Marine Strategy Part Two: UK Updated Monitoring Programmes

Response to Defra, Defra, the Northern Ireland Executive, the Scottish Government and the Welsh Government consultation by Environment Links UK
November 2020

Environment Links UK (ELUK) brings together environment and animal protection organisations to advocate for the conservation and protection of wildlife, countryside and the marine environment. The network comprises the combined memberships of Wildlife and Countryside Link, Scottish Environment LINK, Wales Environment Link and Northern Ireland Environment Link. Taken together, Environment Links UK members have the support of over eight million people in the UK. This response is submitted on behalf of ELUK and is supported by our member organisations listed below:

Executive Summary

We welcome the opportunity to respond to the UK Government's consultation on the updated monitoring programmes outlined in the UK Marine Strategy Part 2. It is in the spirit of collaboration and the interest of the marine environment that we offer our views on the suitability of the proposed monitoring programmes to meet GES and advice and suggestions on improvements across all descriptors. Overall, Environment Links UK's response can be summarised into the following key points:

- **Greater ambition and investment are needed** across the suite of programmes as the current and proposed monitoring programmes are insufficient to achieve GES for UK seas.

- **We are concerned by the number of descriptors monitored against limited baseline knowledge** and note that, for non-indigenous species and contaminants, no efforts are being made to establish baselines for rapidly intensifying threats.

- **We urge the adoption of Remote Electronic Monitoring (REM) on fishing vessels** as an efficient and cost-effective method for collecting data that would support monitoring across multiple descriptors.

- **Additional monitoring is needed for pollutants of increasing profile and concern** such as micro-plastics, emerging contaminants and anti-microbial resistant bacteria with the latter posing a substantial threat to public health.

We acknowledge the barriers to matching ambition with action have rarely been greater and improving spending on marine monitoring is a challenging ask at the time of writing and likely for the foreseeable future. However, we now stand at a critical moment for Ocean Recovery and will fail to achieve GES by the end of 2020. Yet a decade ago, the UK government showed leadership and foresight in developing the vision, framework and footing to manage our seas in an integrated fashion. It can do so again by acknowledging and addressing the challenges outlined in this response and enlisting a broad coalition to improve UK marine monitoring by:

1. Providing greater funding to and integration of NGO, citizen science and academic data collection efforts outlined in response to Q4 that could meet several monitoring needs in a cost-efficient fashion.

2. Working with the fishing industry to secure the resources and commitment required for installing REM across the UK fleet as the bedrock of a comprehensive monitoring framework for both commercial fish species and all bycatch species.

3. Working with the offshore and marine renewables sector to ensure that large-scale expansion of offshore renewable energy generation is delivered in a biodiversity-positive fashion with a system that makes data collection a mandatory condition of the granting of licenses.

Greater ambition and investment

Current monitoring programmes have not supported achievement of GES by 2020 and will remain unchanged for many descriptors, suggesting GES will not be met by 2024.

By the end of 2020, GES will only be achieved for four out of fifteen indicators, with failure to achieve GES expected for six and uncertain outcomes expected for the remaining five. Data deficiencies are cited as the main contributing factor to this uncertainty. We note that for most Descriptors, little or no additional monitoring has been proposed above and beyond existing monitoring programmes – confirmed on page 12 of the consultation document: *"Most of the proposed monitoring programmes are a continuation of existing programmes".*

Marine monitoring requires more effort and investment. The natural capital value of the marine environment is significant - a lack of monitoring and data threatens that capital. As reported in the JNCC's survey of marine natural capital accounts: *''data that we were able to access much was incomplete or inconsistent, often lacking the benefit of regular monitoring. Over a third of UK marine and coastal habitats fall in the category of just 'Seabed' or 'Known unknown''*[1].

Those exploiting that natural capital should help to fund marine monitoring (e.g. offshore wind, fisheries, aquaculture).

We are concerned by the number of descriptors monitored against limited baseline knowledge

The quality of available baseline data varies significantly by descriptor with serious concern for elements of D3 – there appears to be only one new monitoring programme introduced to assess fish stocks to address the gaps identified in 2014. It is also of note that stock status is unknown for 60% of UK shellfish stocks – making it impossible to report that a population is within safe biological limits. Despite being a growing area of concern, there is no baseline for microplastic loads in freshwater or marine environments, nor within seafood – posing a potential public health risk. For D11, there is not enough knowledge of the impacts of anthropogenic sound in the marine environment to understand the impact on UK marine wildlife and ecosystems, let alone whether there is progress towards achieving GES.

We urge the adoption of Remote Electronic Monitoring (REM) on fishing vessels

REM with cameras is an efficient and cost-effective method for collecting data on a large scale with little effort from fishers, particularly if the installation and purchase of the cameras were to be subsidised. REM would make significant contributions to achieving GES for D4, D3 and form the bedrock gold-standard programme of at-sea monitoring.

Additional monitoring is needed for pollutants of increasing profile and concern

Sufficient monitoring of contaminants in the environment is a vital alert system, yet under D8 the proposed monitoring programmes are both insufficient to achieve GES. Furthermore, there is serious

[1] JNNC Initial natural capital accounts for the UK marine and coastal environment

cause for concern due to the list of contaminants monitored in water, sediment and biota not having been updated since 2012. As a result, no emerging contaminants have been considered in that time – this list includes numerous flame retardant chemicals, pharmaceuticals and pesticides. In addition, there is increasing evidence that sewage pollution is putting the health of water-users and wildlife at risk through exposure to antimicrobial resistant bacteria. For pollutants in particular there is a need for greater connectivity between terrestrial, freshwater, estuarine and marine monitoring in order to determine sources and pathways. Marine Strategy monitoring should be better related to that for the Water Framework Directive and other relevant legislation.

Our response to the consultation questions is given below. This response covers the majority of the Marine Strategy descriptors. It provides detailed, fully referenced evidence on where improvements to Marine Strategy monitoring should be made. Whilst lengthy, the response is divided by descriptor to help in identifying actions for different marine policy areas. We intend for this response to be seen as a constructive contribution towards addressing the shortfalls in marine monitoring and would welcome further dialogue on our comments and recommendations.

Response to Consultation Questions

[Note: Responses to Q1 and Q2 have been merged unless otherwise stated]

1)Are the proposed monitoring programmes sufficient to meet the requirements of the Marine Strategy Regulations 2010, bearing in mind our current knowledge base?

and...

2) Are the proposed monitoring programmes sufficient to provide the necessary data to assess progress towards the achievement of GES, and the related targets, as set out in the updated UK Marine Strategy Part One?

Cetaceans (D1 D4)

No, the proposed monitoring programmes are not sufficient to meet the requirements of the Marine Strategy Regulations nor is there sufficient data to assess progress towards the achievement of GES. Whilst the existing monitoring programmes are necessary and go some way to meet the requirements, they are not sufficient to meet the requirements of the Regulation for the majority of cetaceans (with possible exception of bottlenose dolphin populations in the Moray Firth, Scotland and west Wales). As the consultation document reports, the extent to which GES has been achieved for cetaceans is uncertain, and their status at a regional level is unknown.

The criteria to assess progress towards GES and related targets include population abundance, population distribution and bycatch mortality. Data on population abundance are essential to understand the trends in populations over time, and these data are not available for the majority of cetacean species (except coastal bottlenose dolphins). There remains uncertainty about the number of populations or management units of harbour porpoise in UK and regional waters. It is assumed that there is only one population of Risso's dolphins, but this may not be the case for this species and for others. SCANS surveys, bottlenose dolphin and acoustic surveys are important and should continue. However they are required more frequently and in all seasons, not just in July each decade. ECOMASS should also be expanded along the northeast and southwest coasts of England. An increase in effort, as suggested, would assist with the considerable gaps for Data Deficient cetacean species. In addition, NGO survey data fill considerable data gaps. Further gaps remain however, and additional monitoring effort is required together with support for improving existing levels of citizen science data.

The monitoring proposed is not at all sufficient to assess population distribution during the winter season. Most data collected is either collected during July (SCANS surveys) or between May to October (NGO led surveys).

SCANS surveys are required more frequently, and in all seasons, not just in July each decade. More investment is required in NGO-led surveys, including those that utilise citizen science programmes.

A more holistic, ecosystem approach to monitoring is required, with better join up and integration of monitoring. Use of existing data could be improved.

The UK bycatch monitoring programme and the CSIP (and SMASS) and DAERE strandings programmes are important and should continue. However, our understanding of bycatch rates in UK waters is limited by the low level of observer coverage currently provided by the UK Bycatch Monitoring Programme. Monitoring of all protected species bycatch from UK-registered fishing vessels currently focusses on three broad gear types, with annual sampling achieving coverage of <1% total static net effort, 1-2% longline effort and roughly 5% of midwater trawl effort[2]. Another challenge is a lack of wider bycatch monitoring from non-UK vessels fishing in the UK EEZ or the UK fleet fishing in UK overseas territories or outside UK waters.

Whilst we recognise that the UK bycatch monitoring programme collects more data than our European neighbours, it is insufficient and there remains considerable uncertainty in the bycatch rates of all cetaceans, including those most commonly bycaught, due to poor levels of monitoring data. Serious concerns remain about bycatch levels of harbour porpoises in several areas of the UK, and particularly the Celtic Sea (ICES, 2019). To get accurate bycatch rates and to understand trends over time, it will be important to monitor bycatch on non-UK vessels fishing in UK waters.

As far as we are aware, the UK does not ensure compliance with the requirement under the Data Collection Framework for fishermen to report all bycatch events. CSIP post mortems have been reduced in recent years and the scheme is under considerable pressure. The stranding scheme in England does not include seals, which is a significant failing and the stranding scheme in Northern Island does not, to our knowledge, include post mortems.

Additional monitoring needed (Q3):

Additional monitoring is needed that enables:

i) population abundance to be calculated for cetaceans;

ii) post-mortem of seals in England; and

iii) bycatch rates to be calculated for cetaceans in UK waters, UKOTs and where UK fleets are fishing outside of UK waters, including using Remote Electronic Monitoring (REM)[3] that monitors over the side of the vessel so bodies that fall out upon hauling are also recorded.

Furthermore, additional monitoring is required to understand the individual and, particularly, cumulative impacts of noise pollution, as explicitly identified in the D11 Underwater Noise section.

[2] Northridge, S., Kingston, A. and Coram, A. (2020) Preliminary estimates of seabird bycatch by UK vessels in UK and adjacent waters. Report prepared for the Department for Environment Food and Rural Affairs (Project Code ME6024)

[3] See also *Birds*, *Seals* and *Commercial fish* sections

Additional monitoring being carried out (Q4):

Numerous NGOs, including HWDT, WDC, ORCA and IWDG, provide an important contribution in data to assist with population abundance and population distribution monitoring. NGOs, including BDMLR and RSPCA, also provide data that assist with bycatch assessments.

Seals (D1 D4)

No, current monitoring is not sufficient to meet the requirements of the Marine Strategy regulations 2010 nor is there sufficient data to assess progress towards the achievement of GES. Whilst the existing monitoring programmes are welcome, more must be done to improve our knowledge base. As the 2019 assessment has shown, significant data gaps for harbour seals in the Celtic Seas exist and as a result, their status in the Celtic Seas region is unknown.

While population abundance and distribution, and, grey seal pup production are welcome monitoring criteria, these do not adequately address declines. More comprehensive monitoring for bycatch and strandings is required in England and Wales. Monitoring should also include post-mortems. Bycatch rates are currently based on assumptions from sampling that is predominantly in the Western Channel and the Celtic Seas, evidencing the need for increased monitoring of seal bycatch. Bycatch of harbour seals has been reported in areas where declines are occurring. This should be a particular focus of attention and the areas of concern should be prioritised. The rollout of Remote Electronic Monitoring with cameras on fishing vessels would assist in delivering more comprehensive monitoring of bycatch of seals as well as other species[4]. The announcement that a consultation on REM will be carried out by DEFRA is welcome however, similar consultations must take place across the UK. The roll out of REM with cameras must be UK wide, and include a focus on being appropriate for sensitive species bycatch monitoring, in order to make a meaningful contribution to monitoring for purposes under the UK Marine Strategy.

More frequent and wider monitoring of seal populations is required and resources should be directed to support this. As an example, monitoring of breeding populations of harbour and grey seals in Northern Ireland should not only occur at protected sites where they are a designated feature.

Currently, seal distribution is not adequately assessed, as it is used as a surveillance indicator to help determine changes in abundance. However, understanding of seal distribution at sea is an important consideration for determining their status. The Cetacean Stranding Investigation Programme (CSIP) must be expanded to include seals (in England and Wales) and rolled out UK wide. We appreciate that this has been identified under the section titled *Issues and Opportunities* but believe that it must be implemented during this phase of the Marine Strategy. A robust CSIP could also benefit from monitoring under descriptors 8 (contaminants) and 10 (marine litter).

As a general comment, the opportunities listed under the *Issues and Opportunities* section are welcome, however no timeframe for their implementation is included.

Additional monitoring needed (Q3):

Additional monitoring is needed for population abundance, bycatch, and strandings, and seal post mortems are required.

[4] See also Birds, *Cetaceans* and *Commercial fish* sections.

Birds (D1 D4)

i. Bird abundance, demographic characteristics and distribution range

Response to Q1 & Q2

Sampling effort under the Seabird Monitoring Program (SMP) has long been considered insufficient to deliver reliable abundance and productivity trend information for several seabird species[5,6,7] and this continues to be the case despite recommended solutions being identified by statutory-led reviews[8].

While a further review of the SMP is currently underway, at the time of writing there has been limited progress since its initiation over two years ago, and we are alarmed that much of it seems predicated on the assumption of stagnant or declining statutory resourcing. We are concerned that the Breeding Abundance and Breeding Success/Failure Indicators are derived from data which may not be representative for some species due to insufficient sampling coverage, which in turn is a symptom of under-resourcing of both the governance and implementation of the SMP. In addition, Manx shearwater, European storm petrel and Leach's storm petrel are excluded due to insufficient data. These nocturnal, burrow nesting species are difficult to monitor, but implementation of recent developments in monitoring methods [e.g. 9,10] would help to fill this gap.

Our breeding seabirds are essential features and characteristics of UK coasts and seas, some with internationally significant populations for which the UK has a global responsibility. It is therefore critical that the SMP is properly invested in to achieve adequate sampling coverage across all the UK breeding species to ensure that the scheme is sufficient for providing the necessary data for assessing progress towards GES.

Censuses are a key complement to the annual SMP sampling, as they give accurate baseline data for measuring future changes and provide data to assess the reliability of trends derived from annual sampling. They also provide gap-filling data on a periodic basis for poorly-sampled species such as petrels (currently excluded from UKMS assessments due to insufficient data). Initiation of the current census 'Seabirds Count' was plagued by lack of adequate resourcing, with proper progress only made

[5] Mitchell P.I., and Parsons M., (2007) Strategic Review of the UK Seabird Monitoring Programme. JNCC unpublished report

[6] Cook, A.S.C.P. and Robinson, R.A., 2010. How Representative is the Current Monitoring of Breeding Seabirds in the UK? British Trust for Ornithology Report No. 573

[7] Cook, A.S.C.P., Humphreys, E.M., Robinson, R.A. and Burton, N.H.K (2019). Review of the potential of seabird colony monitoring to inform monitoring programmes for consented offshore wind farm projects BTO Research Report No. 712

[8] JNCC (2012) Recommendations for the Seabird Monitoring Programme. JNCC unpublished report, circulated to the SMP partnership.

[9] Perkins, A.J., Bingham, C.J. and Bolton, M., 2018. Testing the use of infra-red video cameras to census a nocturnal burrow-nesting seabird, the European Storm Petrel Hydrobates pelagicus. *Ibis*, *160*(2), pp.365-378.

[10] Arneill, G.E., Perrins, C.M., Wood, M.J., Murphy, D., Pisani, L., Jessopp, M.J. and Quinn, J.L., 2019. Sampling strategies for species with high breeding-site fidelity: A case study in burrow-nesting seabirds. *PloS one*, *14*(8), p.e0221625.

once a Census Coordinator was recruited, around two years after the initial 'soft start'. Periodic censuses will only be sufficient for assessing progress towards the achievement of GES if they are underpinned by the necessary and timely government resourcing at appropriate intervals (every three UKMS reporting cycles, i.e. 18 years, as a minimum).

For the Abundance Indicator, there is insufficient monitoring to include seabirds within the non-breeding component; only one species (great cormorant) is assessed for both non-breeding and breeding seasons. However, if adequately resourced, enhancements to winter gull roost surveys (WinGS, last carried out 2005/6) to supplement WeBS data could provide the data needed to allow inclusion of gull species within the non-breeding component of the Abundance indicator[11].

The Distribution Indicator currently only includes data for waders and a limited number of waterfowl along non-estuarine coasts, based on WeBS and NEWS. It has so far not been possible to include existing data from seabird censuses or WiNGS within the Distribution Indicator due to a technical issue (matching site data between different censuses)[12] . We recommend that priority is given to resolve this, as changes in the distribution of seabirds will reflect different human impacts to those on waterfowl and waders.

The Breeding Success/Failure Indicator and the breeding components of both the Abundance and Distribution Indicators exclude some waterfowl species which are highly reliant on the marine environment during the breeding season, most notably the red-listed red-throated diver. It appears that red-throated diver has been excluded because monitoring is under-resourced and hence insufficient. It is not clear to what extent data from RBBP and SCARRABS have been used in generating any of the indicators, even though they are listed under the 'Periodic surveys'. Further, the RBBP dataset for red-throated diver is extremely biased spatially, with regular and consistent monitoring data only available from Shetland, and because there has not been a survey conducted under the SCARABBS programme since 2006 (efforts to obtain funding for a repeat national survey in 2018 were unsuccessful). At present there is no robust monitoring of eider or red-breasted merganser, which are also highly reliant on the marine environment during the breeding season, despite worrying indications of range contraction for red-breasted merganser for example[13].

Response to Q3

Further research and monitoring is needed before at-sea survey data are included within the Abundance and Distribution indicators. This should be designed to cover both a wider suite of

[11] Burton, N.H.K., Maclean, I. and Austin, G.E., 2009. An assessment of the feasibility of annual monitoring of winter gull roosts in the UK and possible outputs from such a scheme. British Trust for Ornithology.

[12] Humphreys EM Austin GE, Thaxter C, Johnston A, Risely, K Frederiksen, M Burton NHK (2015) Development of MSFD Indicators, Baselines, and Targets for Population Size and Distribution of Marine Birds in the UK. Report to JNCC.

[13] Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. and Fuller, R.J., 2013. Bird Atlas 2007-11: the breeding and wintering birds of Britain and Ireland. Thetford: BTO.

waterfowl than currently possible from WeBS (including internationally important aggregations of non-breeding seaduck, divers and grebes), and at-sea distributions of seabirds[14].

Priority should be given to bespoke monitoring of the critically endangered Balearic shearwater visiting the English Channel and Celtic Sea during the non-breeding season. For wider species monitoring, we welcome the VSAS pilot, but even a successful VSAS programme will need to be supplemented by professional surveys (both boat and aerial) to ensure sufficient representative coverage. This will likely require a combination of data from both statutory - and industry - commissioned monitoring programmes. We note that this is acknowledged to some extent in the Issues and Opportunities section, but it is important to emphasise that the current indicators cannot directly assess the environmental state of offshore sections of the marine regions without including at-sea survey data[15], so a fully comprehensive at-sea monitoring programme is essential to underpin a more complete assessment of progress towards achieving GES. Bespoke land-based surveys over and above WeBs may suffice for a limited number of waterfowl species, but their effectiveness would need testing.

We also highlight some minor clarifications required in the monitoring programmes listed:

We note that the Distribution Indicator is based on data from WeBS and NEWS, but WeBS is not specifically listed as one of the monitoring programmes, only Periodic bird surveys (which covers NEWS but not WeBS).

Some D4 Assessments (Abundance and Breeding Failure indicators for the Greater North Sea) also use data from countries other than the UK[16], but only UK monitoring schemes are listed in the consultation documentation. For completeness, we think it should be made clearer where other countries monitoring schemes do and do not contribute to the assessments. However, we are not in a position to comment whether data from other countries are sufficient.

Additional monitoring being carried out (Q4):

The Breeding Success/Failure indicator focuses on extreme events and fails to identify levels of poor breeding success that can still have negative impacts. To adequately assess this, good demographic information is required, particularly survival rate data[17], and the SMP does not currently provide sufficient data on this parameter. A JNCC commissioned report[18] reviews the available data and provides recommendations for developing a Retrapping Adults for Survival (RAS) programme for seabirds. **BTO's RAS programme** has not been referred to, but its development and enhancement

[14] Hinz et al (2012) and Bradbury, G., Shackshaft, M., Scott-Hayward, L., Rexstad, E., Miller, D., and Edwards, D. (2016) Risk assessment of seabird bycatch in UK waters. Defra Project : MB0126. 272 pp.
[15] ICES 2017. Report of the OSPAR/HELCOM/ICES Working Group on Marine Birds (JWGBIRD), 10–14 October 2016, Thetford, UK. ICES CM 2016/ACOM:29. 124 pp.
[16] Ian Mitchell, Graham French,, Andrew Douse, Simon Foster, Melanie Kershaw, Neil McCulloch, Matty Murphy, & Jane Hawkridge 2018. Marine Bird Abundance. UK Marine Online Assessment Tool.
[17] ICES. 2018. Report of the Joint OSPAR/HELCOM/ICES Working Group on Marine Birds (JWGBIRD), 1–5 October 2018, Ostende, Belgium. ICES CM 2017/ACOM:24. 79pp.
[18] Horswill. C, Walker, R. H., Humphreys, E.M., Robinson, R. A., 2016. Review of mark-recapture studies on UK seabirds that are run through the BTO's Retrapping Adults for Survival (RAS) network. JNCC Report No: 600

would allow a more effective assessment of breeding success/failure (and potentially provide data to develop an Adult Survival rate Indicator which could prove to be a very useful additional indicator[12]).

We would also highlight the **Birdlife Tracking Database**, http://www.seabirdtracking.org/. Whilst not a monitoring programme in its own right, the BirdLife International Seabird Tracking Database is the largest collection of seabird tracking data in existence. It serves as a central store for seabird tracking data from around the world and aims to help further seabird conservation work and support the tracking community.

ii. Seabird Bycatch mortality

Response to Q1 & Q2

No. As the Bycatch Monitoring Programme (BMP) is currently resourced and deployed, the data collected by this programme is insufficient for assessing progress towards the UKMS bycatch mortality indicator. To ascertain bycatch levels across all fisheries in the UK, a more extensive, targeted monitoring programme will be required. Bycatch monitoring under the UKMS should be guided by the Seabird Bycatch Plan of Action (PoA), and in particular, the 'gap analysis of seabird bycatch monitoring'.

Without significant improvements to the monitoring of seabird bycatch rates, fishing effort and population demographics (of both breeding and non-breeding birds), it will continue to be difficult to measure progress towards the UKMS bycatch mortality target.

Recent studies to inform the PoA[19,20] have drawn attention to the inadequacy of the data collected by the existing bycatch monitoring programme. Although the studies provide a much needed, broad-scale picture of seabird bycatch in the UK, there remains considerable uncertainty around the true nature and scale of the problem. These studies demonstrate that to date, the level of observer coverage provided by the BMP proportional to the gear types used, level of fishing effort, distribution of fishing activity, and species bycaught is not representative and is therefore insufficient to accurately or precisely define the scale of the problem in the UK.

To improve data collected by the existing programme, it is fundamental that monitoring coverage is increased, aiming as far as possible to use a systematic, stratified sampling design.

[19] Northridge, S., Kingston, A. and Coram, A. (2020) Preliminary estimates of seabird bycatch by UK vessels in UK and adjacent waters. Report prepared for the Department for Environment Food and Rural Affairs (Project Code ME6024)

[20] Miles, J., Parsons, M. and 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 (Project Code ME6024).

The level of observer coverage for monitoring all species bycatch from UK-registered fishing vessels through the BMP ranges from less than 1% to 5% of effort across three broad gear types[21]. This presents a real challenge for addressing bycatch, as there is very little data on which to base targeted research or drive changes in fishing practices.

Existing studies have attempted to determine best-practice observer coverage for monitoring bycatch across the globe, which can be used to guide improvements in the UK. Such assessments have identified a need for observer coverage at levels significantly higher than is currently deployed in the UK. The minimum levels of observer coverage needed to obtain 'reasonably good estimates of total bycatch' are at least 20% for common species and 50% for rare species[22] and in some cases, may need to be even higher[23,24]. Due to the variable nature of bycatch events, there is a need for high coverage and long-term data, which could be achieved by dedicated observers, electronic monitoring or a combination of both[19].

It is not just the number of observations that is important, but also how that monitoring coverage is distributed (e.g. across the seasons, gear types and geographic area). Current estimates of UK seabird bycatch rates[25] must be caveated with a degree of uncertainty due to a lack of data from certain gears, poor spatial coverage of sampling effort, and biased towards vessels that voluntarily permit onboard observers. Therefore, a more rigorous sampling design is needed to ensure estimates of bycatch rates are representative. One way to achieve this would be to complement onboard observers' data with electronic monitoring. Remote Electronic Monitoring (REM) with cameras could be the gold-standard for at-sea data collection although, other electronic monitoring tools will also be valuable in modernising fisheries monitoring.

In the absence of effective electronic monitoring, observers are currently the primary method for collecting data on seabird bycatch. As such, it should be mandatory to accept fisheries observers onboard vessels, with observers appropriately trained in seabird identification. To improve information on bycatch rates, there should be minimal reliance on self-reporting, but where it is required, data should be validated by independent sources such as observers or REM to ensure the identification of seabird as well as other species[26] is accurate.

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[21] Babcock, E.A. and Pikitch, E.K. (2003) How much observer coverage is enough to adequately estimate bycatch? Pew Institute for Ocean Science, Miami, FL and Oceana, Washington DC

[22] Wakefield, C.B., Hesp, S.A., Blight, S., Molony, B.W., Newman, S.J. and Hall, N.G. (2018) Uncertainty associated with total bycatch estimates for rarely-encountered species varies substantially with observer coverage levels: Informing minimum requirements for statutory logbook validation. Marine Policy. 95, pp 273-282

[23] Curtis, K.A. and Carretta, J.V. (2020) ObsCovgTools: Assessing observer coverage needed to document and estimate rare event bycatch. Fisheries Research. 225(105493)

[24] Good, S.D., Baker, G.B., Gummery, M., Votier, S.C. and Phillips, R.A.(2020) National Plans of Action (NPOAs) for reducing seabird bycatch: Developing best practice for assessing and managing fisheries impacts. Biological Conservation. 247(108592)

[25] Bradbury, G., Shackshaft, M., Scott-Hayward, L., Rexstad, E., Miller, D., and Edwards, D. (2016) Risk assessment of seabird bycatch in UK waters. Defra Project : MB0126. 272 pp.

[26] See *Cetaceans*, *Seals* and *Commercial fish* sections.

All seabird bycatch occurrences (including details on individuals that are caught alive and released) should be recorded and reported by observers, REM or fishers. When data on bycatch is obtained, the priority should be to gather data on bycaught birds to a species or family level. However, information on the age class and sex (at least from a sample of the bycatch) would also be valuable to better understand the impact on different species.

Additional monitoring needed (Q3):

In order to assess total bycatch mortality, bycatch sample estimates need to be scaled up to all vessels fishing in UK waters and to do so requires monitoring of fishing effort. Our knowledge of fishing effort is very limited and where data is available, it is often difficult to access[27].

As a minimum, there should be a requirement for Vessel Monitoring Systems (VMS) or equivalent on all fishing vessels to ensure there is comprehensive data on where fishing vessels operate. However, information obtained from vessel tracking alone will not be sufficient to accurately assess bycatch. Improved information on where and how fishing activity takes place for example, vessel tracking data, paired with information such as fishing effort (hours fished/soak time), gear configuration (e.g. number of hooks, mesh size) and mitigation measures, is essential. Data on these metrics, if recorded, is currently difficult to obtain. However, this level of transparency and accountability is required to deliver the necessary monitoring to inform management and mitigation.

The best long-term prospect for improving monitoring coverage and accuracy of fishing data will likely come from electronic monitoring. Electronic monitoring systems such as REM with cameras, electronic logbooks, catch reporting apps and sensors on gear will be essential for delivering world-leading, cost-effective and sustainable fisheries management. If combined with haul data from electronic logbooks or cameras on vessels, electronic systems would help improve the quality of information on fishing effort. Such systems could gather information on GPS location, date, time, gear type, configuration, and hours fished/soak time. They could also be used to monitor the deployment and effectiveness of mitigation measures. Increased effort is therefore needed to explore opportunities to test and develop technologies for automated and electronic monitoring tools to collect, analyse, validate and monitor fishing activity, mitigation and associated bycatch. To allow accurate assessments to be undertaken, such data should feed into an online database (similar to the EU Fleet Register) that is accessible to regulatory authorities, statutory bodies and researchers (on request). Similarly, non-aggregated fishing effort and bycatch data should be available to inform scientific research and fisheries management decisions.

Given the importance of the UK's seabirds, and limited data currently available through the existing monitoring programmes, there is a clear need for improvement. It is only with increased data on fishing effort, bycatch rates and seabird demographics that the scale of seabird bycatch can be understood and mitigated[28], and progress made towards this GES target.

[27] Hinz, H., Murray, L.G., Lambert, G.I., Hiddink, J.G. and Kaiser, M.J. (2012) Confidentiality over fishing effort data threatens science and management progress. Fish and Fisheries. pp 110-117

[28] Outcome of the OSPAR-HELCOM workshop to examine possibilities for developing indicators for incidental by-catch of birds and marine mammals. September 2019. Available at:

Pelagic habitats (D1 D4)

Response to Q1 & Q2

No, the proposed monitoring programmes are not sufficient to meet the requirements of the Marine Strategy Regulations nor is there sufficient data to assess progress towards the achievement of GES. It is of some concern that we may not be any nearer understanding the environmental status of the pelagic habitat. As the consultation document states (emphasis added) "Prevailing environmental conditions were likely to be driving the observed changes in plankton communities but human activities could not be ruled out and it was uncertain whether Good Environmental Status (GES) has been achieved."

The target for GES is that "Pelagic habitats are not significantly adversely affected by human activities." Further to our response to the Updated UK Marine Strategy Part One, we would again query whether this is a determination that could be made by monitoring plankton populations alone. As outlined in our response to the updated Part One in 2019 "We do not believe the assessment for pelagic habitats can be described as an accurate assessment given the data gaps that exist and the limited scope of the included parameters", a position that is still the case. We stated that "a more appropriate determination of the status of pelagic habitats would be 'unknown' rather than 'uncertain and stable since 2012'". Our concern is now more acute since the consultation document states "Since 2014, UK plankton monitoring has reduced resulting in reduced spatial and temporal density of sampling...some areas are poorly monitored e.g. offshore and coastal areas to the west of Scotland, which reduces ability to perform a robust assessment."

It still remains unclear to what extent natural variability and pressures, including climate change, ocean acidification and cascading effects from fishing, may be influencing the changes seen in plankton distribution and plankton communities. Monitoring is essential to better understand the current status and trends and to begin to understand the relative impact of each of the pressures identified. For example, as cited in the Charting Progress 2 report[29], we have known for some time from the excellent Continuous Plankton Recorder (CPR) survey data that the abundance of the cold water copepod species *Calanus finmarchicus* has decreased in the North Sea since the 1960s. Whilst at the same time that of the warmer water species *C. helgolandicus* has increased[30]. Due to the lower lipid content of the latter species, such shifts will likely have wider consequences for other marine trophic levels that we do not fully understand, underlining the importance of monitoring the status and population of other taxa to provide a fuller picture.

The Charting Progress 2 report classified the status of plankton in all regions around the UK as having "some problems". However, the assessment for plankton for MSFD in the Updated UK Marine Strategy Part One is that "it is likely that GES will be achieved by 2020" (notwithstanding that the updated report acknowledges "uncertainty of not knowing the effect of human activities means that we remain

https://portal.helcom.fi/meetings/Incidental%20bycatch%20WS%201-2019-647/MeetingDocuments/Outcome%20OSPAR-HELCOM%20incidental%20by-catch%20indicator%20workshop_final.pdf

[29] http://chartingprogress.defra.gov.uk/

[30] https://www.gov.scot/publications/scotlands-marine-atlas-information-national-marine-plan/pages/31/

uncertain"). This apparent disparity is a result of the way the MSFD scopes out climate change and carbon dioxide, requiring only that *(Descriptor 1): Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions*. The prevailing climatic conditions include sea temperature that has increased as a result of anthropogenically-driven climate change. In the absence of considering the wider trophic impacts of the altered plankton communities arising from the warmer sea temperatures that are a consequence of anthropogenic activities, the definition of GES for pelagic habitats, if only considering plankton communities, risks becoming circular and self-fulfilling. In our view, GES cannot therefore be said to have been met for pelagic habitats unless the distribution and abundance of pelagic species representative of all trophic levels are in line with the physiographic, geographic and climatic conditions that would be prevailing in the *absence* of the impacts of climate change, *including sea warming and ocean acidification, and other anthropogenic activities such as industrial fisheries and aquaculture.*

We do welcome the work undertaken to develop a common plankton "lifeform" indicator for the first time, and acknowledge that "Determining GES for pelagic habitats [...] is a challenging process, with additional work required to interpret the assessment results and to identify causation of the changes observed."[31] However, given that we are now in a declared climate emergency, with major climatic (ocean warming) and chemical (ocean acidification) impacts, we again state that assessing pelagic habitat health on plankton populations alone is not adequate. **A determination of GES for the pelagic habitat must also consider the health, status and distribution of other components of the pelagic ecosystem**. (Incidentally, this is also particularly relevant in the context of updated IUCN guidelines for the management of Marine Protected Areas which state: "IUCN is opposed to the use of vertical zoning." in MPAs[32]). We note and welcome that there have been new developments in monitoring some pelagic fish populations, notably in the English Channel, but there are clearly substantial geographical and trophic gaps in pelagic habitat monitoring that need to be filled. We therefore remain disappointed that other components of the pelagic ecosystem, including cephalopoda, microbial communities, and other pelagic (teleost and elasmobranch) fish species, particularly those not targeted by commercial fisheries, have not been addressed.

Additional monitoring needed (Q3):

As acknowledged in the consultation document, even when considering plankton alone there are trophic monitoring gaps (e.g. picoplankton), gaps for some nearshore hydrodynamic features (e.g. large estuary "plumes") and "there may also be gaps in some less accessible regions", such as offshore areas and coastal areas to the west of Scotland. It is crucial that these trophic and geographic gaps in plankton monitoring are filled and, as stated above, that the plankton monitoring itself is augmented by relevant monitoring for fish (commercial and non-commercial), cephalopoda, marine mammals and turtles in order to determine a more integrated and holistic picture of the true environmental status of the pelagic habitat. For example, anecdotal evidence suggests that there is an increasing

[31] https://www.sciencedirect.com/science/article/abs/pii/S1470160X19301189#!

[32] https://portals.iucn.org/library/sites/library/files/documents/PAG-019-2nd%20ed.-En.pdf

prevalence of squid in inshore waters, for which we would encourage stock assessments that could contribute to both fisheries management and determination of pelagic habitat status.

Additional monitoring being carried out (Q4):

Both commercial fishery and citizen science data are relevant here. Any stock assessment data available for pelagic commercial fish and cephalopod species should be considered and included when determining the environmental status of the pelagic habitat. The Marine Conservation Society (MCS) encourage volunteers to gather citizen science data on jellyfish, basking shark and turtle distribution which is then shared with the National Biodiversity Network. The jellyfish data in particular may provide further insight into potential changes in nekton distribution, abundance and spring and autumn plankton bloom timing.

Benthic habitats (D1 D4)

Responses to questions 1,2 & 3 combined

The proposed monitoring programmes are not sufficient to meet the requirements of the Marine Strategy Regulations nor is there sufficient data to assess the true nature of GES let alone progress towards it. Existing monitoring programmes are inadequate to allow us to understand the true level of impact various human activities have on the wider seafloor. We do not have enough areas protected and, as alluded to in the consultation document, not enough MPAs are monitored. It is our view that the monitoring programmes do not capture the full range of habitats present in UK waters nor allow for intra-annual variation, even with the suggested improvements as set out in the 'Issues and opportunities' section. Whilst reefs are offered protection by MPAs, these habitats have always tended to have some level of protection through being ill suited to certain activities (e.g. being avoided by bottom trawlers due to the potential for gear to be damaged). By comparison, sand, gravels and muds are not being monitored for long-term condition effectively enough in the absence of human impact.

A range of habitats representative of those found in UK waters at varying depths first need to be adequately protected from human activities and then monitored. Without this, it is impossible to understand the implications of activities on habitats and the biological communities they can support. This must be achieved so that it is possible to establish what 'Good Environmental Status' actually is. The difficulty of establishing whether GES is met for benthic habitats and seafloor integrity, and the importance of determining whether or not there is "evidence of rapid change towards a natural state when pressure is reduced" in order to determine whether the seafloor is being used sustainably and whether additional measures will be required, is explored in detail in a study commissioned by Scottish Environment LINK[33]. With large extents of shelf-sediment habitat, in particular, having been subject to industrial demersal fishing for over a decade, we have lost sight of how these habitats were prior to human impact. Now, due to a lack of any example habitats that have avoided such activities, we have no suitable 'control' environment to which we may compare an affected area and properly assess whether human activities have detrimentally affected the 'health' of the habitat. Only once we establish an accurate baseline upon which to base GES, can suitable management of human activities be implemented. For example, ephemeral habitat-forming species such as blue mussels and sabellaria reef in the east coast of England are not allowed to necessarily persist because of small, managed areas of damaging activities such as seabed trawling. A lack of regulation of demersal towed gear use in offshore MPAs as well as inshore MPAs with no agreed management measures has similar implications. Without removing this pressure from these 'protected' areas, it is impossible to ascertain whether such human activities negate the opportunity for much greater seabed richness accruing, in terms of not only biodiversity but also carbon[34], thereby undermining the seabed as a potential resource for tackling climate change.

In addition, monitoring programmes need to take account of seasonal effects, including the influence of storms, periods of productivity (e.g. spring) and other variables that may change the state of the

[33] https://www.scotlink.org/files/documents/SEL_SeafloorIntegrity_Report_A4_March19-1.pdf

[34] Luisetti et al. (2019) Quantifying and valuing carbon flows… *Ecosystem Services 39, 67-76.*

benthic habitat over the course of a year. The programme of monitoring, for example, makes no reference to how species recruitment events (e.g. sand mason worms, blue mussels on sediments) will be accounted for in management terms - does their periodic occurrence in massive population peaks relate to a well-managed system and GES?

It is our view that a long-term, zoned approach to restricting different fisheries practices on the benthos in different biogeographic regions of the UK factoring in environmental variables is needed. Monitoring should take place over 30-50 years, with adequate control and enforcement regulations placed on fishing vessels to prevent incursion into protected areas where monitoring is taking place. For further information on this, please refer to ICES' BEDPRES report[35] that would suggest closing areas lightly fished to demersal bottom towed fishing gears. In addition, better investment should be sought to enable more frequent and representative monitoring to be undertaken so that human impacts on the full range of habitats can be assessed.

Additional monitoring being carried out (Q4):

Cornwall IFCA, University of Exeter and the Marine Conservation Society are monitoring circalittoral sediment habitats in areas closed to bottom towed fishing gears compared to open grounds. As yet unpublished data is more indicative of the impact of such activities in deeper waters (~50m) than in studies conducted at Lyme Bay[36]. The continuation of this monitoring work and analysis is subject to very limited funding.

The Lamlash Bay No Take Zone also provides a rare example of how zonal restrictions on fishing activity can bring about benthic recovery[37].

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https://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/Fisheries%20Resources%20Steering%20Group/2019/WKBEDPRES2/WKBEDPRES2_Report_2019.pdf#search=WKBEDPRES

[36] Solandt et al., (2020) Revisiting UK Marine Protected Area governance: A case study of a collaborative approach to managing an English MPA. Aquatic Cons: Marine and Freshwater Science https://onlinelibrary.wiley.com/doi/10.1002/aqc.3412

[37] https://www.frontiersin.org/articles/10.3389/fmars.2020.00076/full

Non-indigenous species (D2)

The proposed monitoring programmes are not sufficient to meet the requirements of the Marine Strategy Regulations nor is there sufficient data to assess progress towards the achievement of GES. Monitoring and surveillance are key mechanisms to inform biosecurity and efforts to tackle the impact of Invasive Non-Native Species/Non-indigenous species (INNS/NIS). We know from JNCC UK Biodiversity Indicator B6 that INNS (NIS) are already spreading rapidly in UK marine environments. Moreover, Defra estimates that between 10 and 12 new non-native species are establishing each year in the UK. When these establish in the marine environment, it is often the case that once detected it is too late to take effective remedial action. The impacts of these species can be severe on native biodiversity and habitats.

International trade is the single biggest pathway for the transfer of INNS between territories. As the UK develops new trading relationships post-Brexit, a new array of non-native species will arrive either through hull-fouling and 'stowaways', or through transfer together with moving goods and luggage. If the proposed freeports are established in the UK, we will see goods arriving and landing in our ports without passing through customs or standard surveillance.

In addition to this trade-related compounding of an already accelerating driver of biodiversity loss, as climate change proceeds and the sea surface and shallow layers warm, the establishment conditions that new non-native species encounter upon arrival and release will improve.

Thus, current INNS (NIS) monitoring and surveillance arrangements, already demonstrably inadequate, are set to face a sharply intensifying threat.

Additional monitoring needed (Q3):

We urge that investment is made now to prepare for and avert the worst impacts of this threat through thorough and rapid implementation of the IMO Ballast Water Management Convention, and the establishment of a national INNS Inspectorate, with marine INNS surveillance and biosecurity as a priority, as recommended by the 2019 inquiry by the House of Commons Environment Audit Committee.

Commercial fish (D3)

The published Marine Strategy Part 1 clearly states that:

"The UK will continue to work towards achieving sustainable fishing at levels consistent with MSY. Our intention is to re-introduce the Fisheries Bill, which will put in place a framework to continue making significant progress towards fishing more stocks at MSY, contributing to the achievement of GES. The Bill will set out clear objectives to ensure that fisheries and aquaculture activities are environmentally sustainable in the long-term, that we deliver on MSY in line with our international obligations, and that we apply an ecosystems-based approach to fisheries management measures that accounts for the full range of effects of fishing on ecosystem services, and corresponding societal needs in our decisions."

Whilst the Fisheries Bill provides a broad framework for fisheries management, once the bill gains Royal Assent, the Joint Fisheries Statement and, subsequently, the Fisheries Management Plans (FMP) will be an opportunity to strengthen the currently limited approach to monitoring fishing activity in UK waters and secure the recovery of fish stocks. It is therefore important to capture the monitoring requirements for the Marine Strategy Regulations and ensure that the development of the JFS provides a delivery mechanism. ***It is our view that, as they currently stand, the monitoring programmes are not sufficient to meet the requirements of the high level objectives for GES for commercial fish (D3) nor the associated data gaps already acknowledged in the GES progress report published in 2018.***

In 2020, only 67% of assessed stocks of interest in the UK were fished at or below sustainable levels[38]. As is highlighted in the report, in addition to a third of assessed stocks not being fished at sustainable levels there remains a significant number with too little data to provide an assessment. In particular there is a lack of information with regards to shellfish populations, with limited data on population sizes and even less on the age and size distribution information required to manage a stock sustainably - it is estimated that over 60% of UK shellfish stocks have an unknown status[39]. This is of particular concern as these stocks are predominantly under the sole management of the UK or devolved administrations, and so additional supportive research and assessments are unlikely to be available. Without baseline information on the safe biological limits of a population it is impossible to report that a population is within safe biological limits.

The report additionally raises concerns with regards to the length of datasets available for such stocks. A lack of historical assessment information restricts the accuracy and reliability of current and future stocks assessments. Where stocks lack data due to limits in historical assessment, additional

[38] Defra, 2020. Available at: https://committees.parliament.uk/publications/1181/documents/10114/default/ [Last accessed 28.09.2020]

[39] DEFRA, 2019. Marine strategy part one: UK updated assessment and Good Environmental Status. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/841246/marine-strategy-part1-october19.pdf [Last accessed 1.10.20]

investment should be provided to improve current data collection with an aim to develop long-term datasets for those stocks.

Moreover, it is imperative that the outlined growing fisheries for stocks which currently have little stock-specific data should be prioritised with regards to data collection as existing monitoring programmes are either absent or insufficient. As noted in the UK Government's MOAT assessment, "without expanding the monitoring of some stocks [...] their assessment status may remain 'unknown'". This issue is particularly prevalent in shellfisheries, where most national shellfish stocks have either not yet achieved GES or their status is uncertain.

The requirements of the Marine Strategy Regulations apply to "all Commercially-exploited fish and shellfish". However, there remains a significant number of exploited populations without adequate assessments or harvest control limits in place. This should include not just species exploited for consumption but those also being caught for bait and species being translocated to support other commercial industries such as cleaner fish e.g. wrasse and lumpsuckers used in the aquaculture sector.

While it is encouraging to see the introduction and expansion of the Pelagic Ecosystem Survey and that "both the onshore and offshore programmes have been improved to make them more statistically robust and effective", there appears to be only one new monitoring program introduced to assess fish stocks to address the gaps identified in 2014. The notes themselves highlight that groundfish surveys have continued uninterrupted, but no new assessments to fill the gaps for these species have been included. Additionally, there appears to be a significant lack of new assessments to fill the gaps for data-limited stocks, even for those where it was clear little to no assessments existed in 2014, such as for some inshore shellfish populations for which stock assessments have only been introduced recently.

The report suggests that observers could be used for data collection. This is something that we agree with and fully support, however, the observer coverage must be significant. The current coverage by observers collating catch data at sea equates to less than 1% of total days fished[40]. As one of only a few methods available for at sea observation which takes into account catches rather than just landings, this is a woefully low percentage.

Again it is encouraging to see that workshops to identify data gaps took place but, despite nearly 6 years having passed since these gaps were identified, these appear not to have progressed beyond this stage. As such, it is of great concern that so little additional data collection has been completed or assessments introduced.

The proposed monitoring programmes are therefore not sufficient to provide the necessary data to progress towards the achievement of GES as in most cases they simply indicate business as usual. There is insufficient data collected on populations with regards to age, size and length distribution to

[40] Calculated from the total observer days in England and Wales in here https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/605378/Data_collection_framework_annual_work_plan_2017_to_2019_UK.pdf divided by total fishing days at sea for over 10m vessels in England and Wales

ensure that the population is healthy across all metiers thus compromising the achievability of the high level objective for GES.

Additional monitoring needed (Q3):

Full, verifiable documentation of what is being caught in UK waters is an important step towards understanding the scale of pressure, areas of concern and informing the application of management measures. As drafted the Fisheries Bill does not require all stocks to be covered by a fisheries management plan and, without a robust monitoring program, it will be unlikely that the data will be available to assess progress towards GES. Therefore, we propose that the programme of monitoring should include compulsory assessments of marine waters, best practice selectivity and avoidance measures to ensure positive fishing activities. In addition, there are significant monitoring programmes needed for new fisheries such as the emerging cuttlefish fishery, and there is an urgent need for better assessment of shellfish stocks and non-target commercial species such as gurnard. There also needs to be urgent data collected on the translocated cleaner fish populations as, although they are not being caught for consumption, their catch represents a commercial gain.

As previously stated, at-sea observation will be essential for building data on stock status and monitoring reductions in bycatch, including non-target and sensitive species and habitat impacts. Without this, it is extremely difficult to evaluate and manage fisheries impacts with confidence, to provide consumer certainty, or to recover the health of our seas and fisheries resources. This does not, however, need to be the sole responsibility of observers. ***REM with cameras is an efficient and cost effective method for collecting data on a large scale with little effort from fishers, particularly if the installation and purchase of the cameras were to be subsidised. Whilst the Fisheries bill does not directly commit the UK Fisheries Authorities to the adoption of Remote Electronic Monitoring, the existing legislative framework allows its use, and the technology has both been successfully trialled in the UK and used in several countries around the world. The cameras can support data capture for stock assessments and have the potential to provide insight into the type and frequency of other species incidentally caught in fishing gear[41]. We therefore recommend that this approach should be adopted to provide a more comprehensive monitoring framework.***

REM with cameras should guide all Fisheries Management Plans, which are essential for the recovery of stocks and achieving GES for both D4 and D3. REM will not only help manage catch but, as highlighted in the response to D4 birds, cetaceans and seals, it will also provide vital data to evidence the true scale of marine wildlife bycatch in UK fisheries, thus enabling more targeted fisheries management measures to achieve GES. If the program of monitoring is not robust, then it is unlikely that we will be able to ascertain if Fisheries Management Plans are effective.

Additional assessments of estuarine species or linkages with the existing programmes are needed, although these may not be fit for purpose. Estuaries are essential habitats for many commercial fish species and species which cross the marine/freshwater boundaries. Tagging programmes may be of significant benefit here. The existing transitional waters fish monitoring programmes for WFD

[41] Bradley et al., 2019. Opportunities to improve fisheries management through innovative technology and advanced data systems. Fish Fish. 2019;20:564–583. https://doi.org/10.1111/faf.12361

conducted by the EA and NRW provide vital information on those species which spend all or part of their life in these habitats. These programmes were never adequately resourced and cover only 30% of the transitional water bodies. The existing programmes are being reduced progressively through resource limitations. These programmes need to be protected and enhanced. There is considerable potential in the recent development of collaborative citizen science fish survey exercises. With modest funding support these could develop further into a very effective augmentation of the regulator driven survey programmes, particularly with reference to early life stages of commercial and non-commercial species in intertidal habitats existing within estuaries, saltmarshes and embayments.

Climate change will also present a significant risk to fisheries sustainability. Having thorough existing data sets would support reactive management in the face of a changing climate going forward. Increased and additional improved data collection is therefore essential. We are already seeing shifts in distribution patterns in some stocks in response mainly to temperature change and there is likely to be many other indirect impacts such as predator prey mismatch and range expansion and contraction. Ocean acidification is likely to disproportionately impact shellfish species and has been shown to severely affect shell formation. As such, further assessments looking at the direct impact of ocean acidification on shellfish would be beneficial to track early changes.

Additionally, fish and other marine vertebrates play an important role in the global carbon cycle[42] and so their recovery to levels capable of producing maximum sustainable yield is important when considering tackling climate change. Trueman *et al.* (2014)[43] estimated that mid-water (bentho-pelagic) fishes from the UK–Irish continental slope captured and stored a volume of carbon equivalent to over 1 million tonnes of CO_2 every year. Recovering fish stocks to healthy levels could play an important role in carbon storage in our seas, as well as the added benefit of sustainable and viable fisheries. Meeting GES for this descriptor could therefore also support meeting any new climate change objectives.

Finally, as highlighted in the Welsh Government's response to the Senedd's Climate Change, Environment and Rural Affairs Committee regarding the Committee's report on the UK Fisheries Bill, work is "progressing on the implementation of an SI to introduce a VMS on the Welsh under 12 metre fishing fleet." The response states that "it is currently anticipated the relevant legislation (SI) will be introduced in summer 2021." This is later than had been suggested in the Welsh Government's summary of responses to a consultation on this matter: "this requirement will be implemented via a statutory instrument. The date of implementation is expected to be from late 2019". Whilst timescales have understandably been pushed back, we hope that the SI will be introduced without further delay.

[42] Lutz SJ, Martin AH. 2014. Fish Carbon: Exploring Marine Vertebrate Carbon Services. Published by GRID-Arendal, Arendal, Norway - https://www.grida.no/publications/172

[43] Trueman, C.N., *et al.* (2014) Trophic interactions of fish communities at midwater depths enhance long-term carbon storage and benthic production on continental slopes. Proceedings of the royal society. https://doi.org/10.1098/rspb.2014.0669

Additional monitoring being carried out (Q4):

There having been seabass tagging programs which do not appear to have been included as a new assessment since 2014.

Wales have also conducted research into some shellfish species with NRW.

There is an acknowledged need for stock assessments for species including crab, lobster and scallop in Scotland.

Contaminants (D8)

Sufficient monitoring of contaminants in the environment is vital to act as an alert system. The alarm can only be triggered if a suitably large range of chemicals is being monitored in order to recognise contaminants of emerging concern. The need to prioritise chemicals of concern for monitoring is understandable, as in practice it is not realistic to analyse the sheer number of different samples that are presented due to the hundreds of different chemicals in several different matrices (biota, water column and sediments). However, by only analysing a few selected priority substances you run the risk of missing other hazardous or problematic chemicals. Monitoring programmes also need to be fully harmonised with those on land and in freshwater as ultimately, the land and rivers are the source to the sea.

The proposed monitoring programmes for contaminants are completely insufficient to meet the requirements of the regulations and the assessment of GES. One of the requirements states that the monitoring programmes need to be reviewed every 6 years in order to keep them up to date and the necessary measures need to be taken to achieve and maintain good environmental status of marine waters[44]. The list of contaminants monitored in territorial water, sediment and biota has not been updated since 2012, therefore, no emerging contaminants have been taken into account in that time. In our response to the consultation for Part 1, we stated that *"The current list of contaminants monitored in territorial waters has not been updated from the previous version(...)In its current form it is insufficient to effectively assess contaminants in UK marine waters."*[45]

The current knowledge base around the effects of contaminants on the marine environment is concerning, but there is evidence from research of significant impacts. For example, high levels of legacy persistent organic pollutants (POPs), exceeding toxic effects thresholds, are being reported in UK marine mammals such as orcas[46], harbor porpoises[47] and grey seals[48]. The endocrine disrupting properties of these chemicals are responsible for impacting reproduction and in the case of orcas, threatening the survival of their populations in the UK[49]. Exposure to chemical contaminants has also been shown to be related to the development of cancers with 20% of flat fish from the North sea presenting tumours[50].

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[44] "EXPLANATORY MEMORANDUM TO THE MARINE ...." 15 Jul. 2010, http://www.legislation.gov.uk/uksi/2010/1627/pdfs/uksiem_20101627_en.pdf. Accessed 27 Oct. 2020.

[45] "ELUK response to UK Marine Strategy part one consultation." 13 Jun. 2019, https://www.wcl.org.uk/docs/ELUK%20UK%20Marine%20Strategy%20part%20one%20response.pdf. Accessed 26 Oct. 2020.

[46] "PCB pollution continues to impact populations of ... - Nature." 14 Jan. 2016, https://www.nature.com/articles/srep18573. Accessed 26 Oct. 2020.

[47] "Juvenile harbor porpoises in the UK are exposed to a more ...." 15 Mar. 2020, https://www.sciencedirect.com/science/article/pii/S0048969719348272. Accessed 26 Oct. 2020.

[48] "Persistent Organic Pollutant Burden, Experimental POP ...." 20 Nov. 2018, https://pubmed.ncbi.nlm.nih.gov/30339760. Accessed 26 Oct. 2020.

[49] "Predicting global killer whale population collapse ... - Science." 28 Sep. 2018, https://science.sciencemag.org/content/361/6409/1373. Accessed 26 Oct. 2020.

[50] "Genetic Alterations and Cancer Formation in a European ...." 7 Aug. 2014, https://pubs.acs.org/doi/10.1021/es502591p. Accessed 26 Oct. 2020.

In terms of a current knowledge base around contaminants of concern, ICES in 2017 released a special report at OSPAR's request to identify substances of emerging concern. The list of emerging contaminants that were considered to be a concern for the marine environment included: dechlorane plus, flame retardants both brominated and phosphorus, perfluorinated alkyl substances, benzotriazoles, siloxanes, antifoulants and anti corrosion agents (especially those applied to offshore windmill installations)[51]. The concern surrounding some of these emerging chemicals has also been noted by the NORMAN network by being included in their emerging substances of concern list[52].

Therefore, the current knowledge base of contaminant impacts in the UK marine environment goes far beyond that covered by the current list of monitoring programmes for contaminants. Contaminant monitoring needs to be extended to adequately meet the requirements set out by the Marine Strategy regulations.

In terms of assessing progress towards the achievement of Good Environmental Status (GES), monitoring under the Water Framework Directive for Good *Ecological* Status includes a much larger list of relevant contaminants than those currently monitored in territorial waters under MSFD. Worryingly, the Environment Agency have recently released data showing that no rivers in England achieved Good Ecological Status and the main reason for this was chemical contaminants[53]. Rivers are ultimately the source to the sea and therefore the list of contaminants needs to be extended to adequately assess the achievement of GES in territorial waters. Of the water bodies tested several failed solely due to PFOS (Perfluorooctane sulfonate[54]), which isn't covered in the indicators for territorial water in the marine strategy. Other failures included priority list chemicals[55], which again for the most part are not included in the marine strategy testing in territorial waters.

We have noted that there are a number of items outlined under the operational targets. However, there are few deadlines or specific timelines for development or information on how this work will be supported financially. Of immediate importance for implementation would be determining contaminants of emerging concern. We support the deadline of 2022 and we think it is important that a road-map of how this deadline will be achieved is published. We would also like similar deadlines to be applied to the other points in this list.

Additional monitoring needed (Q3):

As they stand currently, estuarine waters are monitored for a larger group of contaminants due to requirements from the Water Framework Directive, however the list of contaminants assessed in

[51] "OSPAR request on information for use in selecting and ... - ICES." https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/ospar.2017.21.pdf. Accessed 26 Oct. 2020.

[52] "Emerging substances | NORMAN." https://www.norman-network.net/?q=node/19. Accessed 26 Oct. 2020.

[53] "Environment Agency - Catchment Data ...." 17 Sep. 2020, https://environment.data.gov.uk/catchment-planning/. Accessed 26 Oct. 2020.

[54] Perfluorooctane sulfonate - added to Annex B of the Stockholm Convention on Persistent Organic Pollutants in May 2009 http://chm.pops.int/Convention/Pressrelease/COP4Geneva8May2009/tabid/542/language/en-US/Default.aspx

[55] https://www.ospar.org/work-areas/hasec/hazardous-substances/priority-action

territorial water, biota and sediments are inadequate. All monitoring needs to be aligned and extended to include as a minimum:

- Per- and Polyfluorinated substances (PFAS). Both legacy PFAS e.g. PFOA and PFOS as well as emerging PFAS, such as PFBS, PFNA, PFDA, PFUnDA and PFDoDA, used as substitutes for legacy PFAS should be monitored[56].
- Flame retardant chemicals, including both alternative brominated[57] and organophosphorous flame retardants[58]
- Pharmaceuticals, such as those identified in CHEM Trust's 2014 report[59]
- Pesticides, see for instance those listed in OSPAR, the WFD watch list.
- Other groups of chemicals known to contaminate the marine environment which have EDC[60] or other properties of concern[61],including parabens[62], bisphenols[63], phthalates[64].

One of the most important criteria when considering a monitoring programme is that it is representative and is kept up to date. In order to do this, more emphasis needs to be applied to assessing emerging contaminants of concern. In our response to UKMS Part 1 consultation we stated that: *"...criteria must contain an explorational aspect to assess emerging chemicals of concern as well as looking for chemicals in the marine environment that are not currently monitored in the Marine Strategy."*

In a report written by the Natural Capital Committee regarding a response to the 25 year environment plan, they state the importance of developing monitoring beyond what is currently measured in existing monitoring programmes, and instead basing the monitoring programmes on what should be measured[65].

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[56] *"Identifying chemicals of emerging concern in the marine ...." 20 Oct. 2020, https://ec.europa.eu/environment/integration/research/newsalert/pdf/550na1_en_identifying-chemicals-of-emerging-concern.pdf. Accessed 26 Oct. 2020*

[57] *"Emerging Brominated Flame Retardants in the Environment ...." 9 Dec. 2010, https://link.springer.com/chapter/10.1007/698_2010_73. Accessed 26 Oct. 2020.*

[58] *"Organophosphorus flame retardants (PFRs) and plasticisers ...." 15 Sep. 2015, https://www.sciencedirect.com/science/article/abs/pii/S0025326X15004014. Accessed 26 Oct. 2020.*

[59] *"Medicines in the Environment: A Growing Threat to Wildlife ...." 7 Dec. 2014, https://chemtrust.org/medicines-in-the-environment-a-growing-threat-to-wildlife-and-drinking-water/. Accessed 26 Oct. 2020.*

[60] *"Wildlife impacts of chemicals - CHEM Trust." https://chemtrust.org/wildlife/. Accessed 26 Oct. 2020.*

[61] *"Ocean Pollutants Guide | IPEN." https://ipen.org/documents/ocean-pollutants-guide. Accessed 26 Oct. 2020*

[62] *"Tissue-Specific Accumulation and Body Burden of Parabens ...." 5 Dec. 2018, https://pubs.acs.org/doi/abs/10.1021/acs.est.8b04670. Accessed 26 Oct. 2020.*

[63] *"From BPA to BPZ: a toxic soup? - CHEM Trust." https://www.chemtrust.org/wp-content/uploads/chemtrust-toxicsoup-mar-18.pdf. Accessed 26 Oct. 2020.*

[64] *"Urinary Phthalate Metabolites in Common Bottlenose Dolphins." 5 Sep. 2018, https://aqupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018gh000146. Accessed 26 Oct. 2020.*

[65] *"Natural Capital Committee advice on government's 25 Year ...." 23 Jul. 2020, https://www.gov.uk/government/publications/natural-capital-committee-advice-on-governments-25-year-environment-plan. Accessed 26 Oct. 2020.*

Legacy persistent organic pollutants are still causing a myriad of problems, for example with PCB's threatening the survival of Orca populations in the UK, decades after they were banned[66]. However, there are many emerging contaminants that have the potential to cause equally as much harm if they are allowed to continue to pollute the marine environment. It is important that these contaminants are revealed through non-target[67] or early warning screening[68] before they cause irreversible damage to populations and ecosystems.

A concern that is regularly raised in communication around contaminants in the marine environment is that of mixture effect. The environment and wildlife are not exposed to chemicals in isolation and monitoring individual contaminants is an over simplified approach that does not represent real world exposure[69]. Our concern is that synergistic effects may be missed by just monitoring the concentrations of individual contaminants. There needs to be more ecological monitoring at different trophic levels to determine what effect real world cocktails of contaminants are having on the marine ecosystem.

Overall, there needs to be much greater emphasis on monitoring emerging contaminants as well as programmes being reviewed and updated regularly to keep pace with new chemicals being released into use.

The monitoring of anthropogenic chemical contaminants also needs to be extended to include bacterial monitoring and aligned with any future monitoring carried out under the Bathing Water Regulations. There is increasing evidence that sewage pollution is putting the health of water users and wildlife at risk through exposure to antimicrobial resistant bacteria. Increased numbers of seals have been shown to die as a result of antimicrobial resistance in polluted waters[70] and recent research by the European Centre for Environment and Human Health (ECEHH)[71] found that bathers in the UK remain just as likely to become ill from seawater as they were in the 1990s.

Additional monitoring being carried out (Q4):

We welcome the statement in the issues and opportunities section of descriptor 8 to identify and assess the potential impacts of emerging substances. In England specifically the Environment Agency is developing a **Prioritisation and Early Warning System** (PEWS) to identify emerging contaminants of concern in the environment.

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[66] *"PCB pollution continues to impact populations of ... - Nature." 14 Jan. 2016, https://www.nature.com/articles/srep18573. Accessed 26 Oct. 2020.*

[67] *"Letter to the Editor: Optimism for Nontarget Analysis in ...." 9 May. 2019, https://pubs.acs.org/doi/10.1021/acs.est.9b01476. Accessed 26 Oct. 2020.*

[68] *"Early warning about emerging contaminants | Science." 11 May. 2018, https://science.sciencemag.org/content/360/6389/616.4. Accessed 26 Oct. 2020.*

[69] *"Effects of Polar Bear and Killer Whale Derived Contaminant ...." 6 Sep. 2017, https://pubs.acs.org/doi/abs/10.1021/acs.est.7b03532. Accessed 27 Oct. 2020.*

[70] *"Antimicrobial resistance in marine mammals - Brunel ...." https://www.brunel.ac.uk/research/Research-degrees/PhD-Topics/Topics?id=3fc3535d-1819-4fcb-8b03-1de56f4cc3d2. Accessed 28 Oct. 2020.*

[71] *"Exposure to and colonisation by antibiotic-resistant E. coli in ...." https://www.sciencedirect.com/science/article/pii/S0160412017312345. Accessed 27 Oct. 2020.*

The UK Water Industry Research are currently on the 3rd round of their **Chemicals Investigation Programme (CIP3).** The list of contaminants covered in this programme is far more extensive in terms of the emerging contaminants it covers. It would also be a useful way to address the source to sea approach mentioned in the consultation document.

In terms of monitoring contaminants in wildlife, we welcome the statement in the consultation to include integration of chemical monitoring in cetaceans to existing assessments to better understand the bioaccumulation of persistent chemicals. **The Cetacean Strandings Investigation Programme** (CSIP) monitors contaminants as part of their investigations into stranded cetaceans[72].

For birds specifically, **the Predatory Bird Monitoring Scheme** is a long term scheme that looks at quantifying contaminants of concern in the livers and eggs of predatory birds in GB[73]. One long term (> 35 years) study in particular used gannet egg contents from two colonies off the UK coast to measure concentrations of perfluoroalkyl substances (PFAS)[74].

[72] "UK Cetacean Strandings Investigation Programme." https://ukstrandings.org/. Accessed 26 Oct. 2020.
[73] "The Predatory Bird Monitoring Scheme - UK Centre for ...." https://pbms.ceh.ac.uk/. Accessed 26 Oct. 2020.
[74] "Long-term study on gannet eggs shows mixed trends in ...." 5 Oct. 2020, https://pbms.ceh.ac.uk/news-and-media/news/long-term-study-gannet-eggs-shows-mixed-trends-perfluorinated-compounds. Accessed 26 Oct. 2020.

Contaminants in seafood (D9)

Although the list of contaminants monitored in Descriptor 9 is more relevant and up to date than the equivalent lists in descriptor 8, it still lacks contaminants that we consider to be a risk to human health and would benefit from being monitored. In our response to Part 1 in 2019, we stated "*we believe that alongside other contaminants, microplastics should be monitored through this descriptor, especially in light of recent reports from WWF and others on the amount of plastic consumed by humans."* Consuming seafood is one known pathway for humans to ingest microplastics, particularly when eating fish that are intended to be consumed whole[75]. The health impacts of ingesting microplastics are still not completely understood. However, the WHO have raised concerns and called for more research to be conducted on the effects of microplastics on human health[76]. Researchers have also raised the issue of chemical contaminants that are associated with microplastics, either through toxic additives such as phthalates in the plastic or through the ability of microplastics to accumulate persistent organic pollutants in the environment[77]. Additional concern has been raised on the human health risks of nano-sized plastics (<150µm), and consideration should be given to developing monitoring protocols for these in association with those for microplastics and chemical contaminants[78].

We welcome the inclusion of emerging contaminants such as brominated flame retardants and PFAS in this descriptor. However, we think that these lists should continue to be reviewed and expanded regularly. In terms of flame retardants, the novel brominated and organophosphorus flame retardants should be included. For PFAS, although it would be completely unrealistic to monitor all of them, methods need to be developed to take a real world approach to the levels of PFAS in seafood, as it is likely that the handful that are currently monitored only represent the tip of the iceberg.[79] The NORMAN network has published a list of emerging contaminants of concern which would be useful when determining which other contaminants should be monitored[80].

We think it is vital that more research is conducted on the safety for humans of exposure to levels of individual contaminants, but also real world mixtures of contaminants that are likely to be consumed through eating seafood. We welcome the monitoring plans going forward that "*As new chemicals or groups of chemicals of potential concern to sea life and human health are continually being identified (for example perfluoroalkyl substances, PFAS) we will prioritise these for future investigation of their potential risks and inclusion in monitoring programmes subject to resource availability".* However, we

[75] "Microplastics in Seafood and the Implications for Human Health." 16 Aug. 2018, https://link.springer.com/article/10.1007/s40572-018-0206-z. Accessed 27 Oct. 2020.
[76] "WHO calls for more research into microplastics and a ...." https://www.who.int/news/item/22-08-2019-who-calls-for-more-research-into-microplastics-and-a-crackdown-on-plastic-pollution. Accessed 27 Oct. 2020.
[77] "Microplastics in Seafood and the Implications for Human Health." 16 Aug. 2018, https://link.springer.com/article/10.1007/s40572-018-0206-z. Accessed 27 Oct. 2020.
[78] "Microplastics in coastal areas and seafood: implications for food safety" April 2019.https://www.tandfonline.com/doi/full/10.1080/19440049.2019.1585581 . Accessed 6 Nov.2020
[79] "PFASs in the Nordic environment - Nordic Council of Ministers." https://norden.diva-portal.org/smash/get/diva2:1296387/FULLTEXT01.pdf. Accessed 6 Nov. 2020.
[80] "Emerging substances - the norman network." https://www.norman-network.net/?q=node/19. Accessed 27 Oct. 2020.

would raise our concerns around the monitoring of potentially harmful substances only being included subject to resource availability.

We support the monitoring work on contaminants in seafood alluded to in the operational targets section, but there is no deadline or specific timeline for its development. We would like to see more detail on how and when this will be achieved.

Additional monitoring needed (Q3):

There are very few details about the monitoring programmes that are used in this descriptor and we would like to see a timetable of when these monitoring surveys are conducted and target dates for when other emerging substances will be taken into consideration, similar to the 2022 date set in Descriptor 8.

We welcome the statement in the consultation document that more ad-hoc testing would provide a good opportunity to ensure that Descriptor 9 continues to achieve GES. We would however, see it as more beneficial that routine testing is carried out for this range of contaminants rather than solely relying on the data from the surveys for the Marine Strategy requirements.

We think it is important that additional monitoring is carried out for microplastics in seafood, as this is likely one significant route of microplastic ingestion for humans. This monitoring should primarily be focussed initially on seafood that is consumed whole[81].[1]

Recent research conducted by the Marine Conservation Society found an apparent lack of routine monitoring of seafood by Local Authorities in the UK. This seafood should be subjected to monitoring of the same set of contaminants included in this consultation. We support the statement made in the consultation regarding the *"UK working with other countries at regional level to ensure that risks from contaminants that might pose significant risks to humans are taken into consideration."* We would hope that this cooperation between countries would include the level of monitoring that is conducted during these surveys on seafood caught in UK waters being extended to seafood we import from outside the UK.

We would also like to see monitoring of contaminants related to aquaculture, in our response to the previous part 2 consultation in 2014 we said *"the proposed monitoring programme fails to take into account the effect of aquaculture activities and the fact that contaminants can also enter the food chain through these activities".* It is apparent that this hasn't been addressed in the current consultation.

Additional monitoring being carried out (Q4):

No other monitoring known to take place.

[81] "Microplastics in Seafood and the Implications for Human Health." 16 Aug. 2018, https://link.springer.com/article/10.1007/s40572-018-0206-z. Accessed 28 Oct. 2020.

Marine litter (D10)

The current monitoring programme for beach litter is long established and protocols should continue updating it in line with OSPAR and EU MSFD recommendations. The number of beaches monitored should continue as a minimum baseline and should be further improved with additional funding and surveys to beaches which are not immediately accessible. For example, visual ad hoc surveys done via aircraft and boat have shown high levels of litter in places which do not have easy or no road access[82].

The monitoring for seafloor litter continues to require further sample sites.

Fulmar monitoring is based on finding deceased fulmar. Fulmars are currently in decline (the reason for this is not currently well understood[83]) and with limited numbers found alternative species should be investigated to supplement the existing data on litter consumed by marine wildlife.

The monitoring programme is currently insufficient on the interaction of marine litter and climate change. Defra has concluded that "Evidence does not currently indicate climate change will directly affect marine litter or its impact on biota but its influence on water currents…" However, the Environment Agency has clearly outlined that marine litter will be impacted by climate change…Environment Agency Guidance[84] 'Water companies: environmental permits for storm overflows and emergency overflows' states that climate change is one of the factors which is expected to increase sewer flooding and pollution from storm overflows.

In addition, monitoring needs to look at the close linkage between marine litter as a vector for non-native species- with aquaculture in particular noted as a strong vector. Furthermore, marine litter can impact on microbial colonies[85] and affect marine primary producers[86].

Microplastic loads need to be measured at different depths[87] as well as in sediments and on beaches. Seasonal and temporal variations of microplastic loads need to be studied and therefore this should be taken into consideration.

While knowledge of loads of microplastics found in rivers in the UK has been studied, as have discharges from waste waste treatment plants, there appears to be little or no data on microplastic loads in the marine environment and sediments. Therefore the establishment of a programme to address this is urgent.

The proposed monitoring has a number of key areas missing from the programme. Many of these are noted in the operational targets. Some actions could be implemented immediately. For example we

[82] https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=1854
[83] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/marine-litter/plastic-particles-fulmar-stomachs-north-sea/
[84] https://www.gov.uk/government/publications/water-companies-environmental-permits-for-storm-overflows-and-emergency-overflows/water-companies-environmental-permits-for-storm-overflows-and-emergency-overflows
[85] https://pubs.acs.org/doi/10.1021/acs.est.0c02305
[86] https://www.nature.com/articles/s42003-020-0789-4
[87] https://www.nature.com/articles/s41467-020-17932-9

have indicated a number of additional monitoring requirements in question 4 which could be immediately expanded to include live surveys of e.g. nesting birds. There also need to be deadlines or specific timelines for development, and a plan for how this work will be supported financially.

When considering the levels of marine litter, chemical loads associated with the litter should also be taken into account. This should include both toxic additives associated with plastic products such as phthalates and also the ability of microplastics to accumulate persistent organic pollutants in the environment[88,89].

Additional monitoring needed (Q3):

Microplastics is a growing area of concern and this has been highlighted through a number of Defra funded projects e.g. https://www.gov.uk/government/news/government-launches-microplastics-research-to-protect-oceans.

However, there is an immediate need to establish routine monitoring within both freshwater and marine environments. UK authorities should actively support the development and implementation of a monitoring programme as quickly as possible. It is important to establish a baseline of microplastic loads entering the ocean - and therefore monitoring of riverine (and other waterways) loads is important. Microplastic monitoring should also be carried out in seawater and sediments (both at the beach and offshore) as well as within marine biota. We think it is also important that additional monitoring is carried out for microplastics in seafood, as this is likely one significant route of microplastic ingestion for humans[90]. This monitoring should primarily be focussed on seafood that is consumed whole as this is considered to be higher risk.

Microplastics monitoring needs to include two types of monitoring - compliance and investigative monitoring. The former needs to determine effectiveness of applied measures and will need to incorporate upstream sampling as well as that in the marine environment. For example, to understand if PAS standard for reducing plastic pre-production pellet loss is being effective monitoring needs to occur on land, in waterways and in the marine environment. In addition, investigative monitoring should be utilised to understand point sources e.g. sewage waste water discharge (both into marine and freshwater) and biosolids as well specific types of microplastics e.g. different types of pellets - biobeads vs. pre-production pellets.

Future sampling programmes for microplastics under the Marine Strategy and Water Framework Directive must be fully aligned: we recently outlined the need for upstream sampling of microplastics in our response to the Environment Agency's 'Challenges and Choices 2020' consultation: "Research led by Bangor University and Friends of the Earth found that microplastics were present in all UK inland

[88] https://link.springer.com/article/10.1007/s40572-018-0206-z

[89] https://ipen.org/site/plastics-toxic-additives

[90] https://www.sciencedirect.com/science/article/abs/pii/S0269749118302197#:~:text=For%20the%20supermarket%20bought%20mussels,(0.9%20items%2Fg).&text=The%20spectra%20found%20that%2050,of%20rayon%20and%20cotton%20fibers.

waters tested, highlighting the need for widespread monitoring of inland water systems in the UK. Microplastics should be added to the list of pollutants regularly monitored in inland waters, requiring agreement of an accurate, repeatable, reportable method for microplastic quantification. The full consequences microplastics are having on organisms, ecosystems and human health are not yet fully understood. Yet, in alignment with the Precautionary Principle (Rio Principle 15), a lack of scientific understanding of the issue is not an excuse for inaction. Indeed, where there are threats of serious and irreversible environmental and societal damage, a lack of certainty surrounding the issue should elicit policy responses that would accommodate for a worst-case scenario."[91].

Necropsy of stranded mammals and other large marine species such as turtles and basking sharks should be utilised as standard and supported by government funding. Monitoring of plastics (both macroplastic and microplastics) should be carried to determine the levels of litter being ingested. Biogeography of these organisms should be noted wherever feasible.

Additional monitoring being carried out (Q4):

- Pellets are being monitored by volunteers through the 'Great Nurdle Hunt'
- Big microplastic survey[92] uses citizen science to examine different types of microplastics found on beaches[93]
- The Cetacean Strandings Investigation Programme (CSIP) monitors contaminants as part of their investigations into stranded cetaceans, and should be expanded (with appropriate funded resources from Defra) to cover plastics[94]. https://ukstrandings.org/
- Continuous plankton recorder (CPR) https://www.cprsurvey.org/ provides a long standing programme of monitoring but was not specifically set up or designed to examine microplastic loading.
- UK Water Industry Chemicals Investigation Programme and any outcomes from water company programmes such as: https://ukwir.org/sink-to-river-river-to-tap-review-of-potential-risks-from-microplastics
- The Marine Conservation Society coordinates the annual Great British Beach Clean[95], typically at over 400 beaches, each September as well as ad hoc surveys throughout the year, which includes a detailed litter survey. The OSPAR beach litter monitoring programme covering England, Wales and Scotland is a small subset of this data (with Northern Ireland data for OSPAR collected by Keep Northern Ireland Beautiful).

Any additional sources of monitoring should have quantitative data for it to qualify for inclusion. This allows assessment against GES of a reduction in the amount of marine litter. Furthermore, monitoring locations which are closer to the source of pollutants should be included to monitor effectiveness of intervention.

[91] https://www.wcl.org.uk/docs/Challenges%20and%20Choices%20-%20Detailed%20submission%20.pdf
[92] https://microplasticsurvey.org/
[93] https://microplasticsurvey.org/wp-content/uploads/2019/10/Resource-Pack-2019.pdf
[94] https://ukstrandings.org/
[95] https://www.mcsuk.org/beachwatch/greatbritishbeachclean

Underwater noise (D11)

There are many gaps still in the knowledge base and, while the existing monitoring programmes are designed to help fill some gaps, they are not comprehensive. The government programmes lack ambition – only one is actually monitoring ambient underwater noise and is focused largely on the waters to the east of the UK. The marine noise registry holds valuable data on impulsive noise but it is not actually monitoring underwater impulsive noise. Neither monitoring programme is investigating the impact of underwater noise on marine ecosystems and animals at a population level. The Government's Marine Strategy Part One updated assessment published in October 2019 recognises that there is still uncertainty regarding the levels and frequencies of man-made marine noise that lead to effects at a population and ecosystem level, particularly for vulnerable/threatened species and key functional groups. Nor is it understood how to quantify the risk of impact.

Other programmes which involve monitoring – COMPASS, JOMOPANS and JONAS are all EU funded projects with UK scientific group involvement – will provide valuable data and research to improve the knowledge base, however all are time limited. The International Maritime Organization's Guidelines for the Reduction of Underwater Noise from Commercial Shipping, referred to in the Marine Strategy Part One as an example of how the UK has supported activities to reduce noise at an international level, was published in 2014 and provides general guidance to designers, shipbuilders and ship operators. The IMO, when adopting the Guidelines noted that there are significant gaps in knowledge and underwater noise is a complex issue. It was therefore considered that setting future targets for underwater sound levels from shipping was premature since more research was needed.

The high level objective for GES is "loud, low and mid frequency impulsive rounds and continuous low frequency sounds introduced into the marine environment through human activities are managed to the extent that they do not have adverse effects on marine ecosystems and animals at the population level".

The Marine Strategy Part One acknowledges that there is not sufficient knowledge of the impacts of anthropogenic sound in the marine environment to provide a robust assessment of the extent that GES may have been achieved by 2020. In fact, it might be more accurate to say that there is not sufficient knowledge of the impacts of anthropogenic sound in the marine environment to understand the impact on UK marine wildlife and ecosystems, let alone whether or not there is progress towards achieving GES.

In developing programmes which will support improvements in the understanding of the levels and frequencies of man-made marine noise which have an impact on populations and at an ecosystem-level, it is important to acknowledge that underwater noise is now recognised to have an impact on a wide range of marine wildlife including marine mammals, fish and marine invertebrates. A review of studies of human-produced underwater noise covering 66 fish species and 36 invertebrate species noted that turtles, sharks and rays are particularly under-represented in noise impact studies.

Although it is often concluded that there is limited information on the impacts of underwater noise on marine wildlife populations and ecosystems, a very wide range of impacts of underwater noise

have been recorded[96]. Included are impacts on development, high mortality of zooplankton in the presence of noise, anatomical impacts, stress impacts, behavioural impacts, distraction impacts, along with masked communication, changes in schooling behaviour, drops in commercial catches, changes in the performance of ecological services.

In order to assess progress towards achieving GES, it is vital that threshold values for levels of impulsive sound and ambient sound are established and applied, i.e. the second operational targets identified in the UK Marine Strategy Part One. Although the first operational target, conducting more research to establish the impact of noise on marine animals, presumably along with established ecosystem and population impacts, remains important too, threshold values should be established as a matter of urgency so that measures can be identified to commence addressing underwater noise. Baselines and understanding might not be comprehensive, but this would allow some level of assessment of progress. As further monitoring and research provides additional data and knowledge, adjustments can be made if required.

Additional monitoring needed (Q3):

More monitoring is inevitably going to be needed to fully assess progress towards achieving GES, but the resources needed to establish and apply the thresholds values for underwater noise and the development of measures to reduce the impacts of underwater noise are needed first.

[More info to come on HP SACs and monitoring]

Additional monitoring being carried out (Q4):

The Hebridean Whale and Dolphin Trust have been conducting acoustic surveys on the west coast of Scotland since 2002. As well as species monitoring, these recordings are also being used to assess the changing soundscape on the west coast of Scotland and the potential impacts of underwater noise on the population, distribution and behaviour of cetaceans in the region[97]**.**

END

[96] Weilgart, L., 2018. The impact of ocean noise pollution on fish and invertebrates. Report for OceanCare, Switzerland. 34pp

[97] Findlay et al., 2018. Mapping widespread and increasing underwater noise pollution from acoustic deterrent devices. Marine Pollution Bulletin, 135, 1042-1050.