shown that small schooling pelagic fish such as herring and sprat form part of the diet of several marine mammal species, including, common dolphin, bottlenose dolphin (Brasseur et al., 2008), minke whale and humpback whale (Pinn et al., 2018). Links between harbour porpoise and reductions in herring have already been discussed in Section (3.1.2.1), with further discussion of the impacts of reduced availability of forage fish species on cetaceans in Section 4.1.2.

To summarise, small pelagics such as herring, sprat and mackerel are a major food source for a variety of cetacean species across the North Sea. Patterns of prey availability can influence cetacean distribution and abundance.

5.3.1.3 Conclusions and recommended actions for D1, D4 cetaceans

Conclusions and recommendations for cetaceans relating to bycatch

Whilst bycatch is likely to be impacting some cetacean populations to the extent that it is contributing to the failure of this descriptor to achieve GES, it is thought that *pelagic gears* are contributing relatively little to this. **However, the risk arising from this FMP to cetaceans is still considered to be moderate due to the current low levels of sampling of bycatch and the remaining evidence gaps and confidence in existing evidence.** Due to the episodic nature of bycatch incidences and the relatively low sampling effort, risk will vary greatly over space and time. Addressing evidence gaps through ongoing monitoring and research or, where necessary, through enhanced data collection will improve confidence in the assessment of bycatch risks in Scottish pelagic fisheries.

In the short-term, improvements to achieve greater certainty in bycatch estimates, particularly for large offshore pelagic fisheries, would be beneficial. This would also enable a better understanding of the temporal and spatial patterns of bycatch, and demographic information about the individuals bycaught. This information could then be used to highlight species and areas most at risk and enable possible pilot area(s) for more focussed development of mitigation trials and monitoring to be identified with stakeholders.

Ongoing work focusing on understanding and mitigating the impact of bycatch on the wider population is being progressed through Defra's Marine wildlife bycatch mitigation initiative (BMI) and the Clean Catch UK (CCUK) programme. This work is crucial in helping to mitigate bycatch risks and potentially filling some of the evidence gaps identified in this advice, however an action plan to deliver the BMI has not yet been published. Building the evidence base through self-reporting of bycatch events may help support future iterations of this assessment. However, the implementation of Remote Electronic Monitoring (REM), prioritised by risk (e.g. French et al., 2022) would vastly improve our knowledge of, and ability to mitigate, designated species bycatch.

Conclusions and recommendations for cetaceans relating to prey depletion

The risk to this UK MS descriptor (D1, D4 cetaceans) from reductions in prey is considered to be moderate. Pelagic fish species listed under the Pelagic FMP are an important part of the UK Marine food web. Ensuring that exploitation of these species by commercial fisheries remains sustainable is important for the health of the marine ecosystem. It is advisable that the FMP evaluates whether routes to strengthen Ecosystem-based fisheries management (EBFM) and/or an Ecosystem-approach for fisheries management (EAFM) could be implemented to improve current management and align with the UK's objectives to achieve Good Environmental Status. As part of this, it is important to evaluate:

- Does management enhanced with ecosystem information improve the long-term viability of the stock and fishery?
- Does the current and proposed advice framework maintain the Pelagic FMPs target stocks at a level which satisfies the needs of predators? and
- Would alternate management strategies impact predator productivity and ecosystem resilience and, if so, how?

The exploitation of these species and the wider ecosystem impacts should be used to guide a risk-based ecosystem approach that reflects the multiple potentially conflicting social, cultural, and ecological objectives and the trade-offs between human exploitation and a healthy marine ecosystem. This approach necessitates early engagement with stakeholders, decision makers, ICES, and Defra's arms-length bodies, as well as the development of interdisciplinary and pragmatic solutions which promote the application of ecosystem information and models.

5.3.2 UK MS Descriptor D1, D4 biological diversity of seals

The current targets and indicator for the Descriptor '*D1, D4 Biological diversity of seals in maintained*' are shown in Table A3 (Annex 2). A summary of the risks and actions for this descriptor are found in Table 1 for pelagic trawls and Table 2 for pelagic drift nets. Additional evidence for purse seines and handlines has been included in this section where available. Potential risks to this UK MS descriptor arising from the fisheries contained in this FMP arise primarily from bycatch of descriptors and from reductions in available prey to descriptors.

5.3.2.1 Risks to seals from bycatch

For grey seals, bycatch represents the principal fisheries-related pressure, yet the species is generally meeting Good Environmental Status (GES) targets as outlined in Table A3 (Annex 2). In contrast, the common seal population is below target levels in the Greater North Sea, although this decline is not attributed to bycatch.

While figures for the two seal species are presented together in the BMP, most bycatch observations are for *grey* seals. Estimations suggest the vast majority of bycatch occurs in ICES divisions 7f, 7e and 7d with tangle and trammel nets. Again, the majority of seal bycatch is associated with static nets, and some bycatch has been associated with the North Sea sandeel fishery (Northridge et al., 2019, Kingston et al., 2021). There are no set “environmental mortality limits” for grey seals (Kingston et al., 2021) meaning assessment against the incidental bycatch target is not possible, however, available data suggest that pelagic gears are not significantly contributing to current bycatch levels.

5.3.2.2 Risks to seals from reductions in prey

Seals are generalist feeders, although herring can be an important part of their diet (Lindegren et al., 2011). Current available evidence suggests that herring are an important and preferred food source for seal populations in the North Sea (Hall et al., 1998; Das et al., 2003). Their generalist and opportunistic feeding strategy may mean seal populations will hold some resilience to falls in pelagic fish stocks, however this is not a certainty, and more evidence is needed to verify this.

5.3.2.3 Conclusions and recommended actions for seals

Conclusions and recommended actions for seals relating to bycatch

Bycatch is not thought to be negatively impacting this descriptor’s ability to reach GES, However, **the risk arising from the pelagic FMP to seals is still considered to be moderate due to the current level of sampling of bycatch and confidence in existing evidence.** The suggested strategic approach to continue and enhance the bycatch evidence base is outlined in Section 3.1.1.4 and is relevant to assessing and mitigating risks to all UK MS Descriptors.

Conclusions and recommended actions for seals relating to reductions in prey

The risk to this UK MS descriptor from reductions in prey is considered to be moderate. Due to the complexities of ecosystem interactions and trophic links between pelagic fish and seal populations, an Ecosystem Based Approach to Fisheries Management, as described in Section 3.1.2.4., is recommended.

5.3.3 UK MS Descriptor D1, D4 biological diversity of birds

The objectives and indicators for the descriptor 'D1, D4: Biological Diversity of Seabirds is Maintained' are detailed in Table A4 (Annex 2). A summary of the risks and actions for this descriptor are found in Table 1 for pelagic trawls and Table 2 for pelagic drift nets. Additional evidence for purse seines and handlines has been included in this section where available. Potential risks to this UK MS descriptor arising from the fisheries contained in this FMP arise primarily from bycatch of descriptors and from reductions in available prey to descriptors.

5.3.3.1 Risks to birds from bycatch

To align with UKMS GES targets, fisheries shouldn't compromise the long-term viability of marine bird populations due to incidental bycatch. There shouldn't be significant population decline or distribution changes since 1992 caused by human interventions. Widespread breeding failures in marine birds induced by human activities shouldn't persist for more than three out of six years.

Pelagic trawls and purse seines

In a study of bycatch risk to seabirds, Bradbury et al., (2017) identified gannets, fulmars, guillemots, razorbills, black guillemots, puffins, shags, and great northern divers as being the most sensitive species to bycatch in pelagic fisheries. The study showed that bycatch risk was generally lower and more localised in pelagic trawls when compared to static gears, and areas of highest risk shift seasonally in response to seabird distribution (Bradbury et al. 2017).

Three species have been recorded as bycatch in pelagic trawls in the BMP; guillemot, razorbill, and cormorant, with guillemot accounting for 85% of individuals recorded (Northridge et al., 2020). Again, this dataset shows strong seasonal and area-specific trends. All seabird bycatch observations came from midwater trawl fisheries targeting bass (this fishery is now closed) and coastal sprat fisheries in the English Channel. Numbers of birds recorded in the BMP were much lower for pelagic trawls than for static nets.

There is little direct information on seabird bycatch in the UK-registered purse-seine fleet, which is relatively limited in extent and effort (Anderson et al., 2022). As well as the designated species discussed in earlier sections, evidence from Spain indicates shearwaters are vulnerable to bycatch in purse-seines and in the south-west of the English EEZ, shearwaters and gannets may be at risk, notably the critically endangered Balearic shearwater (Anderson et al., 2022). Preliminary estimates by Northridge et al. (2020) and Miles et al. (2020) do suggest that bycatch mortality of some bird species is at levels that significantly affects populations and is above levels compatible with GES. However, pelagic gears are not currently thought to contribute significantly to this bycatch mortality and are unlikely to be preventing the achievement of GES for this descriptor.

Drift nets

Drift nets were not included in the analysis of seabird bycatch by Northridge et al. (2020) despite being part of the BMP sampling regime. French et al. (2022) and expert advice suggest the risk is likely to be moderate.

5.3.3.2 Risks to birds from reductions in prey.

The significance of pelagic fish species to protected seabird species has been discussed in Section 3.1.2.2.

5.3.3.3 Conclusions and recommended actions for seabirds

Conclusions and recommended actions for seabirds relating to bycatch

The risk arising from this FMP to the GES targets for seabirds is considered to be moderate for bycatch in pelagic trawls, purse seines, and pelagic drift nets. Although bycatch is much lower in these gears compared to static nets, the risk remains moderate due to the current level of sampling of bycatch and confidence in existing evidence. The suggested strategic approach to continue and enhance the bycatch evidence base is outlined in Section 3.1.1.4 and is relevant to assessing and mitigating risks to all UK MS Descriptors.

Additionally, this advice has highlighted particular evidence gaps for seabirds in large pelagic trawl vessels and drift nets. Addressing evidence gaps through ongoing monitoring and research or, where necessary, through enhanced data collection will improve confidence in the assessment of bycatch risks in Scottish pelagic fisheries.

Conclusions and recommended actions for seabirds relating to reductions in prey

The risk arising from this FMP to the GES targets for seabirds through the reduction in available prey is considered to be moderate. Due to the complexities of ecosystem interactions and links between relevant pelagic fish and seabird abundance, an Ecosystem Based Approach to Fisheries Management, as outlined in Section 3.1.2.4, is recommended.

Additional work undertaken by NE during the development of recommendations for the English Seabird Conservation and Recovery Plan (ESCaRP) also identified that efforts to increase and improve long-term monitoring of seabird prey and marine ecosystem health were required. Identified actions included: Increasing and improving marine monitoring at all trophic levels; strategic coordination of marine monitoring and facilitation of international coordination, collaboration, and data sharing between countries.

5.3.4 UK MS Descriptor D1, D4 biological diversity of fish

The current targets and indicators for 'D1, D4: Biological Diversity of Fish' are outlined in Table A5 (Annex 2). A summary of the risks and actions for this descriptor are found in Table 1 for pelagic trawls and Table 2 for pelagic drift nets.

While most fishing activities pose inherent high risks to the biological diversity of fish stocks due to non-target bycatch, we are not presenting detailed advice on this descriptor for the Pelagic FMPs. This is because the indicator comprises over 100 sensitive species, and further collaborative work is first needed between relevant government bodies to determine how best to evaluate risks and provide actionable advice at the fishery management level. Given the complexity of interactions between multiple species, fleets, and fishing methods, strategic solutions may be most effective for achieving Good Environmental Status. We will continue engaging with the FMP working group as part of developing a coherent strategy for restoring and protecting biological diversity across fishing activities in the region. In the interim, progress towards the Fisheries Act's sustainability and precautionary objectives will facilitate steps in the right direction.

5.3.5 UK MS Descriptor D4 foodwebs.

The current targets and indicators for 'D4, Foodwebs' are presented in Table A7 (Annex 2). A summary of the risks for this descriptor are found in Table 1 for pelagic trawls and Table 2 for pelagic drift nets.

We are not presenting comprehensive advice for UK MS Descriptor D4 foodwebs in this advice, as substantial further work is required to determine appropriate actions at the fishery level. The current indicators focus on size and trophic structure of ecological communities, involving complex interactions between multiple stocks and fisheries. Strategic collaboration will be imperative to improve ecosystem models and our understanding of how fishing mortality impacts food web dynamics. Isolated changes within individual fisheries are unlikely to meaningfully contribute to achieving Good Environmental Status for this descriptor. As the FMP progresses towards sustainability and precautionary objectives under the Fisheries Act, this may result in incremental steps towards GES for D4. However, we will continue engaging with government and other research bodies as part of developing a coherent overarching strategy for food web protections in the region. The close involvement of the FMP working group in this strategic development will help align operational and policy objectives regarding D4 moving forward.

5.3.6 UK MS Descriptor D1, D6 seafloor integrity

The current targets and indicator for the Descriptor '*D1 & D6 seafloor integrity*' are shown in Table A8 (Annex 2). A summary of the risks and actions for this descriptor are found in Table 1 for pelagic trawls and Table 2 for pelagic drift nets.

Pelagic gears are considered to pose a low risk to benthic habitats (Rosen et al., 2012) within the context of this advice and no further recommendations are made for this gear-descriptor interaction.

5.3.7 UK MS D10 marine litter

The current targets and indicator for Descriptor 'D10 Marine litter' are shown in Table A9 (Annex 2). A summary of the risks and actions for this descriptor are found in Table 1 for pelagic trawls and Table 2 for pelagic drift nets.

5.3.7.1 Risks from marine litter from pelagic fishing

Gear specific estimates of rates of abandoned, lost, and discarded fishing gear (ALDFG) have low certainty due to a small number of studies and low sample sizes. Risks are highest in static gear fisheries (French et al., 2022) where significant quantities of gear are deployed into the marine environment. Mobile gears are a lower risk but may be a source of plastic ropes and netting which contribute to non-biodegradable marine litter when lost, abandoned, or discarded at sea. Abandoned, lost, or discarded fishing gear is associated with entanglements and ghost fishing. However, fishing litter is likely to be a relatively small component of overall marine litter, therefore fishing measures alone are unlikely to contribute significantly to the achievement of GES. Some gear loss is driven by the spatial conflict between mobile and static fleet sectors, where competition for space leads to interaction between mobile and static fishing gears. FMPs may consider ways in which to mitigate this conflict and any associated gear losses.

5.3.7.2 Conclusions and recommended actions for D10 marine litter

There is a moderate risk to marine litter. More robust estimates of ALDFG in the fishery are required.

FMPs could consider initiatives to gather relevant data to record and map gear losses in relevant fisheries in order to better understand the levels of risk and establish baselines.

Individual FMPs may be able to identify and develop mitigating measures/technologies to reduce losses and minimise impacts of ghost fishing and entanglements on marine life.

6 Conclusion and recommendations

This advice has highlighted several moderate environmental risks associated with Pelagic fisheries in Scottish waters, with potential impacts on MPA features, PMFs and the overarching goal of achieving GES. These risks encompass bycatch in the fisheries, prey reduction, and the introduction of marine litter. However, the moderate ratings are considered precautionary; there are potential impact pathways but with limited evidence available against which to assess the occurrence or scale of these impacts. The role of industry will be crucial in both gathering evidence in the form of fisheries-dependent data, and in identifying practical, workable, and locally relevant solutions that can reduce pressures and mitigate risks accordingly. Government will likely need to coordinate different policy areas and delivery tools, going beyond FMPs, and to provide resourcing to develop synergies and maximise the impact of those actions instigated through FMPs. ALBs will

need to ensure timely analysis of evidence supplied and the subsequent provision of robust and appropriate advice. Such an approach is essential to ensure the conservation objectives of MPAs are met or furthered, fisheries make a significant contribution to the achievement of Good Environmental Status, and important steps towards an ecosystem-based approach to fisheries management are taken.

In some cases, existing initiatives will complement the work of the FMPs, such as the UK BMI and Clean Catch UK; these will be important for coordinating and achieving progress beyond the regional scale of FMPs and individual fisheries stock units. In other challenging areas, further work to develop the appropriate vehicles to deliver strategic work at a suitable scale will be required. Government may need to develop a strategy guiding where reductions in pressures need to occur across the fleet and to make decisions accounting for the trade-offs between industry sectors. It might be difficult to do this at the individual FMP level, and thus actions may be necessary at a programme level.

References

- Anderson, O.R.J., Thompson, D. & Parsons, M. (2022). Seabird bycatch mitigation: evidence base for possible UK application and research. JNCC Report No. 717, JNCC, Peterborough, UK.
- Anderwald, P., Evans, P., Dyer, R., Dale, A., Wright, P., & Hoelzel, A. (2012). Spatial scale and environmental determinants in minke whale habitat use and foraging. Marine Ecology Progress Series, 450, 259-274. <https://doi.org/10.3354/MEPS09573>.
- Blanco, C., Raduan, M.A. & Raga, J.A. (2006). Diet of Risso's dolphin (*Grampus griseus*) in the western Mediterranean Sea. Scientia Marina, 70(3), 407-411.
- Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W.G., & Hume, D. (2017). Risk assessment of seabird bycatch in UK waters. Wildfowl & Wetlands Trust, UK.
- Brasseur, S.M.J.M., Scheidat, M., Aarts, G.M., Cremer, J.S.M. & Bos, O.G. (2008). Distribution of marine mammals in the North Sea for the generic appropriate assessment of future offshore wind farms (No. C046/08). IMARES.
- Certain, G., Masse, J., Van Canneyt, O., Petitgas, P., Doremus, G., Santos, M.B. & Ridoux, V. (2011). Investigating the coupling between small pelagic fish and marine top predators using data collected from ecosystem-based surveys. Marine Ecology Progress Series, 422, pp.23-39.
- Daan, N. (1989). Data base report of the stomach sampling project 1981. ICES Cooperative Research Report No.164, p. 144
- Dänhardt, A. & Becker, P.H. (2011). Herring and sprat abundance indices predict chick growth and reproductive performance of common terns breeding in the Wadden Sea. Ecosystems, 14, pp.791-803.
- Das, K., Lepoint, G., Leroy, Y. & Bouquegneau, J.M. (2003). Marine mammals from the southern North Sea: feeding ecology data from $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ measurements. Marine Ecology Progress Series, 263, pp.287-298.
- de Boer, M.N., Saulino, J.T., Leopold, M.F., Reijnders, P.J.H. & Simmonds, M.P. (2012). Interactions between short-beaked common dolphin (*Delphinus delphis*) and the winter pelagic pair-trawl fishery off Southwest England (UK). International Journal of Biodiversity and Conservation, 4(13), 481-499.
- De Pierrepont, J.F., Dubois, B., Desormonts, S.M., Santos, B.O. & Robin, J.P. (2005). Stomach contents of English Channel cetaceans stranded on the coast of Normandy. Journal of the Marine Biological Association of the UK, 85(6), 1539-1546. <https://doi.org/10.1017/S0025315405012762> ↗

Engelhard, G., Peck, M., Rindorf, A., Smout, S., Deurs, M., Raab, K., Andersen, K., Garthe, S., Lauerburg, R., Scott, F., Brunel, T., Aarts, G., Kooten, T. & Dickey-Collas, M. (2014). Forage fish, their fisheries, and their predators: who drives whom? ICES Journal of Marine Science, 71, 90-104. <https://doi.org/10.1093/ICESJMS/FST087>.

Fontaine, M.C., Tolley, K.A., Siebert, U., Gobert, S., Lepoint, G., Bouquegneau, J.M. & Das, K. (2007). Long-term feeding ecology and habitat use in harbour porpoises *Phocoena phocoena* from Scandinavian waters inferred from trace elements and stable isotopes. BMC Ecology, 7, 1-12. <https://doi.org/10.1186/1472-6785-7-1> ↗

French, N., Pearce, J., Howarth, P., Whitley, C., Mackey, K. & Nugent, P. (2022). Risk-based approach to remote electronic monitoring for English inshore fisheries. Natural England Commissioned Reports No. 437.

Fryxell, J.M., & Lundberg, P. (1994). Diet choice and predator—prey dynamics. Evolutionary Ecology, 8, 407–421. <http://dx.doi.org/10.1007/BF01238191>

Furness, R. (2002). Management implications of interactions between fisheries and sandeel-dependent seabirds and seals in the North Sea. Ices Journal of Marine Science, 59, 261-269. <https://doi.org/10.1006/JMSC.2001.1155>.

Garthe, S., Guse, N., Montevecchi, W.A., Rail, J.F. & Grégoire, F. (2014). The daily catch: Flight altitude and diving behaviour of northern gannets feeding on Atlantic mackerel. Journal of Sea Research, 85, pp.456-462.

Gauld, J.A. (1989). Records of porbeagles landed in Scotland, with observations on the biology, distribution and exploitation of the species. Scottish Fisheries Research Report Number 45 1989 ISSN 0308 8022, 16pp.

Green, E. (2017). Tern diet in the UK and Ireland: a review of key prey species and potential impacts of climate change. RSPB Report.

Hall, A.J., Watkins, J. & Hammond, P.S. (1998). Seasonal variation in the diet of harbour seals in the south-western North Sea. Marine Ecology Progress Series, 170, pp.269-281.

Hamer, K.C., Phillips, R.A., Wanless, S., Harris, M.P. & Wood, A.G. (2000). Foraging ranges, diets and feeding locations of gannets *Morus bassanus* in the North Sea: evidence from satellite telemetry. Marine ecology progress series, 200, pp.257-264.

Harris, M.P. & Wanless, S. (1986). The food of young razorbills on the Isle of May and a comparison with that of young guillemots and puffins. *Ornis Scandinavica*, pp.41-46.

Haugland, M., Holst, J.C., Holm, M. and Hansen, L.P. (2006). Feeding of Atlantic salmon (*Salmo salar* L.) post-smolts in the Northeast Atlantic. ICES Journal of Marine Science, 63(8), pp.1488-1500.

IAMMWG. (2015). Management units for cetaceans in UK waters (January 2015). JNCC Report No. 547. Joint Nature Conservation Committee.

Jacobsen, J.A. & Hansen, L.P. (2001). Feeding habits of wild and escaped farmed Atlantic salmon, *Salmo salar* L., in the Northeast Atlantic. ICES Journal of Marine Science, 58(4), pp.916-933.

Jennings, G., McGlashan, D.J. & Furness, R.W. (2012). Responses to changes in sprat abundance of common tern breeding numbers at 12 colonies in the Firth of Forth, east Scotland, ICES Journal of Marine Science, 69(4), 572–577.

<https://doi.org/10.1093/icesjms/fss022>

Kingston, A., Northridge, S. & Thomas, L. (2021). UK bycatch monitoring programme report for 2019. Sea Mammal Research Unit.

Kuhn, C., Baker, J., Towell, R. & Ream, R. (2014). Evidence of localized resource depletion following a natural colonization event by a large marine predator. The Journal of animal ecology, 83 5, 1169-77. <https://doi.org/10.1111/1365-2656.12202>.

Lindegren, M., Östman, Ö. & Gårdmark, A. (2011). Interacting trophic forcing and the population dynamics of herring. Ecology, 92(7), pp.1407-1413.

Luque, P.L., Davis, C.G., Reid, D.G., Wang, J. & Pierce, G.J. (2006). Opportunistic sightings of killer whales from Scottish pelagic trawlers fishing for mackerel and herring off North Scotland (UK) between 2000 and 2006. Aquatic Living Resources, 19(4):403-410. doi:10.1051/alr:2007009

Miles, J., Parsons, M. & O'Brien, S. (2020). Preliminary assessment of seabird population response to potential bycatch mitigation in the UK-registered fishing fleet. Report prepared for the Department for Environment Food and Rural Affairs.

Northridge, S., Kingston, A. & Thomas, L. (2019). Annual report on the implementation of Council Regulation (EC) No 812/2004 during 2018. Sea Mammal Research Unit. <https://www.gov.uk/government/publications/bycatch-of-protected-species-during-2018>

Northridge, S., Kingston, A., Coram, A. & Gordon, J. (2020). Preliminary estimates of seabird bycatch by UK vessels in UK and adjacent waters. Final Report to JNCC. University of St Andrews.

Pierce, G., Santos, M., Reid, R., Patterson, I. & Ross, H. (2004). Diet of minke whales *Balaenoptera acutorostrata* in Scottish (UK) waters with notes on strandings of this species in Scotland 1992–2002. Journal of the Marine Biological Association of the United Kingdom, 84, 1241 - 1244. <https://doi.org/10.1017/S0025315404010732h>.

Pinn, E., Mitchell, I. & Hawkrigde, J. (2018). Abundance and distribution of coastal bottlenose dolphins. UK Marine Online Assessment Tool.

<https://moat.cefas.co.uk/biodiversity-food-webs-and-marine-protected-areas/cetaceans/abundance-and-distribution-of-coastal-bottlenose-dolphins/> ↗

Praca, E. & Gannier, A. (2008). Ecological niches of three teuthophagous odontocetes in the northwestern Mediterranean Sea. *Ocean Science*, 4(1), 49–59.

Priede, I.G. (2019) Deep-sea Fishes Literature Review. JNCC Report No. 619. JNCC, Peterborough. ISSN 0963-8091

Ramos, F., Tornero, J., Rincón-Hidalgo, M., Jiménez, M.P., Cruz, A.D.L. & Muñoz Arroyo, G. (2022). Seabird distribution is better predicted by abundance of prey than oceanography. A case study in the Gulf of Cadiz (SW, Iberian Peninsula). *Centro Oceanográfico de Cádiz*.

Ransijn, J.M., Booth, C. & Smout, S.C. (2019). A calorific map of harbour porpoise prey in the North Sea. JNCC Report No. 633. Joint Nature Conservation Committee.

Ransijn, J.M., Hammond, P.S., Leopold, M.F., Sveegaard, S. & Smout, S.C. (2021). Integrating disparate datasets to model the functional response of a marine predator: A case study of harbour porpoises in the southern North Sea. *Ecology and Evolution*, 11, 17458-17470. <https://doi.org/10.1002/ece3.8380>

Rikardsen, A.H. & Dempson, J.B. (2011). Dietary life-support: the food and feeding of Atlantic salmon at sea. *Atlantic salmon ecology*, pp.115-143.

Robinson, K.P., MacDougall, D.A.I., Bamford, C.C.G., Brown, W.J., Dolan, C.J., Hall, R., Haskins, G.N., Russell, G., Sidiropoulos, T., Sim, T.M.C., Spinou, E., Stroud, E., Williams, G. & Culloch, R.M. (2023). Ecological habitat partitioning and feeding specialisations of coastal minke whales (*Balaenoptera acutorostrata*) using a recently designated MPA in northeast Scotland. *PLoS ONE* 18(7): e0246617. <https://doi.org/10.1371/journal.pone.0246617>

Rosen, S., Engås, A., Fernö, A. & Jørgensen, T. (2012). The reactions of shoaling adult cod to a pelagic trawl: Implications for commercial trawling. *ICES Journal of Marine Science*, 69(2), 303-312. <https://doi.org/10.1093/icesjms/fsr199>

Samarra, F.I.P. & Foote, A.D. (2015) Seasonal movements of killer whales between Iceland and Scotland. *Aquat Biol*, 24, 75-9. <https://doi.org/10.3354/ab00637>

Santos, M.B. & Pierce, G.J. (2003). The diet of harbour porpoise (*Phocoena phocoena*) in the northeast Atlantic. *Oceanography and Marine Biology: An Annual Review*, 41, 355-390.

Santos, M., Pierce, G., Reid, R., Patterson, I., Ross, H. & Mente, E. (2001). Stomach contents of bottlenose dolphins (*Tursiops truncatus*) in Scottish waters. *Journal of the Marine Biological Association of the United Kingdom*, 81, 873 - 878. <https://doi.org/10.1017/S0025315401004714>.

Santos, M.B., Pierce, G.J., Learmonth, J.A., Reid, R.J., Ross, H.M., Patterson, I.A.P., Reid, D.G. & Beare, D. (2004). Variability in the diet of harbor porpoises (*Phocoena phocoena*) in Scottish waters 1992–2003. *Marine Mammal Science*, 20(1), 1-27.

<https://doi.org/10.1111/j.1748-7692.2004.tb01138.x>

Sigurjónsson, J. 1995. On the life history and autecology of North Atlantic rorquals. pp425-41. In: Blix, A.S., Walløe, L. and Ulltang, O. (eds), *Whales, Seals, Fish and Man: proceedings of the International Symposium on the Biology of marine mammals in the North East Atlantic, Tromsø, Norway, 29 November-1 December 1994*. Elsevier, Amsterdam.

Similä, T. (1997). Sonar observations of killer whales (*Orcinus orca*) feeding on herring schools. *Aquatic Mammals*, Volume 23, pp. 119-126

Steenweg, R.J., Ronconi, R.A. & Leonard, M.L. (2011). Seasonal and age-dependent dietary partitioning between the Great Black-backed and Herring gulls. *The Condor*, 113(4), pp.795-805.

Stienen, E.W.M. (2006). Living with gulls: Trading off food and predation in the Sandwich Tern *Sterna sandvicensis* (Doctoral dissertation). University of Groningen, Netherlands.

Sveegaard, S., Nabe-Nielsen, J., Stæhr, K.J., Jensen, T.F., Mouritsen, K.N. & Teilmann, J. (2012). Spatial interactions between marine predators and their prey: herring abundance as a driver for the distributions of mackerel and harbour porpoise. *Marine Ecology Progress Series*, 468, pp.245-253.

Torda, A. (2003). A comparative study of the diet of guillemots *Uria aalge* and razorbills *Alca torda* killed during the tricolor oil incident in the south-eastern North Sea in January 2003.

Trancart, T., Rochette, S., Acou, A., Lasne, E., & Feunteun, E. (2014). Modelling marine shad distribution using data from French bycatch fishery surveys. *Marine Ecology Progress Series*, 511, 181-192. <https://doi.org/10.3354/meps10907>

Utne, K.R., Skagseth, Ø., Wennevik, V., Broms, C.T., Melle, W. & Thorstad, E.B. (2022). Impacts of a changing ecosystem on the feeding and feeding conditions for Atlantic salmon during the first months at sea. *Frontiers in Marine Science*, 9, p.342.

Wanless, S., Harris, M.P., Newell, M.A., Speakman, J.R. & Daunt, F. (2018). Community-wide decline in the occurrence of lesser sandeels *Ammodytes marinus* in seabird chick diets at a North Sea colony. *Marine Ecology Progress Series*, 600. 193-206.

<https://doi.org/10.3354/meps12679>

Wilson, L.J. & Hammond, P.S. (2019). The diet of harbour and grey seals around Britain: Examining the role of prey as a potential cause of harbour seal declines. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 29, pp.71-85.

Annex 1.

Table A1 Full list of UK MS descriptors. Those in bold are scoped into this advice.

UK MS Descriptor	Ecosystem component	Screened into this fisheries advice
D1 – Biological diversity	Cetaceans	Yes
	Seals	Yes
	Birds	Yes
	Fish	Yes
	Pelagic habitats	No
	Benthic habitats	Yes
D2 -non-indigenous species	N/A	No
D3 -Commercially-exploited fish and shellfish	N/A	Yes
D4 -Food webs	Cetaceans	Yes
	Seals	Yes
	Birds	Yes
	Fish	Yes
	Pelagic habitats	No
D5 -Eutrophication	N/A	No
D6 -Sea-floor integrity	Pelagic habitats	No
	Benthic habitats	Yes
D7 -Hydrographical conditions	N/A	No
D8 -Contaminants	N/A	No

D9 -Contaminants in fish and other seafood for human consumption	N/A	No
D10 -Litter	N/A	Yes
D11 -Introduction of energy, including underwater noise	N/A	No

Annex 2

Table A2 UK MS indicators and targets for D1, D4 Cetaceans

Descriptor	Target 2019	Indicator	North Sea	Trend	Celtic Seas	Trend
D1; D4: CETACEANS	The long-term viability of cetacean populations is not threatened by incidental bycatch.	Harbour porpoise bycatch - Marine online assessment tool (cefasc.co.uk) Cetaceans - Marine online assessment tool (cefasc.co.uk)	GES Achieved	Insufficient data to assess	GES status unknown/uncertain	Insufficient data to assess
	There should be no significant decrease in abundance caused by human activities.	Abundance and distribution of coastal bottlenose dolphins (OSPAR)	Achieved	stable/mixed	GES status unknown/uncertain	stable/mixed
		Abundance and distribution of cetaceans other than coastal bottlenose dolphins (OSPAR)	Partial	stable/mixed	GES status unknown/uncertain	stable/mixed
	Population range is not significantly lower than the favourable	Abundance and distribution of coastal bottlenose dolphins (OSPAR)	Achieved	stable/mixed	GES status unknown/uncertain	stable/mixed

	reference value for the species.	Abundance and distribution of cetaceans other than coastal bottlenose dolphins (OSPAR)	Partial	stable/mixed	GES status unknown/ uncertain	stable/mixed
--	----------------------------------	--	---------	--------------	-------------------------------	--------------

Table A3 UK MS indicators and targets for D1, D4 Seals

Descriptor	Target 2019	Indicator	North Sea	Trend	Celtic Seas	Trend
D1; D4: SEALS	The long-term viability of seal populations is not threatened by incidental bycatch.	Marine mammal bycatch (OSPAR)	GES status unknown/ Uncertain	Unknown	GES status unknown/ uncertain	Unknown
	Population abundance and distribution are consistent with favourable conservation status.	Grey seal abundance and distribution	Achieved	improving	achieved	improving
		Harbour seal abundance and distribution	Not achieved	stable/mixed	GES status unknown/ uncertain	Unknown
	Grey seal pup production does not decline substantially in the short or long-term.	Grey seal pup production (OSPAR)	Achieved	improving	achieved	improving

Table A4 UK MS indicators and targets for D1, D4 Birds

Descriptor	Target 2019	Indicator	North Sea	Trend	Celtic Seas	Trend
D1, D4: BIRDS	The long-term viability of marine bird populations is not threatened by deaths caused by incidental bycatch catch in mobile and static fishing gear.	Seabird bycatch				
	The population size of species has not declined substantially since 1992 as a result of human activities.	Marine bird abundance (OSPAR)	Not achieved	declining	Not achieved	declining
	Widespread lack of breeding success in marine birds caused by human activities should occur in no more than three years in six.	Marine bird breeding success/failure (OSPAR)	Not achieved	declining	Partial	declining
		Kittiwake breeding success	Not achieved	declining	Not assessed	Unknown
	There is no significant change or reduction in population distribution caused by human activities.	Distribution of breeding and non-breeding marine birds	Not assessed	Unknown	Not assessed	Unknown
		Invasive mammal presence on island seabird colonies	Not assessed	Unknown	Not assessed	Unknown

Table A5 UK MS indicators and targets for D1, D4 Fish

Descriptor	Target 2019	Indicator	North Sea	Trend	Celtic Seas	Trend
D1, D4: FISH	Incidental bycatch is below levels which threaten long-term viability and recovery of fish populations.	To include bycatch numbers of vulnerable species and catch rates per fishing fleet	GES status unknown/ Uncertain	Unknown	GES status unknown/ Uncertain	Unknown
	The population abundance of sensitive species is not decreasing due to anthropogenic activities and long-term viability is ensured.	Recovery in the population abundance of sensitive fish species (OSPAR)	Not achieved	stable/mixed	Achieved	stable/mixed
	For fish species in the Habitats and Birds Directive population abundance and geographic distribution meets established favourable reference values.	UK assessments of listed fish species	Not achieved	stable/mixed	Achieved	improving
	For listed fish species, the area and the quality of the habitat is sufficient.		GES status unknown/ Uncertain	Unknown	GES status unknown/ Uncertain	Unknown

Table A6 UK MS indicators and targets for D3 Commercial Fish

Descriptor	Target 2019	Indicator	North Sea	Trend	Celtic Seas	Trend
D3: COMMERCIAL FISH AND SHELLFISH	The Fishing mortality rate of populations of commercially exploited species is at or below levels which can produce the maximum sustainable yield.	Commercial fishing pressure for stocks of UK interest.	Partial	Improving	Partial	Improving
	The Spawning Stock Biomass of populations of commercially exploited species are above biomass levels capable of producing the maximum sustainable yield.	Reproductive capacity of commercially exploited stocks of UK interest.	Partial	Improving	Partial	Improving

Table A7 UK MS indicators and targets for D4 Foodwebs

Descriptor	Target 2019	Indicator	North Sea	Trend	Celtic Seas	Trend
D4: FOODWEBS	The species composition and relative abundance of representative feeding guilds are indicative of a healthy marine food web.	Mean maximum length of fish (OSPAR).	Not achieved	Stable/mixed	Not achieved	Stable/mixed
		Selected plankton lifeforms pairs (e.g., large vs small zooplankton) (OSPAR)	GES status unknown/ Uncertain	Unknown	GES status unknown/ Uncertain	Unknown
	The balance of abundance between representative feeding guilds is indicative of a healthy marine food web.	An indicator of biomass of predatory feeding guilds for fish is currently under development using current data. This could be expanded to seabirds and marine mammals.	Not assessed	Unknown	Not assessed	Unknown
	The size structure of fish communities is indicative of a healthy marine food web.	Fish community size structure: Typical Length (Tyl - OSPAR) and/or Large Fish Index (LFI - OSPAR)	Not achieved	Stable/mixed	Partial	Improving
	Productivity of the representative feeding guilds, characterised by key species, is indicative of a healthy marine food web.	D4C4s required information on multiple components (seabirds, marine mammals, fish, and pelagic habitat).				

Table A8 UK MS indicators and targets for D1, D6 Seafloor integrity

Descriptor	Target 2019	Indicator	North Sea	Trend	Celtic Seas	Trend
D1; D6: BENTHIC	The physical loss of each seabed habitat type caused by human activities is minimised and where possible reversed.	Physical loss of predicted habitats	Not achieved	unknown	Not achieved	Unknown
	The extent of habitat types adversely affected by physical disturbance caused by human activity should be minimised.	Extent of Physical damage indicator to predominant and special habitats (OSPAR)	Not achieved	Unknown	Not achieved	Unknown
		Benthic communities' indicator (OSPAR)	GES status unknown/ Uncertain	Unknown	GES status unknown/ Uncertain	Unknown
	Habitat loss of sensitive, fragile, or important habitats caused by human activities is prevented, and where feasible reversed.	Physical loss of predicted habitats indicator (Extent of benthic habitat)	Not achieved	Unknown	Not achieved	Unknown
	The extent of adverse effects caused by human activities on the condition, function and ecosystem processes of	Benthic communities' indicator (OSPAR)	Not assessed	Unknown	Not assessed	Unknown
		Aggregated Infaunal Quality Index	Not achieved	Unknown	Partial	Unknown
		Aggregated Saltmarsh Tool	Not achieved	Unknown	Achieved	Unknown

	habitats is minimised.	Aggregated Rocky Shore Macroalgal Index	Achieved	Unknown	Achieved	Unknown
		Aggregated Intertidal Seagrass Tool	Achieved	Stable/mixed	Achieved	Stable/mixed
		Intertidal rock community change indicator (MarClim)	GES status unknown/ Uncertain	Unknown	GES status unknown/ Uncertain	Unknown

Table A9 UK MS indicators and targets for D10 Marine Litter

Descriptor	Target 2019	Indicator	North Sea	Trend	Celtic Seas	Trend
D10: MARINE LITTER	A decrease in the total amount of the most common categories of litter found on surveyed beaches	Litter types on beaches	Not achieved	Declining	Not achieved	Declining