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Mapping the flow of data from monitoring programmes into UK Marine Strategy indicators for seals
Technical notes: Dataflow descriptions & recommendations

Sophie Rush[1], Yessica Griffiths[1], Karen Webb[1], Eleonora Manca[1]

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For further information on JNCC's report series please contact:
Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough PE1 1JY
https://jncc.gov.uk/
Communications@jncc.gov.uk

Department for Environment Food & Rural Affairs

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Author affiliations:
[1] JNCC, Monkstone House, City Road, Peterborough, PE1 1JY

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Summary

Under the UK Marine Strategy (UK MS) the UK is required to determine and measure the status of the health of its seas. For this, specific indicators are used for different ecosystem components to measure and assess progress. Data used for the calculation of seal indicator assessments originate from a series of regional monitoring programmes carried out by a number of organisations, none of which were set-up specifically to fulfil the requirements of the UK MS indicator assessments. The data landscape underpinning the UK MS indicator assessments is therefore complex and the risk of duplication of effort and underutilisation of data resources great. This piece of work aims to follow and depict the flow of data from monitoring programmes to the indicators, with the goal of highlighting areas where the flow of data could be streamlined, improved or, in the case of missing data links, created. We have outlined issues that could impact the efficiency and quality of the indicator assessments and made recommendations on how to address them.

This report forms part of a series of three reports describing the flow of data into each of the UK MS biodiversity indicators. Collectively these reports will provide the initial step in improving the efficiency of data flowing into indicators and achieving a more inclusive, accessible, and robust marine biodiversity evidence base.

Contents

1 Introduction

The health of our seas is vital for our food and energy security, our economy and social well-being; over half of the UK population lives within 15 km of the sea. The seas have an integral role in regulating our climate by storing excess carbon dioxide and heat created by human activities and providing over 50% of the oxygen we need. As well as being enjoyed for recreational activities, the seas are crucial to the UK economy, providing oil and gas, maritime transport, and renewable energy (DEFRA 2019).

To determine the state of and changes in the health of the UK's wide variety of marine ecosystems, specific indicators have been developed under the UK Marine Strategy (HM Government 2012). The UK Marine Strategy (UK MS) seal biodiversity indicators are primarily reliant on data from monitoring programmes undertaken by the Sea Mammal Research Unit (SMRU) and Non-Governmental Organisations (NGOs) (e.g. National Trust, The Wildlife Trusts and volunteer groups). Many of these programmes are commissioned by UK statutory environmental bodies or funded by the Natural Environment Research Council (NERC). In England, Wales and Northern Ireland, these data are collected at localised scales and pieced together, where possible, with data from the SMRU Scottish monitoring programme to provide an overview of the health of the UK seal populations.

This means that currently the pathways of data feeding into the indicators are not standardised or streamlined, and it is unclear whether indicators capture all available data.

In 2008 the Marine Environmental Data and Information Network (MEDIN) was established, to improve access to, and management of, UK marine environmental data and information. MEDIN aims to achieve this primarily through a coordinated framework for managing marine data and information (see Figure 1). Ideally, general monitoring activities carried out by the statutory environmental bodies or other organisations should be registered at the UK Directory of Marine Observing Systems (UKDMOS). Specific datasets produced by monitoring activities should be made accessible and archived at one of the MEDIN Data Archive Centres where they can be assigned a persistent identifier (PID) in form of a Digital Object Identifier (DOI). Metadata describing the datasets should be published via the MEDIN Discovery Portal to ensure optimal discoverability. The datasets DOIs can then be linked to UKDMOS under the overarching monitoring survey. Dataset products (combinations of individual datasets) produced as part of the indicator assessments should be archived in the same manner (see Figure 1) but original sources of raw data from which these data products are derived can be traced back easily using PIDs. Ideally, the Marine Online Assessment Tool (MOAT) would contain metadata (information about the dataset) on the datasets collated for indicator assessments (e.g. raw data, compiled data set, data snapshot) and link them back to the data archiving centre where they have been deposited. The infrastructure behind the MEDIN framework requires further development to function optimally and consistent usage among statutory bodies and other organisations is needed.

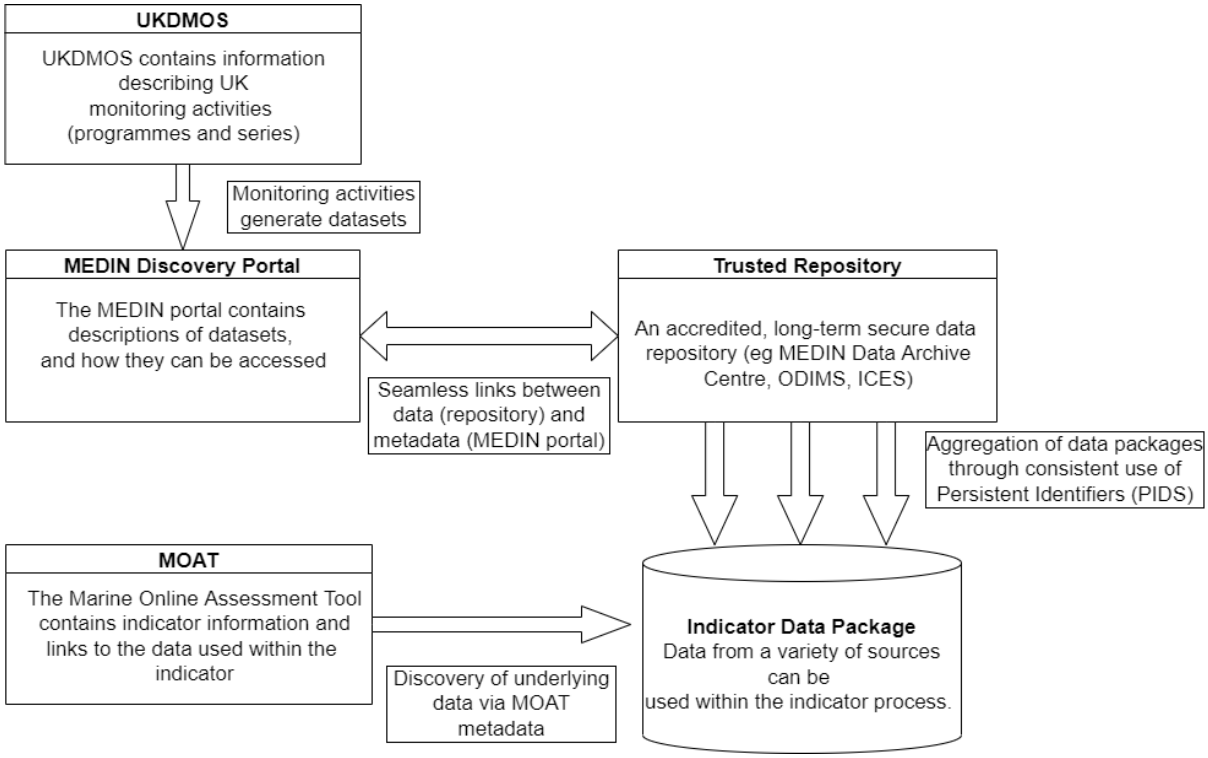

Figure 1. Idealised flow for UK monitoring programmes. It should be possible to access indicator data packages either from data collection information (UKDMOS) to datasets (MEDIN) or directly via indicator assessments (MOAT) with links maintained to support traceable and transparent reporting of assessment results.

This paper describes the pathway of data from monitoring programmes into two indicators used for UK MS assessments of seals:

- Changes in abundance and distribution of seals
- Grey seal pup production

Missing, dysfunctional, and duplicated links impacting the flow of data from collection to the indicators are identified, and key issues and recommendations highlighted. Diagrams providing graphical representation of the dataflows are provided in the accompanying Annex; these diagrams should be viewed alongside the technical notes in Section 4.

This report forms part of a series of reports describing the flow of data into each of the UK MS biodiversity indicators. Collectively these reports will provide the initial step in improving the efficiency of data flowing into indicators and achieving a more inclusive, accessible, and robust marine biodiversity evidence base.

A summary of the limitations and assumptions of this report are provided in Section 5.

2 Key dataflow issues

Collecting, analysing, archiving, and publishing of seal monitoring data in the UK is undertaken by a variety of organisations including universities, research institutions, NGOs and some of the UK statutory environmental bodies. This report focuses on the issues surrounding data availability and the flow of data into the seal indicator assessments, once data have been made accessible by organisations. Data processing within each organisation differs depending on resources and internal data infrastructure which can often cause a significant time-lag between the collection and publishing of data (several years in some instances).

Problems that are universal in data handling and usage which have not been individually addressed as part of this report involve comparability and standardisation of data across different monitoring surveys and regions. Data processing within each organisation differs depending on resources and internal data infrastructure, which can often cause a significant time-lag between the collection of data and publishing of data (several years in some instances). Although not the focus of this report, these are issues that could hamper the outcome of the indicator assessments which rely on a wide range of timely and high quality (quantitative and comparable) data.

2.1 General marine biodiversity dataflow issues

2.1.1 Discoverability of data

Many organisations are battling a backlog of data to be made available on their database and/or stores. This carries the risk that most recent data are not available for indicator assessments. Some of this backlog is caused by individual organisation's internal lack of resources and manpower, others are caused by inefficiencies and limited engagement in the UK wide data infrastructure such as MEDIN.

2.1.2 Resource intense dissemination to UK wide databases

Data upload to UK portals and online GIS applications can be a complex process requiring several steps and specialist knowledge. These include creation and upload of metadata associated with the dataset to a metadata directory; choice of data portal (often dictated by regional policy driver); making datasets compliant with UK data standards and the specific requirements of the individual data portal and upload of the dataset. For example, The Marine Environment Monitoring and Assessment National (MERMAN) database does not always accept the newest taxonomic nomenclature conforming with the World Register of Marine Species (WoRMS). Whilst currently resource intensive, these processes are required to ensure availability and discoverability of datasets, compliant with the FAIR data principles (Findable, Accessible, Interoperable and Reusable) to provide a consistent, transparent and UK-wide coverage of data for the inclusion in the indicator assessments.

2.1.3 Inconsistencies in data sharing between organisations

Data sharing between organisations often relies on communication between individuals of the different organisations. This carries the risk that data sharing is patchy, infrequent and might be lost if individuals move roles. This could also cause confusion around permissions to share and re-use dataset for other purposes. In addition, the responsibilities for data management and the collation of data to support indicator development often sits within different teams or departments within organisations requiring ongoing cross-departmental liaison and engagement.

2.1.4 Inconsistencies in response to data calls

Contributions of data to UK assessments or data products relevant for assessments are often based on ad-hoc provision of data in response to data calls. Such calls require specific and varying data formats and are regularly responded to by individuals and rely on availability and good will of specific personnel. This can result in data calls that are infrequently responded to and carry the risk of not utilising recent data in the indicator assessments.

2.1.5 Duplication of data upload effort:

Submission of data to one UK database/portal does not automatically guarantee data is made available on other UK portals. Until recently, for example, data submitted to Marine Recorder were not routinely uploaded to and disseminated through DASSH. This causes duplication of effort by some organisations. Some of the duplication will be removed by the re-development of the Marine Recorder. Yet, clarifying and increasing linkages, and wider adoption of existing data standards between the different UK data portals might be a useful next step.

2.1.6 Underutilisation of available resources:

Within UK statutory monitoring, global/European or even UK based data portals are only interacted with at the end of the data publishing chain. Data deposited in these portals are from a wide range of monitoring activities (including academic) and over a greater regional scale. Thus, data that is available from portals such as OBIS, GBIF, and DASSH could prove very valuable for the indicator assessment. As a rule, these portals are currently not used as the start point for data acquisition for indicator assessments.

2.2 Seal indicator specific data issues

The seal indicators rely heavily on monitoring surveys around the UK, conducted by a range of organisations. Given the length and difficultly of accessing parts of the UK coastline, it can be impractical to survey the whole coastline every year. This results in variability in the spatial and temporal availability of monitoring data both within and between seasons and presents challenges for the indicator assessments which rely on comparable time-series monitoring data to determine causality. To acquire indicator compatible data, many surveys would require aerial or thermal imagery carried out by trained organisations and would need additional funding support. Generally, data are collected by an organisation and uploaded to their own database or store. Data that are compatible with the indicator assessments is either requested or disseminated to data repositories and consequently made available to global data portals such as the OSPAR Commission Data and Information Management System (ODIMS), International Council for the Exploration of the Sea (ICES) Portal or the National Biodiversity Network (NBN) Gateway. There are several areas where this report has identified inefficiencies in this process:

2.2.1 Missing data

Currently, not all available seal data are used for indicator assessment owing to spatial and temporal variation in sampling effort inconsistent with the data requirements of the indicator.

2.2.2 Transparency of final datasets

The publishing of the final dataset assembled for the purpose of the UK MS indicator assessments and the linking of its metadata to MOAT or DASSH has not been realised. However, the OSPAR indicator final dataset can be accessed through ODMIS via MOAT.

3 Key recommendations

3.1 General recommendations for marine biodiversity dataflows

3.1.1 Use of a wider breadth of data

To include a greater breadth of monitoring data (outside of statutory programmes), data needs to be acquired from wider sources. Currently, none of the global, European or UK-wide data portals (e.g. ODIMS, OBIS, UKDMOS, DASSH) have been used as a source of data for assessments. It is acknowledged that using downstream data aggregators does potentially increases the risk of dataset duplication without a consistent and careful use of Persistent Identifiers (PIDs). Therefore, a short project could be set-up to understand the risks of duplication of datasets and to identify ideal access points for sourcing the most complete dataset for the indicator assessments. Ideally DASSH, as the MEDIN biodiversity Data Archiving Centre (DAC) and UK node of OBIS, should provide the most complete marine biodiversity picture at the UK scale.

3.1.2 Streamline dataflow for relevant components of indicators

There should be a standardised, transparent and auditable flow of data feeding into the indicator assessments. Useable data for assessments should be identified using UKDMOS (for monitoring programmes) and the MEDIN Discovery Portal (for datasets) and ideally sourced from DASSH (or from the ideal access point along the DASSH data pipeline (e.g. Marine Recorder)). To function optimally, organisations need to actively engage with UKDMOS and DASSH to support improvements to the system and interface. All UK marine biodiversity data collectors should be encouraged to upload their data and information to DASSH and UKDMOS.

3.1.3 Improve uptake of UKDMOS by SNCBs

UKDMOS should be a first port of call to check what monitoring programmes are collecting data which could be included in the indicator assessment. Currently, UKDMOS is underutilised as a tool to search for data but also by the individual data producers for registering their monitoring programmes. It would be useful to generate greater buy-in to UKDMOS by the different statutory bodies and other monitoring organisations.

3.1.4 Improve user-friendliness of MEDIN and MEDIN DACs

Accessibility of datasets is dependent on data publication to open data portals and Data Archiving Centres (DACs) such as DASSH. At present, the process for data ingestion by the DACs creates bottlenecks. A simplified more user-friendly interface for data ingestion and creation of metadata, as part of an update of the MEDIN network, could improve user uptake amongst the statutory bodies and other organisations.

3.1.5 Automate data-sharing processes

Currently data have to be uploaded manually to an organisation's internal database. From there, the process to make these data publicly available also requires manual interaction. It would be more cost-efficient and less resource intensive to establish better interconnection between internal and external databases, as well as between external databases which automate the process of sharing data to external databases such as DASSH or Marine Recorder.

3.1.6 Establish single point of contact

Often requests for data to be used within assessments are submitted to individuals within an organisation. This could lead to data not being made available when individuals are unavailable or move roles. Organisations could consider setting-up a single point of contact for data calls which is serviced by all members of a department rather than specific individuals. Ideally reliance on data calls will be reduced as data ingestions bottlenecks are resolved.

3.1.7 Futureproof new projects

The current problems exist because monitoring programmes were set-up prior to the existence of a data strategy. All new projects and monitoring programmes supported by public funds should require a detailed data strategy which follows the UK Marine Monitoring and Assessment Strategy (UKMMAS) Data Strategy.

3.1.8 Provide data standards and guidelines

The UK Marine Monitoring and Assessment Strategy are in the process of updating data standards and guidelines for UK monitoring. Providers of public data should be encouraged or mandated to adhere to these guidelines and standards and adopt them into their organisation.

3.1.9 Scope out data portals for useable data

For future assessment it will be useful to include a greater breadth of monitoring data. So far, none of the global, European or UK-wide data portals (e.g. ODIMS, UKDMOS, DASSH) have been used as a source of data for indicators. It is acknowledged that using downstream data aggregators does potentially increases the risk of dataset duplication without a consistent and careful use of Persistent Identifiers (PIDs). Therefore, a short project could be set-up to evaluate data held within each of the data portals outlined in Appendix 3 and determine their usefulness and relevance to the indicator assessment.

3.2 Recommendations for seal indicator dataflows

3.2.1 Align monitoring surveys

In Scotland, seal monitoring is part of a comprehensive programme carried out by SMRU, while in the rest of the UK monitoring is conducted at a localised scale by individual organisations and without national coordination. The datasets which are generated locally within Wales, England, and Northern Ireland, are often spatially and/or temporally disparate and not always compatible with the indicator requirements. These variations are caused by a number of factors including accessibility of sites and resourcing constraints limiting the survey effort and frequency. An effort to align monitoring of seal populations across the UK and encourage or enable surveying at similar spatial and temporal scales would improve the coverage of data for seal indicator assessments.

3.2.2 Transparency of datasets

Publish UK MS indicator data snapshot on DASSH. Currently the MS indicator data snapshot is not publicly accessible on a UK DAC. DASSH is the most suitable DAC as it is the UK's Archive for Marine Species and Habitats Data.

4 Technical notes on indicator dataflows

4.1 Indicator: Changes in abundance and distribution of seals

4.1.1 Technical summary

This indicator is used to assess progress of seal abundance and distribution against the targets set out in the UK Marine Strategy Part One for the two UK native species of seals; the Atlantic grey seal and the harbour seal (HM Government, 2012). The dataflow for this indicator has been represented graphically in the accompanying Annex (Figure 1).

The indicator uses estimates of seal numbers derived from various monitoring programmes surveying the number of seals hauled out on land. Both grey and harbour seals are counted in August during the harbour seal annual moulting season, when a high and relatively consistent proportion of the harbour seal population are hauled out.

Data included in assessments:

Northern Ireland

- SMRU: August aerial counts (Note these are not part of the SMRU coordinated monitoring programme and are only conducted when commissioned).

Scotland

- SMRU: August aerial counts of Scotland's entire coastline.

England

- SMRU: August aerial counts of the east coast of England.
- ZSL and SMRU: August aerial counts of the Thames Estuary.
- Industry Nature Conservation Association: August land counts in the Tees Estuary.

The organisations listed above submit their count data or abundance estimates to SMRU's (Sea Mammal Research Unit) internal database. SMRU creates an estimate of abundance and distribution dataset using different analytical methods depending on the seal species and the method for data collection at each colony. For grey seals, SMRU runs a population model (developed by the University of St Andrews) based on UK grey seal August counts and grey seal pup production estimates to predict grey seal population. To estimate total abundance of harbour seals, a scalar is based on the proportion of the population hauled out during August moult surveys (Thompson *et al.* 2019).

The UK abundance and distribution estimates dataset is submitted to the ICES biodiversity data portal which specifically assembles data to support OSPAR assessments on seals. The data formatting is checked by ICES before being made available on the portal. SMRU is contracted by JNCC to carry out an analysis of trends which JNCC screens and uses as the UK basis of the OSPAR seal indicator assessments (OSPAR M3 and M5 indicators). The final OSPAR data assessment snapshot is published on the OSPAR Data and Information Management System portal (ODIMS). The final outputs of the OSPAR assessment form the basis of the UK MS assessment.

4.1.2 Future development

Future versions of this indicator will include an element of human pressures on seal populations. This will use data gained from seal post-mortem and stranding programmes which are already being carried out in Northern Ireland and Scotland. A one-year funded seal post-mortem trial will start in 2022 for England and Wales as part of CSIP (UK Cetacean Strandings Investigation Programme). Previously strandings data have been collected on a voluntary basis and have not formally fed into the indicator assessments. Stranding and post-mortem it not currently captured within any MEDIN DACs and would need to be requested from organisations carrying out the programme to be included in the indicator assessment.

Individual mature grey seals are usually faithful to particular breeding sites, despite their ability to travel long distances. Therefore, for the OSPAR assessment, the European populations are subdivided into Assessment Units (AU) in order to describe changes at a 'local' scale. Data from all colonies reported are summed to make assessments at the AU level. Historically, data from monitoring programmes with fewer than four data points available for an assessment unit would not be included in the OSPAR assessment. However, in the current OSPAR assessment (2021, unpublished) this rule has been relaxed in some cases, for example when combining the trends in grey seal August counts across the single OSPAR assessment unit for grey seal abundance. This OSPAR assessment was the first time that time series have been generated from the grey seal summer counts.

At present the UK datasets for seals abundance and distribution are not uploaded to any MEDIN DAC. Discussions are ongoing amongst the key organisations involved in this indicator as to which will be the most viable and efficient data products to archive within DASSH (The Archive for Marine Species and Habitats Data) in the future.

Historically, the Scientific Committee on Seals (SCOS) report series has been used by SMRU to inform the Marine Scotland Seal Licencing Expert Group on the number of licences that can be issued for seal biological removal (licensed culling). However, recent legislative change has banned biological removal for the protection of fisheries in Scotland which means this will no longer be allowed in future assessments. Although licenses can still be issued to kill seals in certain circumstances *(Conservation of Seals Act 1970).* Any anthropogenic removals such as bycatch will still need to be documented.

4.1.3 Missing, Duplicated and dysfunctional links

A number of regional monitoring programmes carried out in Wales and the south, south-west and north-west of England are not included in the indicator assessment. A recent review (SCOS 2020) has outlined that the difficulty in monitoring particular sites and variabilities in spatial and temporal scale of data has meant some localised datasets are not compatible with the indicator. Scotland aims to carry out a national monitoring survey for August counts of the entire Scottish coast every 5 years. However, data from the rest of the UK rely on small, localised surveys, largely conducted by NGOs, at various spatial and/or temporal frequencies. Although these datasets are not included in the UK MS or OSPAR indicator assessments, the data submitted to SMRU are used qualitatively, alongside the population model, in the SCOS report series on the population index and distribution by Seal Management Units (SMUs). A comprehensive list of all formal seal monitoring surveys currently conducted across the UK, including information on survey methods and whether they are currently used in the UK MS (and OSPAR) indicator assessments, is provided in Table 1 of the Appendix.

SMRU uses telemetry at sea data to determine the proportion of the grey and harbour seal population that may be at sea during the land count, however, this data does not currently

feed into the indicator assessments which are based solely on counts of individual seals on land. SMRU uses the at sea data to mitigate for any seals missing (at sea) at the time of the land count, to gain a more accurate estimate of the population. Inclusion of estimates of sea use by seals could significantly improve the robustness of the indicator and provide a clearer indication of the abundance and distribution of the seal population in the UK.

4.2 Indicator: Grey seal pup production

4.2.1 Technical summary

This indicator is used to assess progress of grey seal pup production against the target set out in the UK Marine Strategy Part One (HM Government 2012). The dataflow for this indicator has been represented graphically in the Annex (Figure 2).

In Scotland, pup production is estimated from counts of pups during the grey seal breeding season using predominately dedicated aerial surveys (apart from in Shetland). These counts are uploaded to the SMRU internal database where they feed into the grey seal pup-production dataset. In the east of England, there are varied surveys of pup counts carried out during the breeding season. This means pup production is estimated on a colony level from surveys involving a variety of methods (e.g. dye marking pups, estimating pup age to only count pups which were likely to be born since the last count). These pup production estimates are also uploaded to the SMRU internal database and combined with the overall UK pup count to produce the UK grey seal pup production dataset.

The UK grey seal pup production dataset is based on three broad sources:

- SMRU: calculates a pup production model based on aerial surveys of Scottish colonies (Russell *et al.* 2019).
- NatureScot: land and vessel-based counts of grey seal pups in Shetland.
- English pup production estimates from specified surveys:
    - National Trust: Pup production estimates from land counts at Farne Islands and Blakeney (Blakeney up until 2019).
    - Lincolnshire Wildlife Trust: Pup production estimates from land counts at Donna Nook.
    - Friends of Horsey Seals: Pup production estimates from land counts at Horsey.

The grey seal pup production dataset is submitted to the ICES biodiversity data portal which specifically assembles data to support OSPAR assessments on seals. The data formatting is checked by ICES before being made available on the portal. SMRU generates the analysis which JNCC uses to produce the UK portion of the OSPAR assessment. The OSPAR Marine Mammal Expert Group (OMMEG) collate the inputs from the other OSPAR parties and combine with the UK portion to create the regional scale OSPAR assessment. The final OSPAR assessment data snapshot is published on ODIMS. JNCC extracts and analyses the UK-relevant data for the UK MS assessment.

4.2.2 Future development

At present the UK datasets for grey seal pup production are not uploaded to a MEDIN DAC. SMRU is currently considering which datasets would be the most viable and effective to make accessible.

Recently the military have been conducting observations of grey seal pups at Castlemartin Range in Pembrokeshire. These data (photo-monitoring and disturbance measurements) will likely feature in the SMRU internal database going forward.

Whole colony surveys have recently stopped for one of the four key east England colonies. SMRU has recently extended its breeding surveys to the east coast of England over two breeding seasons (2018 and 2021). Such surveys allow comparable pup production estimates across the main Scottish and English colonies (> 95% UK pup production), but their continuation is dependent on future funding.

4.2.3 Issues, gaps and missing or dysfunctional links

Variation in survey methods between monitoring in Scotland and the rest of the UK means that not all available data can be included in the pup production model which depends on aerial counts and is run on an individual colony basis. For areas which meet indicator data requirements ground-based pup production estimates can be used to estimate trends in pup production. As such, a number of pup surveys are not included in the indicator assessment. A comprehensive list of all formal seal monitoring surveys currently conducted across the UK, including information on survey methods and whether they are currently used in the UK MS (and OSPAR) indicator assessments, is provided in Table 1 of the Appendix.

5 Assumptions and limitations of paper

The dataflows described in this report are based on those used for the 2018 UK MS indicator assessments (HM Government 2019). However, where changes in the pathways have been implemented or where changes are expected for the next round of assessments, this has been described in the Future Development sections. Where possible, detail relating to specific assessment rounds has been removed from the dataflow diagrams to maximise their future applicability.

These seal indicators are also used for the NE Atlantic OSPAR assessments, with the outputs reworked and scaled for the UK MS assessments. The dataflows for these assessments are intertwined and therefore represented graphically as one flow diagram with both outputs. However, the focus of this report is on describing the flow into the UK MS assessments.

This report is focused on monitoring programmes conducted or commissioned by statutory bodies or external programmes which already have an established pathway into UK MS indicator assessments. There is additional seal monitoring ongoing throughout the UK, which is not currently included within UK MS indicator assessments. For example, monitoring conducted by citizen science, research institutes, Non-Government Organisations (NGOs) and various industries. This paper lists the organisations carrying out seal monitoring in the UK and that could potentially be used in the indicator assessments in the future but focuses on improving the dataflow for already established pathways into the UK MS assessment. The mapping of external data pathways and the exploration needed to determine the compatibility of individual external datasets with the seal indicators, is outside the scope of this paper.

This report focuses on the flow of data into the indicator assessments and not the indicator assessments themselves. Where missing links are identified, this could provide additional data for assessments. However, further exploration of data quality and compatibility would be required. The confidence, quality and coverage of data feeding into assessments is not included in the scope of this report.

This report and accompanying dataflow diagrams (see accompanying Annex) depict the flow of monitoring datasets and not the flow of associated metadata which may follow separate pathways.

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Appendix 1: Acronym list

Acronym	Definition
AU	Assessment Unit
BioDIG	Biodiversity Data and Information Group
CSIP	UK Cetacean Strandings Investigation Programme
DAC	Data Archiving Centre
DAERA	The Department of Agriculture, Environment and Rural Affairs in Northern Ireland
DAERA	Department of Agriculture, Environment and Rural Affairs (Northern Ireland)
DASHH	The Archive for Marine Species and Habitats Data
DEFRA	The Department for Environment, Food and Rural Affairs for UK and Northern Ireland
DOI	Digital Object Identifier
FAIR	Findable, Accessible, Interoperable and Reusable
GBIF	The Global Biodiversity Information Facility
GS	Grey Seal
HBDSEG	Healthy Biologically Diverse Evidence Group
HS	Harbour Seal
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
INCA	Industry Nature Conservation Association
JNCC	Joint Nature Conservation Committee
MCZ	Marine Conservation Zone
MEDIN	Marine Environmental Data and Information Network
MERMAN	Marine Environment Monitoring and Assessment National database
MME	Marine Mammal Ecology
MOAT	Marine Online Assessment Tool
MSFD	Marine Strategy Framework Directive
NBN	The National Biodiversity Network
NE	Natural England
NERC	The Natural Environment Research Council
NGO	Non-Governmental Organisation
NIEA	Northern Ireland Environment Agency
NRW	Natural Resources Wales
OBIS	Ocean Biodiversity Information System

Acronym	Definition
ODIMS	OSPAR Commission Data and Information Management System
OMMEG	OSPAR Marine Mammal Expert Group
OSPAR	Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic)
PID	Persistent Identifier
QA	Quality Assurance
QC	Quality Control
RSPB	The Royal Society for the Protection of Birds
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SCOS	Special Committee on Seals
SMRU	Sea Mammal Research Unit (University of St Andrews)
SNCB	Statutory Nature Conservation Body
UK	United Kingdom
UK MS	United Kingdom Marine Strategy
UKDMOS	UK Directory of Marine Observing Systems
UKMMAS	UK Marine Monitoring and Assessment Strategy
WG	Working Group
WoRMS	World Register of Marine Species
WT	Wildlife Trust
ZSL	The Zoological Society of London

Appendix 2: Seal monitoring surveys carried out in the UK per region

Table 1. Details of seal monitoring surveys, by species and survey metric, carried out per region of the UK (Adapted from OSPAR website, 2022), by species and survey metric. The * symbol denotes data utilised in the 2018 UK MS indicator assessments (HM Government 2019). (Acronyms used: DAERA – Department of Agriculture, Environment and Rural Affairs (Northern Ireland); INCA – Industry Nature Conservation Association; NE – Natural England; NERC – Natural Environment Research Council; NIEA – Northern Ireland Environment Agency; NRW – Natural Resources Wales; SMRU – Sea Mammal Research Unit; RSPB – Royal Society for the Protection of Birds; ZSL – Zoological Society of London.)

UK by region	**Harbour seals (all ages)** **August moult counts**	**Grey seals (all ages)** **Counts from August harbour seal moult surveys**	**Grey seals (pups)** **Pup production estimates derived from pup surveys** (no. of pups produced during breeding season)
Northern Ireland (funded by DAERA)	• *SMRU: single aerial survey ~ every 5 years. • NIEA, The Marine and Fisheries Division, National Trust: boat-based surveys, aim for six surveys for highest priority sites per year, including Strangford lough, Dundrum and Tyrella and Carlingford Lough.	• *SMRU: single aerial survey ~ every 5 years. • NIEA, The Marine and Fisheries Division, National Trust: boat-based surveys, aim for six surveys of highest priority sites per year, including Strangford lough, Dundrum and Tyrella and Carlingford Lough.	• NIEA, The Marine and Fisheries Division, National Trust: boat-based surveys, aim for six surveys of highest priority sites per year, including Strangford lough, Dundrum and Tyrella and Carlingford Lough.
South-west Scotland (funded by NatureScot, Marine Scotland and NERC)	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: single aerial survey ~ every 5 years.	• No formal monitoring as population very low.
West Scotland (funded by NatureScot, Marine Scotland and NERC)	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: repeat aerial survey, annual to 2010 biennial thereafter.

UK by region	**Harbour seals (all ages)** **August moult counts**	**Grey seals (all ages)** **Counts from August harbour seal moult surveys**	**Grey seals (pups)** **Pup production estimates derived from pup surveys** (no. of pups produced during breeding season)
Western Isles (funded by NatureScot, Marine Scotland and NERC)	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: repeat aerial survey, annual to 2010 biennial thereafter.
Orkney & North coast (funded by NatureScot, Marine Scotland and NERC)	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: repeat aerial survey, annual to 2010 biennial thereafter.
Shetland (funded by NatureScot, Marine Scotland and NERC)	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: ground count (some boat surveys), annual since 2004.
Moray Firth (funded by NatureScot, Marine Scotland and NERC)	• *SMRU: single, annual, aerial survey.	• *SMRU: single, annual, aerial survey.	• *SMRU: repeat aerial survey, annual to 2010, biennial thereafter.
East coast Scotland (funded by NatureScot, Marine Scotland and NERC)	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: single aerial survey ~ every 5 years.	• *SMRU: repeat aerial survey, annual to 2010, biennial thereafter.
North-east England (funded by NE and organisations carrying out surveys)	• *SMRU: single aerial survey ~ every 5 years. • INCA: Land counts in Tees Estuary.	• SMRU: single aerial survey ~ every 5 years.	• SMRU: repeat, aerial survey (2018 and 2021). • *National Trust: ground count, annual, at Farnes Islands.

UK by region	**Harbour seals (all ages)** **August moult counts**	**Grey seals (all ages)** **Counts from August harbour seal moult surveys**	**Grey seals (pups)** **Pup production estimates derived from pup surveys** (no. of pups produced during breeding season)
South-east England (funded by NE, NERC and organisations carrying out surveys)	• *SMRU: single/repeat, annual, aerial survey of Greater Wash and Donna Nook. • *ZSL and SMRU: single / repeat, aerial/boat/land surveys, of Thames ~ at least every 2 years.	• *SMRU: single/repeat, annual, aerial survey of Greater Wash and Donna Nook. • *ZSL and SMRU: aerial/boat/land surveys, of Thames ~ at least every 2 years.	• *SMRU: repeat, aerial survey (2018 and 2021). • *Lincolnshire Wildlife Trust: ground count, annual, at Donna Nook. • *National Trust: ground count, annual, at Blakeney Point. • *Friends of Horsey Seals: Ground count, annual, at Horsey. • No breeding in the Thames.
South England (funded by NE and organisations carrying out surveys)	• Langstone Harbour Board and Chichester Harbour Conservancy: annual land/boat-based surveys since 2015 in the Solent.	• Langstone Harbour Board and Chichester Harbour Conservancy: annual land/boat-based surveys since 2015 in the Solent.	• No formal monitoring.
South-west England (funded by NE and additional organisations)	• None/few harbour seals	• Cornwall Seal Group Research Trust: land and boat-based surveys, ad hoc, at five main areas: North Devon, Lundy (Managed by Lundy Company), Cornwall, Isles of Scilly and South Devon.	• Cornwall Seal Group Research Trust: land and boat-based surveys, ad hoc at five main areas: North Devon, Lundy (Managed by Lundy Company), Cornwall, Isles of Scilly and South Devon.
North-west England (funded by NE and organisations carrying out surveys)	• Cumbria Wildlife Trust at South Walney Nature Reserve: aerial/land/vessel surveying.	• Cumbria Wildlife Trust at South Walney Nature Reserve: aerial/land/vessel surveying.	• Cumbria Wildlife Trust at South Walney Nature Reserve : aerial/land/vessel surveying.

UK by region	**Harbour seals (all ages)** **August moult counts**	**Grey seals (all ages)** **Counts from August harbour seal moult surveys**	**Grey seals (pups)** **Pup production estimates derived from pup surveys** (no. of pups produced during breeding season)
North Wales (funded by NRW and organisations carrying out surveys)	• No systematic surveys for harbour seals. None/very few.	• Hilbre Bird Observatory: Hilbre Island. • Bardsey Island Trust: Bardsey Island from 2009. • NRW: North Wales wide surveys (land/vessel) 2001, 2002 to 2003 (Westcott 2002; Westcott & Stringell 2004). • Some sites are surveyed more frequently but this is not dedicated monitoring and so cannot be relied upon for assessments.	• NRW: North Wales wide breeding surveys (land/vessel) 2001, 2002 to 2003 (Westcott 2002; Westcott & Stringell 2004). • Ocean Ecology commissioned by NRW: North Wales wide breeding surveys (land/vessel) 2017. • Bardsey Island Trust: Bardsey Island. • Some sites are surveyed more frequently but this is not dedicated monitoring and so cannot be relied upon for assessments.
West Wales (funded by NRW and organisations carrying out surveys)	• No systematic surveys for harbour seals. None/very few.	• RSPB: Ramsey Island • NRW MCZ staff and Welsh Wildlife Trusts: Skomer MCZ	• RSPB: Ramsey Island. • NRW MCZ staff and Welsh Wildlife Trusts: Skomer MCZ, Pembrokeshire Coast National Park. • NRW: West Wales wide surveys (land/vessel) conducted in 1992, 1993 and 1994 (Baines *et al.* 1995).
South Wales (funded by NRW and organisations carrying out surveys	• No systematic surveys for harbour seals.	• No systematic surveys as very few grey seals.	• No systematic surveys as very few grey seals.

Appendix 3: Summary of data portals

Table 2. Amended from (Sinclair 2022). Description of existing public database or portal that may in the future or already does receive seal data from key sector (public, charity, industry and academia) organisations and individual data recorders in the UK data landscape.

Scottish / UK database or portal	Description of system purpose and niche	Sector contribution
DASSH **(Archive for marine species and habitats data)** **UK Data Archive Centre**	**Purpose:** DASSH operates as the archive for marine biodiversity data. It provides tools and services for the long-term curation, management and publication of marine species and habitats data, within the UK and internationally (e.g. EurOBIS, EMODNet). DASSH is a key provider of marine data to the NBN. **How it differs from other systems:** DASSH has well established links between UK and International marine data systems, which other UK databases and portals, such as NBN, do not have. DASSH archives fully attributed data, while only summary data is available through the NBN. DASSH supports both marine species and habitats data. DASSH, as a DAC, has a very flexible database structure and is able to receive data from many different sources and in multiple formats, whereas Marine Recorder has a strict database structure and can only accept data in that format. DASSH fulfils the niche well as a data archive and data disseminator, Marine Recorder fulfils the niche as a data management system.	All sectors
ICES **Global Portal**	**Purpose:** The ICES data portal is separated into several thematic portals focused on the marine environment including benthic and pelagic biota as well as oceanographic and pressure data. Data in the ICES data portal are collected for the purpose of aiding assessments of expert groups and regional sea conventions. The ICES data portal has a web-based user-interface which provides a suite of tools which help visualise and calculate data products. Data held in ICES data portal contributes to OSPAR CEMP, ICES stock assessments and AMAP contamination assessments. **How it differs from other systems:** The ICES data portal focuses on the ICES regions and providing data for specific assessments.	All sectors

Scottish / UK database or portal	Description of system purpose and niche	Sector contribution
OSPAR Biodiversity Portal (Seals) **(Housed within the ICES Global Portal)**	**Purpose:** The Biodiversity Portal for seals sits within the ICES data portal. The database hosts seabird and seals abundance and distribution records. The portal assembles data supplied by contracted parties to OSPAR and the ICES area. The ICES data portal has a web-based user-interface which provides a suite of tools which help visualise and calculate data products. The database is covered by the ICES data policy. **How it differs from other systems:** It is specifically purposed to supporting OSPAR and providing the information needed to feed into biodiversity regional assessments.	Seals and seabirds
OSPAR ODIMS **Global Portal**	**Purpose:** The OSPAR Data and Information System (ODMIS) is an online tool providing a single point of access to all the data and information gathered through OSPAR's Joint Assessment and Monitoring Programme across the different thematic work areas of the Convention. It will help ensure that data is readily accessible for OSPAR assessments, but also help a broad range of users to find data held by OSPAR, to facilitate access to it and make use of it. **How it differs from other systems:** ODIMS is focused on the OSPAR regions and includes data from different aspects related to Ocean health which include information on benthic species but also on offshore industry, hazardous Substances, environmental impact of human activity, etc. It is specifically designed to hold data for OSPAR assessments.	All Sectors