Identifying locations considered to be least damaged/more natural in Scotland’s seas

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Executive summary

Sustainable Seas for All recommended a number of broad policy approaches that should be followed in developing an ecologically coherent network of MPAs in Scotland’s seas. This included identifying locations considered to be least damaged/more natural (LDMN) to examine what ecological value they could contribute to the development of the network. The Scottish MPA Selection Guidelines will be applied to those locations identified as being LDMN before being applied more widely. The purpose of this report is to describe how existing marine activities data have been used to identify the locations considered to be LDMN in Scotland’s seas.

The marine activities data used to produce the LDMN data layer came from a wide range of sources, including the Scottish Government co-funded data layers contract MB106, Marine Scotland’s State of Scotland’s Seas Atlas, and work with national stakeholders. A sensitivity matrix developed by MarLIN was used to identify the pressures to which MPA search features are sensitive. Another matrix was used to identify which activities were linked to these pressures. The collated marine activities data were used along with information on pressure footprints (the extent of pressure being exerted beyond the area over which an activity occurs) was applied where available. Layers were produced for each pressure theme and aggregated together to map the extent of pressures occurring in Scotland’s marine environment. The inverse of this aggregated pressure layer was taken to produce an initial LDMN data layer, to which a set of principles were applied to rationalise the layer into a series of discrete locations.

Following revision of the layer based on a stakeholder workshop and consultation exercise on the provisional LDMN locations, a total of 31 LDMN locations were identified across all Scottish MPA regions. The greatest numbers of LDMN locations were located in the Far West Scotland MPA region, which represented a range of deep sea environments including banks, seamounts and sedimentary plains and basins. This was followed by the West MPA region, which comprised largely of sea lochs and locations wholly in territorial waters. The South West MPA region had three LDMN locations - two bays and one sea loch. The North MPA region had the fewest LDMN locations, one representing a large extent of the Faroe-Shetland Channel and another relatively smaller area north-east of Fair Isle.

A more detailed analysis of the biodiversity value of LDMN locations and the contribution they could make to the MPA network is still to be undertaken and will be reported on elsewhere. However, an initial assessment suggests approximately two thirds of the habitat MPA search features in territorial waters are potentially well represented by the LDMN locations, but the types of places are similar to those already included within the MPA network e.g. intertidal areas, sea lochs, estuaries and islands. Therefore, the types of features present in these LDMN locations e.g. seagrass beds, horse mussel beds, blue mussel beds and maerl beds are those which may already be afforded protection. However, large-scale features, low or limited mobility and mobile MPA search features have generally not been recorded within the LDMN locations, with the exception of ocean quahog.

Within offshore waters, LDMN locations cover a range of deep sea environments to the far west and north of Scotland. These include sediment plains and basins, seamounts, bank features and channels. The known distribution of approximately three-quarters of the MPA search features in offshore waters are potentially well represented by the LDMN locations. The majority of these features are habitats, most notably coral gardens and carbonate mound communities. The exception to this is burrowed mud. In contrast, large scale features and limited or low mobility features such as fan mussel, ocean quahog and northern feather star aggregations are not well represented. However, spawning aggregations of mobile species such as blue ling are relatively well covered, as are point records of mobile species such as orange roughy.
The approach has made best use of existing national datasets and knowledge to enable LDMN locations to be identified in Scotland’s seas. Provision of additional information by stakeholders has supported the finalisation of the LDMN locations to which the MPA Selection Guidelines will be applied. An understanding of the potential contribution of the LDMN locations to the network will assist in the development of an ecologically coherent network of MPAs in Scotland’s seas.
1. **BACKGROUND**

The Marine (Scotland) Act (2010) and the UK Marine and Coastal Access Act (2009) include new powers and duties to designate Nature Conservation Marine Protected Areas (MPAs) to protect biodiversity and geodiversity considered to be of importance in Scotland’s seas.

Sustainable Seas for All\(^1\) recommended a number of broad policy approaches that should be followed in developing an ecologically coherent network of MPAs. This included identifying locations considered to be least damaged/more natural to see what they could contribute to the development of the network. This report describes and presents the work that has been done to implement this approach.

2. **PURPOSE OF THIS REPORT**

The purpose of this report is to describe how existing marine activities data have been used to identify the areas considered to be least damaged/more natural prior to application of stage 1 of the Scottish MPA Selection Guidelines\(^2\).

3. **THE APPROACH**

To identify the areas considered to be least damaged/more natural (LDMN) it was first important to understand the extent to which marine activities influence their surrounding environment. Marine habitats and species are sensitive to pressures that may or may not be associated with activities. One of the first steps therefore was to identify which activities may be associated with those pressures that affect marine features of conservation interest.

3.1. **Assessing MPA search feature sensitivity to pressures**

A report has been produced by MarLIN that presents an assessment of the sensitivity of marine features of conservation interest to physical, chemical and biological pressures. The sensitivity assessments were made using information from the MarLIN sensitivity assessment work\(^3\), along with expert knowledge from stakeholders and scientific experts. The sensitivity assessments for each feature were made against a defined pressure intensity, referred to as a benchmark. The matrix produced provides a sensitivity assessment score for each feature alongside a confidence score. The sensitivity assessment was based on an assessment of the feature’s resistance (tolerance) and resilience (recovery) to a given pressure (for more information please see Tillin et al. 2010).

This work has been furthered by scientific experts to complete sensitivity assessments for all listed MPA search features in line with the methodology undertaken for the MarLIN report. Each pressure category comprises a number of pressures, each of which has an associated pressure benchmark. The pressure categories and their associated benchmarks included in the LDMN work are presented in Annex A. There were some pressure categories identified in the MarLIN report that were not included in the LDMN work. These included climate change related pressures (e.g. pH change, temperature change at a regional/national scale).

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\(^1\) SSfA was published in 2008 and set out the Scottish Government’s proposals for sustainable management of the marine environment and proposals for the Scottish Marine Bill.

\(^2\) The final Scottish MPA Selection Guidelines are available under the following link: [http://www.scotland.gov.uk/Topics/marine/marine-environment/mpanetwork/mpaguidelines](http://www.scotland.gov.uk/Topics/marine/marine-environment/mpanetwork/mpaguidelines)

\(^3\) [http://www.marlin.ac.uk/sensitivityrationale.php](http://www.marlin.ac.uk/sensitivityrationale.php)
which were removed because they are not spatially explicit i.e. the presence of a coastal power station does not mean that area is of greater exposure to climate change pressures than any other). Litter was also removed as a pressure because there was not enough information on marine locations where this could be an issue and its sources. Whilst it is recognised that these pressures could be an issue for some of the MPA search features e.g. cetacean data were not available to support their inclusion in this broad based assessment. Additionally, pelagic trawling, purse seining and drift netting were also excluded from the analysis because the majority of MPA search features were not determined to be sensitive to these activities and their associated pressures. We noted that the cetacean MPA search features may be sensitive to these activities but it was found that other activities and their associated pressures removed areas where pelagic trawling, purse seining and drift netting are known to be occurring.

3.2. Associating pressures with activities

As part of the MarLIN work, the activities thought to cause the benchmark level of the pressures outlined in Annex A were summarised into a pressure-activities matrix by JNCC and Natural England in consultation with key industry groups. This matrix was modified by JNCC and SNH to reflect what we know of activities within Scottish waters. This matrix, and the sensitivity assessment work, was combined to create a final matrix that provides:

i. A sensitivity assessment for each MPA search feature against the pressure benchmarks;
ii. An assessment of the activities thought to be related to each pressure benchmark.

The activities thought to be associated with each pressure of relevance to the selection of MPAs are presented in Annex B. An understanding of which pressures MPA search features are sensitive to, and the activities associated with those pressures, formed the basis for identifying locations in Scotland’s seas considered to be least damaged/more natural.

3.3. Collating activities data to produce pressure maps

The next step was to collate marine activities data to provide information on the extent of pressures occurring in Scotland’s seas. Information was collated from a Scottish Government co-funded data layers contract known as MB106\(^4\), Marine Scotland’s State of Scotland’s Seas Atlas\(^5\), and work with national stakeholders to verify and collate additional activities data. The data used to construct the LDMN data layer is introduced in Section 4 and more thoroughly outlined in the summary data tables provided in Annex C.

3.4. Considering the footprints of activities

When considering the use of activities data to produce pressure maps, we felt that it was important to represent what was known about the potential wider effects of activities occurring in the marine environment i.e. effects which may extend outwith the area over which activities are undertaken. This would allow us to represent the pressure footprint of an activity. For example, the discharge from a sewage disposal pipe is likely to be associated with pressures that cover a wider area than the area covered by the disposal pipe. Furthermore, an activity may have a different size of footprint associated with it depending on the pressure being considered. For example, a wellhead might have a 500 m\(^2\) footprint

\(^4\) MB106 was a contract which set out to collate the range of primary activities occurring in the UK maritime area http://randd.defra.gov.uk/Document.aspx?Document=MB0106_10042_FRP.pdf

\(^5\) Available from http://www.scotland.gov.uk/Publications/2011/03/16182005/0
for the pressure structural abrasion (both as a result of the physical presence of the wellhead and activities associated with it), but the footprint is unlikely to be the same for other pressures associated with wellhead drilling such as synthetic compound contamination.

Eastwood et al. (2007) estimated the physical footprint for some activities occurring in the UK offshore marine environment as a proxy for direct, physical pressure. This was based on expert knowledge and industry practice and resulted in the production of a series of activity footprints. This, along with other relevant and available studies (e.g. Benn et al. 2010) and expert advice, has been used to identify pressure footprints where applicable. It is important to note that some of the activities data we collated does not have spatial data associated with it, i.e. points and polyline data. We have used the studies highlighted above and expert judgement to assign footprints where possible, but for others this information was not available. The information used to produce each pressure layer and whether or not activity extent/pressure footprint information was available is presented in Annex D and more specifically alongside each data type in Annex C. Where information on physical extent/pressure footprint was not available this information was used for context when interpreting the locations considered as LDMN. A summary of this information in presented in Annex E.

3.5. Developing the least damaged/more natural data layer

The Scottish MPA Selection Guidelines highlight that the guidelines will be applied to those locations identified as being least damaged/more natural before being applied more widely. Figure 1 illustrates the steps involved in developing the LDMN data layer6 with a description of each step provided as a summary below:

**Step 1 Assign marine activities to associated pressure(s)**

This was done in accordance with the activities-pressures associations presented in Annex B. It is important to note that some activities were excluded from the process at this stage on the grounds that they do not generally interact with MPA search features (excluding cetaceans). These activities were pelagic trawling and purse seining and drift netting. The pressure radionuclide contamination was excluded at this stage because none of the MPA search features were deemed to be sensitive to the pressure benchmark level as defined in Annex A. The pressure 'introduction of microbial pathogens (disease)' was also removed at this stage as it specifically relates to native oyster microbial pathogens and there are a very limited number of farms in Scotland.

**Step 2 Assign physical extent and pressure footprints to marine activities**

The purpose of this step was to represent the extent of the pressure the activity is exerting on the marine environment to enable the pressure layers to be produced in Step 3. The physical extent and pressure footprint information used for associated activities data are presented in Annex C. Where we could not find evidence to support the addition of physical extent or pressure footprint information to point or polyline data, then the data has not been included in the development of the LDMN data layer. However these data have been retained for context when interpreting the LDMN locations and are presented in Annex E.

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6 A technical note of the process used to produce the least damaged/more natural data layer in ArcGIS is provided in Annex F
Step 3  Produce individual pressure layers from processed marine activities data

In this stage by ‘processed’ we mean marine activities data that has had physical extent/pressure footprint information assigned to it. The datasets which fed into the production of each pressure layer and whether or not this information had a physical extent and/or pressure footprint associated with it are presented in Annex D.

Step 4  Produce an aggregated pressure layer from individual pressure layers

Once all individual pressure layers had been produced, they were aggregated to produce a single layer representing the extent of pressures to which MPA search features are sensitive to

Step 5  Extract the inverse of the aggregated pressure layer to identify the locations considered to be least damaged/more natural

To identify the locations considered to be LDMN, the inverse of the aggregated pressure layer produced at Step 4 was extracted. The resulting layer is presented and discussed in Figure 2 and Section 5.1 respectively.

Step 6  Examine overlap between least damaged/more natural locations and MPA search features and wider biodiversity interests to identify potential benefits to the MPA network

The last step in the process was to assess the contribution LDMN locations could make to the development of the network. The initial results are presented in the LDMN location profiles supplementary report but the full assessment in terms of the contribution these locations could make to the MPA network will be reported on elsewhere.
Figure 1 Flow chart illustrating the development of the least damaged/more natural data layer

**Step 1** - Assign marine activities to associated pressure(s)

**Step 2** – Assign physical extent and pressure footprints to marine activities

**Step 3** – Produce individual pressure layers from processed marine activities data

**Step 4** – Produce an aggregated pressure layer from individual pressure layers

**Step 5** – Extract the inverse of the aggregated pressure layer to identify the areas considered to be least damaged/more natural

**Step 6** – Examine overlap between least damaged more natural locations and MPA search features and wider biodiversity interests to identify potential benefits to the MPA network

Legend
- Land
- Example MPA search feature records
- Example activities
- Example physical extent/pressure footprint
- Example pressure layers
- Example least damaged/more natural area
4. THE DATA

4.1. Data included in the least damaged/more natural data layer

The marine activities data which helped produce the LDMN data layer have come from a wide range of sources as described previously in Section 3.3. A summary of the data is provided in Annex D and the data summary tables presented in Annex C. The latter is intended to provide an overview of which sector-specific data were used and how the data were treated prior to inclusion.

The sections that follow summarise the scope, source and known limitations of the data used in producing the least damaged/more natural data layer and have been set out in accordance with the broad sector-specific data groupings in Annex C.

4.1.1. Coastal development and infrastructure

Data under this group includes information on activities such as waste disposal (discharges, dumping grounds), coastal infrastructure such as marinas, ports and harbours, and activities occurring close to or at the coastal zone such as navigational dredging, aquaculture and recreational boating. Data sources under this group were largely national organisations and advisory bodies such as Scottish Environment Protection Agency, Marine Scotland Science and Cefas. Physical extent and/or pressure footprint information for data in this group were not available in some cases, such as for ports, marinas and harbours, coastal power plants and coastal quarrying sites. Consequently although this data did not contribute to the production of the LDMN data layer it was used as context in its interpretation. The full extent of data sets that were treated in this way is presented in Annex E.

4.1.2. Primary marine industries

Data under this group includes information on activities carried out by national or international organisations in Scotland’s seas, such as oil and gas exploration, military activities, telecommunications and power cable laying and renewable energy developments. As a starting point, data representing these activities were taken from the data layers contract as described in Section 3.3 and were subsequently verified and updated through close liaison with representative stakeholder organisations such as Oil and Gas UK, Ministry of Defence, the UK Cable Protection Committee and The Crown Estate.

4.1.3. >15 m fishing vessel activity

Data on >15 m vessel fishing activity includes aggregated effort data from 2006 to 2009 estimated from UK and non-UK VMS data. All data have been split by principal gear types\(^7\). VMS data were supplied through the MMO and DEFRA and was speed filtered and anonymised by Cefas. The resolution of the grid cells representing VMS data are 2 x 2 nautical miles.

Aggregated VMS data from vessels active beyond British Fishery Limits from 2002 to 2006 were also used and were supplied by the North East Atlantic Fisheries Commission (NEAFC). Due to data quality issues it was not possible to identify either gear type or flag state from the information provided, nor could we divide the data between steaming and

\(^7\) Gear type for UK vessels has been linked to skipper logbook information. For non-UK registered vessels where logbook information is not available, gear type is based on the ‘primary gear’ listed on the EU fleet register (http://ec.europa.eu/fisheries/fleet/index.cfm?method=Search.menu).
fishing activity because the data were transmitted without information on vessel speed. As a result, it has not been possible to identify areas of bottom contact gear fishing activity with any degree of confidence in areas beyond British Fishery Limits.

Given these issues, we worked on the assumption that areas of high vessel aggregation are likely to be the best indicators of fishing activity. Where possible, we used the concentration of vessels/VMS pings and landings data (by ICES sub-division) to help identify areas of potential demersal fishing effort. As each data grid represented an area of approximately 50km² we only considered grids where there were more than 10 vessels/10 VMS pings (~2 per year) per grid. This was done to decrease both the risk of picking up vessels that were steaming and the risk of missing areas where there has been historic fishing effort.

4.1.4. <15 m fishing vessel activity

There are no national datasets relating to activity of fishing vessels <15 m around Scotland. This is an issue not just for the selection of MPAs but for wider marine management. Marine Scotland has established the ScotMap project, but results were not available to support creation of the LDMN data layer and so a pragmatic approach was taken to make best use of existing data (see section on <15 m vessel activity in Annex C). This involved individually reviewing locations that had been provisionally identified as LDMN to take account of knowledge of activity of <15 m vessels. For areas covered by fishery orders under the Inshore (Scotland) Fishing Act, these were noted with the relevant restrictions. For areas not covered by fishery orders, the review involved consideration of data created through a range of projects as well as discussion with Marine Scotland Science and other stakeholders. The data relating to <15 m fishing activity are presented in Annex E and were used as contextual data rather than being incorporated into the aggregated pressure layer used to create the LDMN data layer.

4.2. Contextual information not included in layer development

The LDMN data layer was produced with a view to representing only those activities known to occur in Scotland’s seas. It does not include information on planned activities which are going to take place in the future, nor those areas which may be of interest for future development. However, we have considered this information when interpreting the locations considered to be LDMN. A summary of this contextual information is provided in Annex E.

4.3. Data peer-review

On 8th June 2011, a workshop was held with national stakeholder representatives to discuss and further verify the activities data being used to underpin the development of the LDMN data layer, as well as to review initial locations identified as LDMN.

A summary of data-specific actions by sector are provided in Annex G with a commentary on whether or not these actions are short-term, i.e. in the context of the LDMN work, or longer-term, i.e. for the benefit of the Scottish MPA Project more generally. Additional data which has fed into finalisation of the LDMN data layer have been included in the relevant annexes of this report.
5. THE LEAST DAMAGED/MORE NATURAL DATA LAYER

5.1. Initial analysis

From the initial analysis potential LDMN locations were identified to varying degrees across all MPA regions, with the size of areas typically larger offshore compared to territorial waters (Figure 2). This is a reflection of our understanding of where and how Scotland’s seas are used and the scale of the information used to construct the layer. The locations largely appear as pixilated blocks due to the format of the predominant data type feeding into production of the layer being 2x2 nm fishing vessel VMS grid cells.
Figure 2 Initial least damaged/more natural data layer showing all locations identified from the analysis
5.2. Rationalisation of the initial least damaged/more natural data layer

To help standardise review of the initial LDMN data layer a set of criteria to rationalise the areas being taken forward as LDMN were developed and applied. The criteria were as follows:

- Single VMS grid cells in isolation were removed from further consideration as these were considered too small in terms of applying the MPA Selection Guidelines.
- Removal of areas which overlapped with high levels of known existing activity not incorporated into the production of the layer e.g. <15 m fishing vessel activity, ports, harbours.
- Removal of areas which were largely intertidal because of issues relating to scale and/or issues relating to the resolution of the data. This also applied to some areas that consisted of very thin coastal strips. Those that were adjacent to larger, subtidal areas were retained.
- Removal of areas which were heavily divided e.g. subdivisions of some sea lochs by fishing activity and of parts of the North Sea by oil and gas activity.
- Some of the larger, offshore areas were subdivided using large-scale units such as basins and/or a common bathymetry.

Annex H lists the nine areas, all within territorial waters, that were removed from further consideration at this point together with the reasons why they were removed. Note that areas removed because they comprised a single grid cell (or part of one) or very small intertidal areas are not listed. The reasons why these areas were removed were largely because they were too small and/or on further review of known activities were considered unlikely to be LDMN.

Figure 3 shows the provisional LDMN locations following application of the above criteria that were presented to stakeholders at the LDMN workshop in June 2011.

5.3. Finalising the least damaged/more natural data layer

On 8th June 2011, a workshop was held with national stakeholder representatives to review the initial locations identified as LDMN. A summary of sector-specific comments relating to the LDMN locations presented in Figure 3 are provided in Annex I. Where appropriate, comments have been used to adjust, remove or add LDMN locations ahead of the analysis being finalised. The decisions made as a result of these comments against the provisional LDMN locations are fully documented in Annex J.

Figure 4 shows the final LDMN locations. Those locations coloured blue represent the full extent of the final LDMN locations. Those locations coloured grey represent locations which have been removed from consideration as LDMN locations either as a result of stakeholder comments/consideration of additional data or as a result of re-applying the same principles outlined in Section 5.2. A summary of the final LDMN locations by Scottish MPA region are provided in Section 5.4 and a series more detailed individual location profiles in the supplementary report.
Figure 3 Potential least damaged/more natural locations in Scotland’s seas that were presented to stakeholders at the least damaged/more natural workshop
Figure 4 Final least damaged/more natural locations in Scotland’s seas
5.4. Summary of least damaged/more natural locations by MPA region

5.4.1 East MPA region

The East MPA region contains six LDMN locations (Figure 5). Two of the locations, St Andrew’s Bay, Tay and Eden estuaries, and Dornoch Firth, are completely within territorial waters. The other four locations are completely within offshore waters – one of which lies close to Montrose and Marr Banks and three of which lie further offshore.

*Figure 5 Least damaged/more natural locations in the East MPA region*
5.4.2 North MPA region

The North MPA region contains two potential LDMN locations (Figure 6). The Faroe-Shetland Channel lies completely in offshore waters to the north of the MPA region and the other lies to the northeast of Fair Isle in territorial waters.

*Figure 6 Least damaged/more natural locations in the North MPA region*
5.4.3 West MPA Region

The West MPA region contains nine LDMN locations – all of which lie in territorial waters (Figure 7). Seven sea lochs have been identified, all of which occur on the west coast. The two remaining LDMN locations in the region are around or close to islands (South-west Tiree including Skerryvore and West Islay and Loch Indaal).

Figure 7 Least damaged/more natural locations in the West MPA region
5.4.4 South West MPA region

The South-west MPA region contains three LDMN locations (Figure 8). There are two, relatively small, coastal areas at Wigtown Bay and Mersehead Sands and one in a sea loch in the Clyde Sea – the southern area of Loch Long.

Figure 8 Least damaged/more natural locations in the South West MPA region
5.4.5 Far West MPA Region

The Far West MPA region contains eleven LDMN locations and represents the greatest number and largest identified in Scotland’s seas (Figure 9). The LDMN locations identified in this region represent a range of deep sea environments including seamounts (Anton Dohrn); sedimentary basins and plains (Rockall Trough, areas adjacent to George Bligh Bank, and the Hatton-Rockall and Icelandic Basins), and bank features (Hatton Bank).

Figure 9 Least damaged/more natural locations in the Far West MPA region
5.5. Relationship between least damaged/more natural locations and other work

A number of LDMN locations overlap with existing protected areas including Sites of Special Scientific Interest, Special Areas of Conservation and Special Protection Areas. Alongside work on LDMN locations, JNCC and SNH are undertaking an analysis of the contribution that could be made by these existing protected areas to the MPA network. This will help prioritise existing protected areas (including those which overlap with LDMN locations) to determine which could make the greatest contribution to the MPA network.

Some of the LDMN locations overlap with proposed offshore wind and wet renewable developments. These locations remain in the LDMN data layer as the assessment is based on the current status of the locations. Future planned developments will be considered as the subsequent stages of the guidelines are applied to those LDMN locations with the potential to make a contribution to the MPA network.

Some of the LDMN locations overlap with Areas of Search for inshore and offshore aggregation Special Protection Areas. Both pieces of work are still at an early stage. There will be continued liaison to ensure that there is join-up in the discussions and decision-making.

6. ASSESSING THE LIKELY CONTRIBUTION OF LEAST DAMAGED / MORE NATURAL LOCATIONS TO THE MPA NETWORK

There are a number of LDMN locations for which there is limited biodiversity information and so it has been difficult to assess the contribution that they might make to the MPA network. A more detailed analysis of the final LDMN locations will be undertaken, not only of the MPA search features that are likely to be present but also of other marine biodiversity and geodiversity interests. This should include, for example, areas which serve a wider functional role such as nursery or spawning areas. The results of this analysis and the potential contribution these locations can make to the MPA network will be reported on in due course. The following sections give an overview of the potential contribution from an initial review of the locations and the MPA search features present within them.

6.1. Potential contribution within territorial waters

Within territorial waters, the types of locations that have been identified as least damaged/more natural are similar to those already included within the MPA network e.g. intertidal areas, sea lochs, estuaries and islands covered by Special Areas of Conservation, Special Protection Areas and Sites of Special Scientific Interest. Therefore, the types of features that are likely to be present in these areas are those which may already be afforded protection.

The known distribution of approximately two thirds of habitat MPA search features are potentially well represented by the LDMN locations. These are largely intertidal habitats (e.g. seagrass beds and sea loch egg wrack beds) or relatively shallow subtidal habitats (e.g. horse mussel beds, blue mussel beds and maerl beds). However, the distribution of the other habitat MPA search features is not well reflected. These can be grouped as those that are found in similar types of places as those identified as LDMN but whose distribution does not overlap (e.g. flameshell beds and native oysters) and those where there is an overlap but only in places considered to be on the edges of the habitats’ main extent and distribution (e.g. burrowed mud, maerl or coarse shell gravel with burrowing sea cucumbers and shallow tide-swept coarse sands with burrowing bivalves).
The low or limited mobility MPA search features have generally not been recorded within the areas identified as LDMN. The exception to this is the ocean quahog which appears to be fairly frequently recorded within the locations. The mobile species MPA search features\(^8\) show a similar picture. Generally in territorial waters the locations identified as LDMN do not overlap with areas known to be used by mobile species although there are some exceptions. They are also generally considered too small in relation to areas known to be used by the mobile species to be likely to provide a conservation benefit.

In terms of the large-scale features, the known fronts do not overlap with the LDMN locations. For shelf banks and mounds and shelf deeps, whilst there is some overlap, the LDMN locations largely lie outwith the main range and distribution of these features.

In summary, within territorial waters the LDMN locations have the greatest potential to deliver benefits for some of the habitat MPA search features including blue mussel beds, horse mussel beds and tide-swept algal communities amongst others. Generally, these are the intertidal or shallow sublittoral habitats found in nearshore waters. There are a small number of records/small overlap in distribution between the LDMN locations and the low mobility and mobile species (with the exception of ocean quahog which appears to be quite generally distributed). The same applies to the large-scale features. Further, more detailed assessment of some of the data relating to these features and/or new survey work may reveal a greater potential to deliver benefits than this initial analysis suggests.

**6.2. Potential contribution within offshore waters**

Within offshore waters, LDMN locations cover a range of deep sea environments to the far west of Scotland. These include sediment plains and basins (such as the Hatton-Rockall Basin and Rockall Trough), seamounts (such as Anton Dohrn), bank features (such as Hatton Bank) and channels (such as the Faroe-Shetland Channel). Some of these locations overlap with Special Areas of Conservation designated for biogenic reef, as well recognised Areas of Search for Special Areas of Conservation. Others overlap with fisheries closures which have been designated to protect Vulnerable Marine Ecosystems such as corals and sponges. The off-shelf environment to the north of Scotland is also well represented by the Faroe-Shetland Channel LDMN location, with the least representation being shelf features in the east MPA region.

The known distribution of approximately three-quarters of the MPA search features in offshore waters are potentially well represented by the LDMN locations. The majority of these features are habitats, most notably coral gardens and carbonate mound communities. In contrast, limited or low mobility features such as fan mussel, ocean quahog and northern feather star aggregations are not represented. In offshore waters, spawning aggregations of mobile species such as blue ling are relatively well covered, as well as point records of mobile species such as orange roughy. Although most habitat MPA search features are potentially well covered, it is worth noting that burrowed mud is not.

With regards to large scale features, there is some overlap with shelf banks and mounds and shelf deeps, however the majority of the known distribution of these features fall outside of LDMN locations. Fronts are not represented within any of the LDMN locations in offshore waters, however our understanding of the types of fronts and their spatial distribution in Scotland’s seas is still under development. Sections of the continental slope do overlap with the Rockall Trough LDMN location, as do parts of the Anton Dohrn seamount.

\(^8\) NB Black guillemot have not been included in this analysis because work for this species in terms of development of the MPA network is focussed firstly on identifying the contribution that could be made by existing protected areas.
In summary, within offshore waters LDMN locations have the greatest potential to deliver benefits for a moderate number of habitat MPA search features. Generally these opportunities in the Far West and North MPA regions. It is worth noting that the majority of LDMN locations in the Far West and North MPA regions are also of geodiversity interest. The Faroe-Shetland Channel LDMN location in the North MPA region in particular contains or borders combinations of MPA search features, some of which are considered to be unique in the UK context, for example there are some records of deep sea sponge aggregations in this LDMN location. As such, the area may make an important contribution to the development of the Scottish MPA network. Low or limited mobility MPA search features such as ocean quahog are not considered to be well covered by LDMN locations. However, this may be an artefact of low survey effort for both ocean quahog and all limited or low mobility MPA search features in offshore waters.

7. DISCUSSION

7.1. The approach

The approach used to identify locations considered to be least damaged/more natural relies on linking activities to pressures and making an assessment of the likely interaction between those pressures and MPA search features. The approach has merit in that it enabled us to make a more accurate assessment of the locations considered to be LDMN according to the activities and their associated pressures relevant to the MPA search features. In particular, we sense-checked which pressures the MPA search features were sensitive to and the likely coincidence between the activities associated with those pressures and the MPA search features.

The two main disadvantages of the method are that it does not make any assessment of intensity or of cumulative effects, both of which are important in determining what the effect of an activity/activities are likely to be on MPA search features in a given location. The inclusion of these would have made the assessment process overly complex, particularly given the purpose and scale of the LDMN locations. They also would have added a greater level of uncertainty to the results, particularly in relation to cumulative effects which are relatively poorly understood. However, the intensity of activities should be considered when more detailed discussions take place in relation to specific locations at later stages (particularly stages 3, 4 and 5) in the application of the MPA Selection Guidelines.

7.2. Data collation and review

An intensive process of data collation and review was undertaken to support the identification of LDMN locations in Scotland’s seas. The focus of the data collation exercise was on national datasets that enabled spatial assessments of the extent of particular activities to be made. The exercise was effective in that a large number of activity datasets were collated from a range of different organisations and reflected a broad range of activities known to take place in Scotland’s seas. There were two main issues relating to data collation: firstly, that for some activities there were no available national datasets and, secondly, some of the activities which were mapped at a national scale did not have any associated spatial extent information.

In terms of activities not covered by national datasets, the most obvious of these is a lack of data on activity of the <15m fishing fleet. This is recognised as a significant gap but something which was beyond the scope of the LDMN work to address. The ScotMap pilot currently underway in the Pentland Firth and around Orkney will provide the type of data that is required, however the timescales for the roll-out of ScotMap are beyond those of the
LDMN work. Therefore a pragmatic approach was taken in that potential LDMN locations were identified and then discussed with Marine Scotland Science and others to make best use of existing knowledge of fisheries activity in those locations. Other activities for which there are known gaps in datasets available at a national scale include recreational activities. Discussions with representative organisations have helped to provide contextual information. For those activities which were mapped at a national scale but for which no spatial extent had been recorded, this information on activities was taken into consideration when interpreting the LDMN locations i.e. it was used to provide context rather than contributing directly to the production of the LDMN data layer.

There should be more detailed consideration of activities that have not been mapped at a national scale (including those which are mapped but which do not have a spatial extent), particularly during the application of stages 3, 4 and 5 of the MPA selection guidelines, including for recreational and <15m fishing activity.

### 7.3. Application of the methodology

Section 3.5 and Figure 1 describe the six-stage process used to develop the LDMN data layer from the available activities datasets. The advantage of the process is that there is transparency in the links made between the different activity datasets, through the pressure layers to the aggregated pressure layers and eventually to the LDMN data layer (as an inverse of the aggregated pressure layers).

The main challenge in creating the pressure layers was in understanding the pressure footprints likely to be associated with specific activities. For some, such as oil and gas infrastructure and subsea cables, pressure footprints were agreed based on a review of the primary literature and through consultation with industry experts. For many activities, however, it was not possible to define pressure footprints beyond the known extent of those activities. This meant that in some cases the physical extent was used as a proxy for the pressure footprint. For others, the results of detailed analysis/modelling work carried out by others were used as a proxy for the pressure footprint. For example, Category 1 and 2 areas from the locational guidelines\(^9\) were used as a proxy for the footprints for finfish farming. These are considered to provide a good representation of the likely extent of pressure footprints although it is acknowledged that in some places they may represent an overestimate of the pressure extent.

### 8. CONCLUSIONS

The approach has made best use of existing national datasets and knowledge to enable LDMN locations to be identified in Scotland's seas. The national stakeholder workshop held as part of this piece of work gave us the opportunity to discuss those locations provisionally identified as LDMN with stakeholders. Provision of additional information by stakeholders has supported the review and finalisation of the LDMN locations to which the MPA Selection Guidelines will be applied. Applying the MPA Selection Guidelines first to LDMN locations enables the Scottish MPA Project to meet the commitment made through Sustainable Seas for All. Whilst there are some limitations on what these locations might contribute to the MPA network, this approach enables us to prioritise the wider application of the MPA Selection Guidelines.

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\(^9\) Locational guidelines apply to finfish farms in Scottish sea lochs. Water bodies are designated as category 1, 2 and 3 areas on the basis of Marine Scotland Science (MSS) predictive models to estimate environmental sensitivity of sea lochs, based on combined nutrient enhancement and benthic impact indices (http://www.scotland.gov.uk/Topics/marine/Fish-Shellfish/18716/guidance)
Guidelines by helping identify remaining MPA search feature gaps in the development of the ecologically coherent network of MPAs in Scotland’s seas. A more detailed analysis of LDMN locations will be undertaken, not only of the MPA search features that are likely to be present but also of other marine biodiversity and geodiversity interests. The results of this analysis and the potential contribution these locations can make to the MPA network will be reported on in due course.

9. REFERENCES


10. GLOSSARY OF TERMS AND ACRONYMS

AA EQS ......................... Annual Average Environmental Quality Standard
ArcGIS .......................... A suite of Geographic Information System (GIS) software products produced by ESRI
DEFRA .......................... Department for the Environment, Food & Rural Affairs
Exposure ......................... The degree to which marine habitats and species overlap with pressures
Footprint ......................... The extent to which a pressure influences the underlying environment
HSE ............................... Health and Safety Executive
ICES ............................. International Council for the Exploration of the Sea
IFGs ............................... Inshore Fisheries Groups
JNCC ............................. Joint Nature Conservation Committee
LDMN ............................. Least damaged/more natural
MarLIN ........................... Marine Life Information Network
MESH ............................. Mapping European Seabed Habitats project – Multinational consortium lead by JNCC (2004-2008) to create a structure to collate and improve habitat maps at a national level, contributing in turn to the compilation and aggregation of marine habitat data at an international level.
MMO .............................. Marine Management Organisation
MoD ............................... Ministry of Defence
NEAFC ........................... North East Atlantic Fisheries Commission
SEPA ............................. Scottish Environment Protection Agency
SHETL ............................. Scottish Hydroelectric Transmission Limited
SNH ............................... Scottish Natural Heritage
PELs ............................... Permissible Exposure Limits
Pressure ......................... A force acting upon the marine environment
Pressure benchmark ........ A defined intensity at which a pressure is exerted
RYA ............................... Royal Yachting Association
Sensitivity ....................... The degree to which species or habitats are resilient and resistant to pressure
SAC ............................... Special Area of Conservation as designated under the European Habitats Directive.
SPA ............................... Special Protection Area as designated under the European Birds Directive.
SSSI ...................... Site of Special Scientific Interest designated under the Wildlife and Countryside Act 1981.

UK SeaMap ................. UK project designed to produce a new seabed habitat map for the UK marine area. UK SeaMap is based on a predictive mapping approach using available physical and biological data. The project builds on previous work to develop predictive habitat models, particularly UKSeaMap 2006 and the MESH project.

VMS.......................... Vessel Monitoring System - a near real-time, usually satellite based, positional tracking system for fishing vessels