

Condition

Assessment 2019

Strangford Lough Part 2 Area
of Special Scientific Interest
(ASSI) and Intertidal Special
Area of Conservation (SAC)



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Document version control		
Version	Date	Comments
Version 0.1	01/03/2017	Initial draft
Version 0.2	09/08/2018	Additions and amendments
Version 0.3	12/02/2019	Review
Version 1.0	26/09/2022	Signed off
Version 2.0	11/10/2022	DAERA Website

Cover photograph: Granagh Bay intertidal rock

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This report should be cited as:

Alvarez Alonso, C. and Stewart-Moore, S. Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC) Condition Assessment 2019. Department of Agriculture, Environment and Rural Affairs. September 2022.

Acknowledgements:

Many people have contributed to this report. Those who have made substantial contributions to the text have been listed as authors.

The authors would like to thank the following people who contributed to the report and/or have provided support and data:

CEDaR, Joe Breen, Colin Armstrong, Nuala McQuaid, Aoibheann Morrison, Dawn Diamond, Philip Stewart, Claire Young, Susan McCambridge, Gillian Annett, Trevor Harrison, Liz Pothanikat, and Tim Mackie of DAERA and Julia Nunn.

Contents

Summary	6
Background	10
Methodology	12
Condition monitoring and assessment	12
Intertidal survey 2016	14
Site integrity monitoring	16
Water Framework Directive (WFD) water body monitoring and status assessment 16	
Site condition monitoring and assessment: 2016 ASSI and SAC intertidal survey	18
Audley’s Castle Rocks	18
Survey details	18
Site description	18
Survey date.....	18
ASSI features assessed	18
Results.....	19
Site condition assessment	21
Bar Hall Bay	22
Survey details	22
ASSI features assessed	22
Results.....	22
Site condition assessment	26
Granagh Bay.....	27
Survey details	27
ASSI features assessed	27
Results.....	28
Site condition assessment	31
WFD water body monitoring and condition assessment	31
Uses and activities information and condition assessment	32
Discussion	33
Condition assessment.....	33
Species	36

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Biotopes and communities	38
Intertidal mudflats and sandflats and sub-features.....	39
Enhanced compliance checks and mitigation to protect against accidental discharges, chemical pesticide pollution and proper drainage plans should be considered to improve the WFD classification of Strangford Lough North and ultimately to protect against diffuse run off that may be affecting mudflats and sandflats.	39
Coastal saltmarsh	39
Intertidal rock and underboulder communities	40
PMFs	40
Non-native species	41
Conclusion	42
Recommendations	44
ANNEX 1 (condition assessment tables)	47
ANNEX 2 (species lists).....	56
ANNEX 3 (biotopes)	72

Figures

Figure 1 ASSI boundary for Strangford Lough Part 2 within the SAC boundary	10
Figure 2 Current habitat map of the intertidal are and seal haulout locations in Strangford Lough Part 2 ASSI.....	11
Figure 3 Sites surveyed for 2016 site condition assessment of Strangford Lough Part 2 ASSI and WFD in Strangford Lough South coastal water body	17
Figure 4 Audley’s Castle Rocks 2016 survey location	18
Figure 5 General photos of Audley’s Castle Rocks showing (a) top of shore lichen-dominated bedrock, (b) upper shore <i>Fucus spiralis</i> and <i>Pelvetia canaliculata</i> on mixed substrata, (c) lower shore dominated by <i>Ascophyllum nodosum</i> and <i>Fucus vesiculosus</i> and (d) kelp-dominated boulders at the bottom of the shore.....	19
Figure 6 Species-rich underboulder communities on lower shore at Audley’s Castle Rocks	20
Figure 7 Bar Hall Bay 2016 survey location.....	22
Figure 8 North, East, South and West facing photos taken at Bar Hall Bay in 2016	23
Figure 9 General condition photos taken at Bar Hall Bay in 2016	23
Figure 10 General photos of Bar Hall Bay intertidal rock zone in 2016 showing (a) lichen-dominated bedrock on the upper shore, (b) limpet and barnacle communities on upper/mid shore bedrock and rockpools, (c) <i>Ascophyllum nodosum</i> and (d) <i>Fucus serratus</i> dominated shore.....	24
Figure 11 Position of transect line and biotopes surveyed at Bar Hall Bay.....	26
Figure 12 Granagh Bay 2016 survey location	27

Figure 13 General north, east, south and west facing photos taken at Granagh Bay in 2016 28

Figure 14 The rock zone at Granagh Bay in 2016 showing (a) lichen-dominated upper shore, (b) upper/mid-shore furoid and *P. canaliculata* bands, (c) *Ascophyllum nodosum* zone on lower shore and (d) kelp-dominated sublittoral fringe 29

Figure 15 Position of transect line and biotopes surveyed at Granagh Bay 30

Figure 16 Diversity index and taxonomic evenness compared to previous years (1968-2012)..... 36

Figure 17 Total number of species recorded compared to previous years and taxonomic types recorded 37

Tables

Table 1 Strangford Lough Part 2 ASSI and intertidal SAC summary results..... 9

Table 2 List of marine interest features on Audley’s Castle 18

Table 3 Audley’s Castle condition assessment..... 21

Table 4 List of marine interest features on Bar Hall Bay 22

Table 5 Bar Hall Bay condition assessment..... 26

Table 6 List of marine interest features on Bar Hall Bay 27

Table 7 Granagh Bay condition assessment 31

Table 8 WFD 2018 interim classification for Strangford Lough (South) water body . 31

Table 9 Feature condition assessment of designated features in Strangford Lough Part 2 ASSI 34

Table 10 Strangford Lough ASSI Part 2 and intertidal SAC site condition assessment and number of biotopes and species recorded between 2013 and 2018 35

Table 11 Comparisons with existing species data (1968-2013)..... 36

Table 12 Species missing and species recorded for the first time in this reporting cycle (monitoring years 2013-2018) 37

Table 13 Comparisons with existing biotope data (1968-2013) 38

Table 14 Recommendations and suggested actions for Strangford Lough Part 2 ASSI and the overlapping intertidal area of the SAC..... 44

ANNEX 1 Tables

Table 1.1 Strangford Lough Part 2 ASSI – Intertidal mudflats and sandflats – Condition assessment table 47

Table 1.2 Strangford Lough Part 2 ASSI – Intertidal rock and underboulder communities – Condition assessment table 51

ANNEX 2 Tables

Table 2.1 Total number of species and type of species recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC 56

Table 2.2 Diversity indexes changes 57

Table 2.3 List of species/genera recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC 57

Table 2.4 List of PMF species NOT recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC..... 70

Table 2.5 List of non-native species NOT recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC 70

Table 2.6 List of PMF species NEWLY recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC 71

Table 2.7 List of non-native species NEWLY recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC 71

ANNEX 3 Tables

Table 3.1 Total number of biotopes and type of PMF habitats recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC 72

Table 3.2 Biotopes recorded between 2013-2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC 73

Table 3.3 List of PMF biotopes NOT recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC..... 76

Table 3.4 List of PMF biotopes NEWLY recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC 77

Summary

The Marine and Fisheries Division within the Department of Agriculture, Environment and Rural Affairs (the Department) has responsibility for designation, monitoring and management of Marine Protected Areas (MPAs) that have been designated under the Marine Act (Northern Ireland) 2013, The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended), The Conservation (Natural Habitats, etc.) (Amendment) (Northern Ireland) (EU Exit) Regulations 2019 and The Environment (Northern Ireland) Order 2002.

This work area contributes towards obligations under international and national policy and legislation, including the Convention on Biological Diversity (CBD), the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and the Bern Convention.

The Department carries out a rolling programme of MPA surveillance, monitoring and reporting every six years in support of The Conservation (Natural Habitats, etc.) Regulations 1995 (Northern Ireland) (as amended)¹ (Habitats Directive at the time of this assessment)², The Environment (Northern Ireland) Order 2002³ and The Marine Act (Northern Ireland) 2013⁴. Monitoring and assessing the condition of the ecological features of individual sites will enable relevant authorities and agencies to adapt management measures accordingly to ensure conservation objectives are achieved. Achieving ‘favourable condition’ on individual sites will also make an important contribution to achieving favourable conservation status across the MPA network⁵.

Joint Nature Conservation Committee (JNCC) guidance states that the features that are to be monitored are the interest features for which the site has been notified or designated. They include habitat types, species and complex features such as habitat mosaics and species assemblages. Each interest feature must be identified, monitored, assessed and reported upon separately.

- [Common Standards Monitoring - Introduction to the Guidance Manual \(jncc.gov.uk\)](https://jncc.gov.uk)⁶.

Monitoring and assessment of the condition of the interest features of individual sites will enable relevant authorities and agencies to adapt management measures accordingly to ensure conservation objectives are achieved. Achieving ‘favourable condition’ on individual sites will make an important contribution to achieving

¹ [The Conservation \(Natural Habitats, etc.\) Regulations \(Northern Ireland\) 1995 reporting](#)

² [Habitats Directive reporting](#)

³ [The Environment \(Northern Ireland\) Order 2002 reporting](#)

⁴ [Marine Act \(Northern Ireland\) 2013 reporting](#)

⁵ [Assessing Conservation Status: The UK Approach](#)

⁶ [JNCC, \(2004\), Common Standards Monitoring Guidance for Marine, Version August 2004, ISSN 1743-8160](#)

favourable conservation status across the UK national site network (Emerald network) and MPA network.

The Conservation Objectives contain details of the attributes (measurable targets such as extent/range of habitat/species, diversity/species composition of habitats etc.) for each interest feature within the site: the condition assessment determines the condition status of each interest feature when compared against relevant feature attributes.

Condition monitoring and assessment of the designated features of Strangford Lough Part 2 ASSI and the overlapping intertidal SAC was delivered through targeted intertidal surveys carried out by the Department at three sites during April and May 2016, along with other recent available evidence and expert judgement.

The sites, positions and methodologies used in each intertidal SAC/ASSI survey were selected to enable comparison and ground-truthing of primary features evidence from previous surveys and assessments; however, on some occasions these were adapted due to weather conditions or other *in situ* matters. Sites previously identified by the baseline surveys, Northern Ireland Littoral Survey (NILS), carried out in the 1980s, were used when possible. These surveys were carried out along transect lines from the upper to lower shore at each site.

Furthermore, information from Site Integrity Monitoring (SIM) surveys and surveillance, the Department's WFD water body monitoring programmes and other biological surveys in the area within the reporting cycle are available in Marine Recorder⁷ were also taken into account in order to assess the condition of the designated features.

The results of the Strangford Lough Part 2 ASSI and corresponding intertidal area of the SAC assessment are summarised in the Table 1. The condition assessments of subtidal features within the SAC and other intertidal areas overlapping ASSI Part 1 and 3 are assessed separately in the following documents:

- [Strangford Lough Subtidal Special Area of Conservation \(SAC\) Condition Assessment 2019](#)
- Strangford Lough Part 1 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC) Condition Assessment 2019
- Strangford Lough Part 3 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC) Condition Assessment 2019

All designated intertidal habitats were deemed to be in favourable condition in Strangford Lough ASSI Part 2 and the overlapping intertidal area of Strangford Lough SAC.

⁷ [Marine Recorder](#)

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

A total of **17 Northern Ireland (NI) Priority Marine Features (PMFs)** were recorded across Strangford Lough Part 2 ASSI. These included **five PMF habitats**: coastal saltmarsh, intertidal underboulder communities, intertidal mudflats, sheltered muddy gravels and tide-swept channels and **12 PMF species**: the egg wrack *Ascophyllum nodosum* var. *mackayi*, Devonshire cup coral *Caryophyllia (Caryophyllia) smithii*, European lobster *Homarus gammarus*, the cushion star *Asterina phylactica*, northern starfish *Leptasterias (Leptasterias) muelleri*, smelt *Osmerus eperlanus*, grey seal *Halichoerus grypus*, common seal *Phoca vitulina*, king scallop *Pecten maximus*, queen scallop *Aequipecten opercularis*, variegated scallop *Mimachlamys varia* and chiton *Tonicella marmorea*.

Nine non-native species were also recorded: oyster thief *Colpomenia peregrina*, Japanese wireweed *Sargassum muticum*, hook weed *Bonnemaisonia hamifera*, green sea fingers *Codium fragile atlanticum*, worm wart weed *Gracilaria vermiculophylla*, saltmarsh cordgrass *Spartina anglica*, sea-squirt *Corella eumyota*, sand gaper *Mya arenaria* and the barnacle *Austrominius modestus*.

Several anthropogenic activities with the potential to adversely impact the listed features were recorded in the intertidal area: litter, chemical, urban sewage and unregulated shellfish collection. The [pressures](#) associated with these activities may pose a threat to the designated features and, therefore, it should be monitored closely. Further [sensitivity](#) and [vulnerability assessments](#) are suggested to be able to assess the risk of damage to the habitats and inform management. No significant damage to the designated features, from anthropogenic activities, was identified in Strangford Lough Part 2 ASSI to date.

The following **recommendations** are suggested for Strangford Lough Part 2 ASSI and the overlapping intertidal SAC:

- continued monitoring, assessment and reporting of the MPA and feature condition, including NI PMFs occurring at the different sites;
- continued integrity monitoring, management and enforcement of on-site activities;
- further development and refining of the Strangford Lough seabed habitat map on the intertidal area;
- further sensitivity and vulnerability assessments to determine the risk of damage to the habitats from existing activities;
- continued monitoring and management of levels of litter;
- continued monitoring and management of unregulated shellfish harvesting;
- continued monitoring and management of non-native species;

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

- targeted survey work on the saltmarsh between High Water Mark (HWM) and Low Water Mark (LWM) to establish baseline of extent; and
- improvement of WFD classification within the SAC.

Table 1 Strangford Lough Part 2 ASSI and intertidal SAC summary results

ASSI Features	SAC Features	Condition Assessment		
		2002-2007	2008-2013	2014-2019
Intertidal mudflats and sandflats	Mudflats and sandflats not covered by seawater at low tide	Favourable	Not assessed	Favourable
Intertidal rock and underboulder communities	Reef	Favourable	Not assessed	Favourable
Common seal (Harbour seal)	<i>Phoca vitulina</i>	Favourable	Not assessed	Unfavourable - Declining (Reported within condition assessment for entire SAC)

Background

Strangford Lough Part 2 ASSI was designated on the 12th April 1989. This ASSI is located in the southern end of the lough, encompassing the narrow entrance, known locally as the ‘Narrows’, where tidal flows reach 7.5 knots during Spring tides (Figure 1 **Error! Reference source not found.****Error! Reference source not found.**). This ASSI covers an area of 700 Hectares.

Strangford Lough Part 2 ASSI comprises intertidal foreshore with a range of soft sediment and rocky substratum. Soft sediments within the ASSI range from clean sandy mud to extensive soft mudflats and muddy sand, an example of which is found at Bar Hall Bay. Bar Hall Bay is also one of the places where natural transitions from mudflat and saltmarsh to freshwater fen, maritime heath and scrub are evident.

Strangford Lough Part 2 ASSI also encompasses a number of sheltered bedrock and boulder shores, which support diverse assemblages of flora and fauna. Granagh Bay in particular has the complete range of substrates, occurring within a relatively

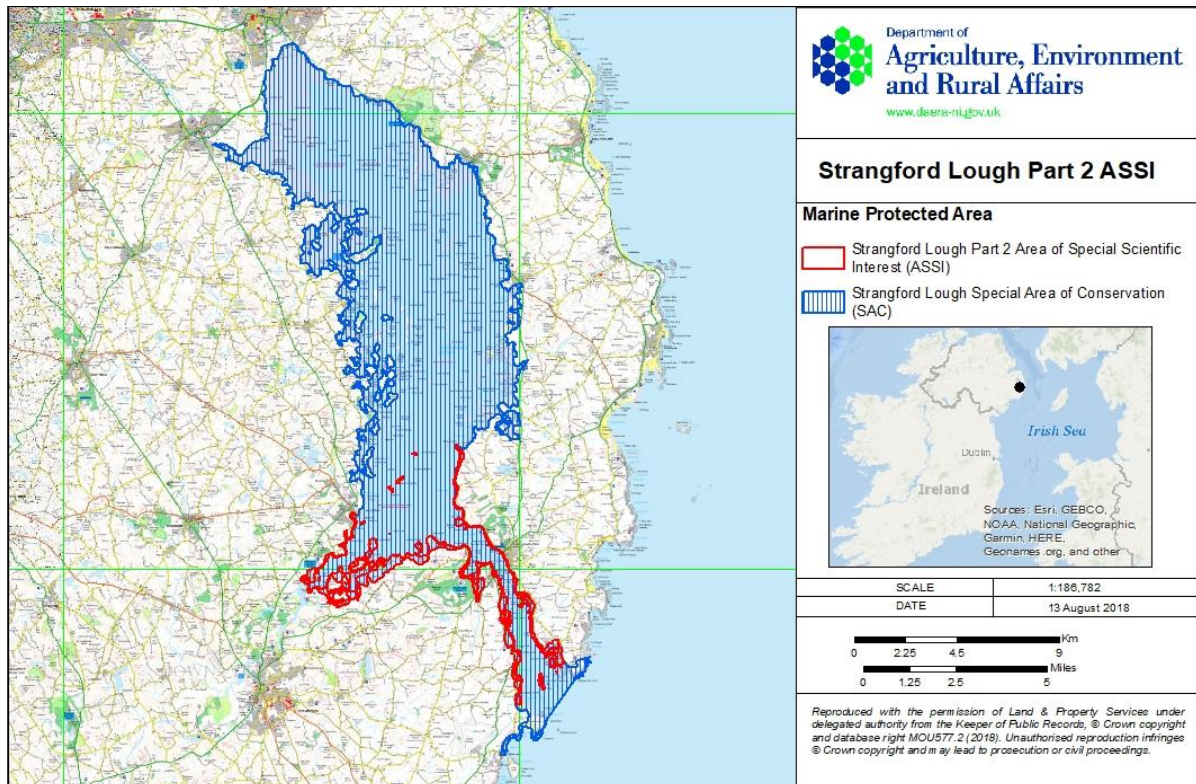


Figure 1 ASSI boundary for Strangford Lough Part 2 within the SAC boundary confined area.

Many phyla are represented within Strangford Lough Part 2 ASSI. This high species richness is attributed to the range of physiological features and tidal variations resulting from the immense tidal flow through the Strangford Narrows. There is a high diversity of sea anemones within the ASSI, including *Corynactis viridis*, for which Strangford Lough is at the northern extreme of their range. The extensive mudflats within the ASSI support dense communities of burrowing organisms such

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

as the bivalve mollusc *Macoma balthica* and the amphipod *Corophium volutator*, while the muddy sand at Bar Hall Bay supports a large population of *Lanice conchilega*.

Strangford Lough Part 2 ASSI was designated based on the following primary marine features (Figure 2):

- Intertidal mudflats and sandflats
- Intertidal rock and under-boulder communities
- Common seal (harbour seal)

Strangford Lough SAC includes the following designated marine features with components on the intertidal area overlapping with the ASSI:

- Annex I: Mudflats and sandflats not covered by seawater at low tide
- Annex I: Reef
- Annex II: *Phoca vitulina*

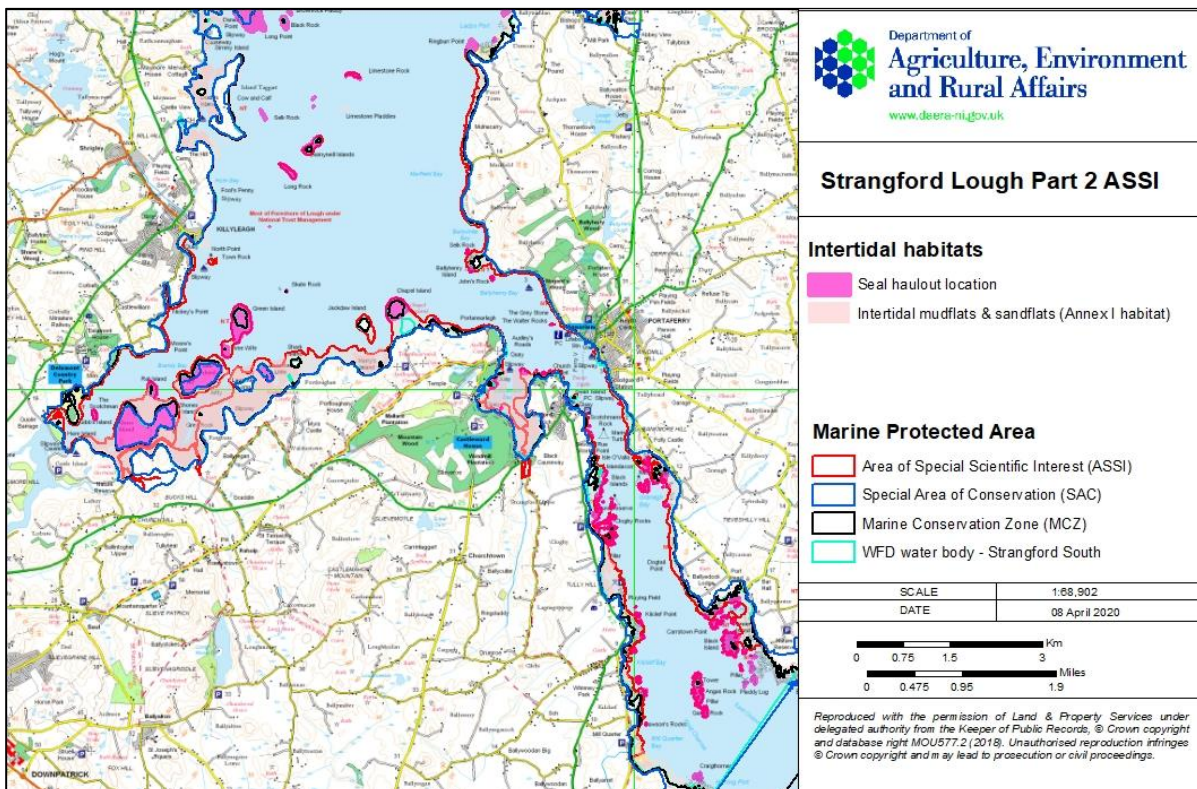


Figure 2 Current habitat map of the intertidal are and seal haulout locations in Strangford Lough Part 2 ASSI

Further information on Strangford Lough SAC designation⁸, Strangford Lough Part 2 ASSI citation⁹ and conservation objectives¹⁰ can be found on the [Department's website](#).

Additionally, Strangford Lough was re-designated as Northern Ireland's first Marine Conservation Zone (MCZ) on the introduction of the Marine Act (Northern Ireland) 2013.

As part of the monitoring and management of Strangford Lough SAC, MCZ and ASSI by the Department, these features and subsequent sub-features require assessment to ensure that they are maintained in favourable condition.

Methodology

Condition monitoring and assessment

Site condition monitoring and assessments are interpretations of the condition of a site at a particular point in time based on quantitative field observations, available evidence and expert judgement. The assessment is made on the targets and attributes provided in ANNEX 1 (condition assessment tables). The condition assessment for the 2014-2019 reporting period is based on habitat and species data gathered between the 2013-2018 monitoring period, with 2019 as the reporting year. This evidence includes data collected by the Department during the targeted 2016 intertidal ASSI and SAC monitoring and condition assessment surveys, along with any additional information in the intertidal area available in Marine Recorder⁷ gathered between 2013 and 2018. These included other various habitat surveys carried out by the Department, CEDaR surveys, Ulster Wildlife, Seasearch etc. For this assessment, the biotope and species data extracted from Marine Recorder⁷ was restricted to the ASSI boundary. Although some intertidal records are georeferenced as lying outside the ASSI boundary limits (but within the SAC boundary) they still represent designated intertidal habitat features within both MPAs. However, if they have not been included in the ASSI assessment, they have been included in the SAC assessment. Until polygons of the designated features (intertidal rock, mudflats) are available especially where these extend beyond the ASSI boundary, there are caveats in the data that has been available for the current assessment.

The information gathered was compared to data collected by the NILS from 1984 to 1986, the Strangford Lough Ecological Change Investigation (SLECI)¹¹ survey (2004-2005) and the subsequent condition assessments completed by the

⁸ [Strangford Lough SAC Reasons for Designation](#)

⁹ [Strangford Lough Part 2 ASSI citation](#)

¹⁰ [Strangford Lough SAC and ASSI Conservation objectives](#)

¹¹ [Strangford Lough Ecological Change Investigation \(SLECI\) \(2004\)](#)

Department in 2007 along with any other readily available data from previous reporting cycles.

In order to assess the condition of the ASSI and the overlapping intertidal area of the SAC, focus was directed on the key marine elements (primary attributes) of each designated feature as detailed in the Strangford Lough SAC conservation objectives (Error! Reference source not found.).

Aerial photographs obtained through the Northern Ireland Environment Agency (NIEA) Emergency Response to Coastal Oil, Chemical and Inert Pollution from Shipping (EROCIPS) Coastal Survey 2006, Ordnance Survey Northern Ireland (OSNI) vector maps and georeferenced aerial photographs known as orthophotographs provided by Land Property Service (LPS) were also considered in this assessment.

The sites selected for condition assessment monitoring were based on the historical presence of key features or quality indicators such as PMFs, characteristic species, communities and representative biotopes identified during previous surveys or studies. The three sites within the Strangford Lough Part 2 ASSI, surveyed in 2016 by the Department as part of the intertidal designated sites monitoring and condition assessment programme, are shown in **Error! Reference source not found..**

The methodology used for monitoring the condition of selected sites followed generic advice provided by the Joint Nature Conservation Committee (JNCC) including the 'Common Standards Monitoring' (CSM) guidance¹², the Marine Monitoring Handbook (MMH)¹³, Monitoring guidance for marine benthic habitats¹⁴ and relevant OSPAR recommendations.

Community and biotope richness is an important attribute for measuring the condition of the habitat features. The objective is to ensure that the key biotopes and representative species (and particularly PMF features) characterising communities of conservation importance have been retained in the ASSI and intertidal area of the SAC and evidence of such retention is accepted as an indicator of favourable condition. It is considered that recording the presence/absence of a selection of key biotopes ([Marine Habitat Classification](#) for Britain and Ireland), indicator species and PMFs, and their relative abundance at the site, is a practical and appropriate proxy measurement for the total number of species and habitat types in the area, providing a snapshot of the intertidal communities of the MPAs. All biological records gathered in 2016 were submitted to Marine Recorder⁶.

¹² [Common Standards Monitoring Guidance for Marine 2004](#)

¹³ [Marine Monitoring Handbook 2001](#)

¹⁴ [Monitoring guidance for marine benthic habitats](#)

Information of any anthropogenic uses, activities, pressures or disturbance which may have implications for the site and/or with regard to activities laid out in the schedule of the ASSI citation was also considered in this assessment.

JNCC CSM⁶ guidance states that interest features are assessed using one of the following four condition categories. These are all common standards:

- **Favourable:** Condition objectives are being met;
- **Unfavourable:** Condition objectives are not being met;
- **Partially destroyed:** The feature, habitat or processes essential to support it have been removed or irretrievably altered. A condition assessment should be carried out on the remaining, intact feature; and
- **Destroyed:** The interest feature, its supporting habitat or processes, have been affected (completely or partially) to such an extent that there is no hope of recovery.

The JNCC has listed the following trend qualifiers which were previously considered part of the common standards as optional, which the Department may choose to use as required:

- **Favourable – maintained:** The conservation objectives which were met at the previous assessment are still being met;
- **Favourable – recovered:** The interest feature has gained favourable condition, having been previously recorded as unfavourable;
- **Favourable – declining:** All targets are being met, but identified pressures indicate that unfavourable condition will result if these pressures are left unaddressed;
- **Unfavourable – recovering:** The interest feature has begun to show, or is continuing to show, a trend towards favourable condition;
- **Unfavourable - no change:** The interest feature is unfavourable but neither declining nor recovering; and
- **Unfavourable – declining:** The interest feature is declining as a consequence of damaging activity, but where recovery is possible, either spontaneously or if suitable management input is made.

Intertidal survey 2016

Sedimentary sites

The shore at each site was walked from the upper littoral fringe to the low water mark. Different zones were recorded along a transect line using a handheld TRIMBLE GPS and within each zone PMFs, key biotopes and representative species were identified, recorded and backed up with photographs, then later compared to those which were expected to occur based on data from previous surveys.

Quantitative sampling was carried out to assess the abundance of representative species. This included core and quadrat sampling, both of which were restricted to the lower shore at each site.

At each site, five quadrats were set randomly along the lower shore, photographed and the location recorded. Within each quadrat the percentage cover of *Zostera* spp. and opportunistic green algae (OGA) was estimated and the number of cockles, sand mason worms *Lanice conchilega* and lugworm *A. marina* casts were counted. Where possible, the abundance of species ([SACFOR](#)) within each quadrat was recorded, although sometimes species lists were restricted to presence/absence.

Three core samples were also collected randomly along the lower shore and processed in the lab, using a 0.002m³ handheld cylinder core (as opposed to the NILS and SLECI surveys which used 0.01m³ and 0.025m³ cores respectively). The specimens from core samples were sieved using a 0.5 mm sieve, fixed in 4% buffered formalin and species were later identified, quantified and preserved in 70% ethanol. The smaller core used in this survey, following WFD criteria and guidance, may lead to reduced species counts compared to those recorded in previous years. It was, therefore, considered that only a significant increase or decrease in species quantities would indicate an impact, or spatial variability of the habitat. The depth (mm) of the anoxic layer was also measured using a ruler and where available compared to the depth recorded in previous NILS findings and expected range values according to the CSM guidance but was also taken as a baseline for comparison with future monitoring programmes. A significant increase and/or deviation from the expected values of the anoxic layer depth are considered an indicator of a shift in the organic material supply to the littoral sediment. This could lead to a feature being assessed as unfavourable due to the associated reduction of species richness.

Aerial photography from the NIEA survey was used to assess the extent of the features of interest. An attempt was also made to take general condition photographs in each zone, facing north, east, south and west to allow direct comparison with past (and future) surveys. Moreover, the extent and mapping of the mudflats and sandflats in Strangford Lough Part 2 ASSI were digitally mapped by remote sensing in 2018. The latest OSNI post-positional vector polygons and lines describing the MLWM and MHWM were overlaid with all of the orthophotography layers from 2012-2017 (or most recent available). All intertidal and littoral fringe, such as saltmarsh habitat, seagrass and *Sabellaria*, spatial data was overlaid to provide groundtruthing. The orthophotographs with the lowest tide were selected or where it was clear that the images were not captured at low tide, the mean low water vector line was used as a proxy. Then the intertidal mudflats were digitised zooming in to resolution scale 1:400, between the low and high water marks. Any rock or other habitats that were not mudflat-sandflat data, identifiable from these images or the groundtruthing data, were then erased (using ArcGIS geoprocessing tool) from the polygon.

Additionally, data on *Zostera* spp was gathered from the site condition intertidal surveys and compared with data from surveys conducted by the Department as well as data from the 2003 NIEA and Quercus baseline study on the distribution of *Zostera* spp.NI.

Rocky shores

A similar approach to sedimentary sites was taken for monitoring rocky shores. The shore was walked from the upper shore to the sublittoral fringe, along which separate zones were identified and the key biotopes and species were recorded within each. The biotope composition and representative species were compared with what was expected to occur based on the results from previous surveys. Where possible, the location of separate zones and biotopes were recorded using the handheld TRIMBLE GPS. Additionally, aerial photography and general condition photography at different zones were used to assess the extent of the features.

Site integrity monitoring

Other ongoing monitoring efforts, such as the Department's site integrity monitoring, risk based and surveillance surveys, have also contributed to gather scientific evidence on listed features and their condition during the 2014-2019 reporting period of time in Strangford Lough.

Water Framework Directive (WFD) water body monitoring and status assessment

In addition to the targeted intertidal monitoring for designated sites, the latest relevant WFD water body assessments (2018) were used to inform the condition assessment of the MPA.

Under the WFD, Strangford Lough is divided into two coastal water bodies, Strangford Lough (North) and Strangford Lough (South). The WFD assesses the ecological status and chemical status of water bodies and these assessments are used to provide an overall surface water status. In coastal water bodies ecological status is determined using a number of biological quality elements including phytoplankton, macroalgae, angiosperms, and benthic invertebrates; additional supporting quality elements such as dissolved oxygen levels, nutrients (dissolved inorganic nitrogen), specific chemical pollutants, and hydromorphology; high impact invasive species are also assessed. Each biological quality element is classified into one of five classes ('bad', 'poor', 'moderate', 'good', 'high') based on its degree of deviation from expected conditions. Supporting quality elements are typically classified into three ('moderate', 'good', 'high') classes. Ecological status is then assessed as the worst classification of all the biological and supporting quality elements. Chemical status is assessed through the monitoring of a suite of identified hazardous substances and the results are classified into two ('good' and 'less than good') classes. Ecological status and chemical status are used to provide an overall

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

surface water status classification, which is the lowest of the two status assessments.

WFD monitoring stations that are relevant for this assessment, can be seen in Figure 3. All WFD assessments for the different biological quality elements (seagrass, macrophytes etc.) are classified according to the Ecological Quality Ratio (EQR)¹⁵ score, defined by the WFD and use different sampling methodologies (refer to the Common Implementation Strategy for the Water Framework Directive (2000/60/EC¹⁶)). When possible, layers (extent) and data were clipped to the relevant ASSI polygon in order to inform the features condition assessments (e.g. seagrass or macroalgae).

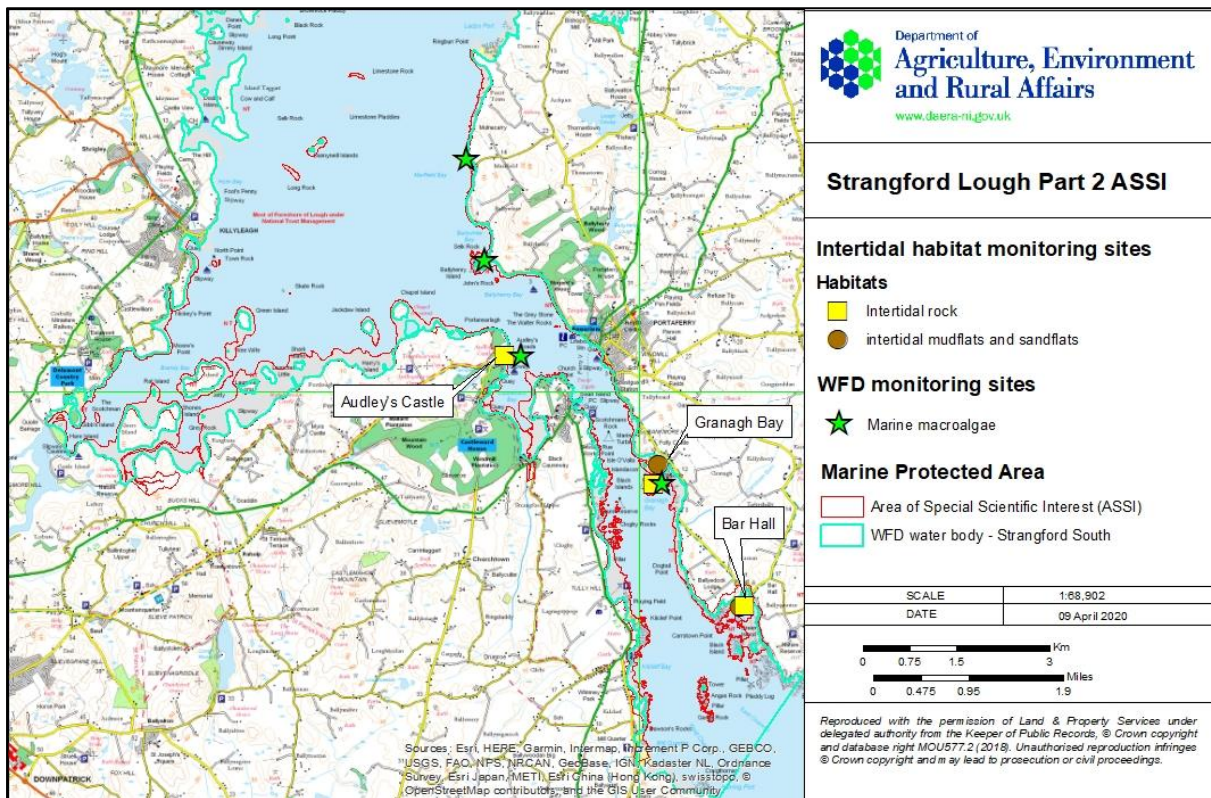


Figure 3 Sites surveyed for 2016 site condition assessment of Strangford Lough Part 2 ASSI and WFD in Strangford Lough South coastal water body

¹⁵ [Ecological Quality Ratios for Ecological Quality Assessment in Inland and Marine Waters](#)

¹⁶ [Common Implementation Strategy for the Water Framework Directive \(200/60/EC\)](#)

Site condition monitoring and assessment: 2016 ASSI and SAC intertidal survey

Audley's Castle Rocks

Survey details

Site description	<p>Located at the northern end of the entrance to Strangford Lough, on the western shore beneath Audley's Castle (Figure 4).</p> <p>A sheltered, rocky site, with bedrock on the upper shore dominated by fucoids, whilst boulders on the lower shore are dominated by <i>A. nodosum</i> and kelps and support diverse underboulder communities.</p>
Survey date	07/06/2016



Figure 4 Audley's Castle Rocks 2016 survey location

ASSI features assessed

Table 2 List of marine interest features on Audley's Castle

List of marine interest features	Previous surveys
Intertidal rock and underboulder communities	<p>DAERA (2005, 2015)</p> <p>NILS (1985)</p>

Results

General condition photographs showed no change in the extent of the ‘intertidal rock and underboulder communities’ in the area.

The top of the shore was characterised by lichen-dominated supralittoral bedrock (Figure 5a) above narrow bands of *Pelvetia canaliculata* and *Fucus spiralis* on eulittoral mixed rock (boulders/cobbles/pebbles) (Figure 5b). Mixed substratum lower down the shore was dominated by *A. nodosum* and *Fucus vesiculosus* (Figure 5c). A sublittoral fringe of boulders and cobbles at the bottom of the shore was cloaked in mixed kelps such as *Saccharina latisimma* and *Laminaria digitata* and red algae (Figure 5d). This zone supported a diversity of ascidians, sponges and underboulder communities (Figure 6).

The general description of the site is consistent with that described before.



Figure 5 General photos of Audley’s Castle Rocks showing (a) top of shore lichen-dominated bedrock, (b) upper shore *Fucus spiralis* and *Pelvetia canaliculata* on mixed substrata, (c) lower shore dominated by *Ascophyllum nodosum* and *Fucus vesiculosus* and (d) kelp-dominated boulders at the bottom of the shore



Figure 6 Species-rich underboulder communities on lower shore at Audley's Castle Rocks

Distinctive species and taxon richness

The species composition of the rocky shore at this site displayed typical intertidal zonation and the general description of conspicuous species was very similar to that reported before. The species list was dominated by seaweeds and molluscs but also included ascidians, sponges, bryozoans, crustaceans, cnidarians, echinoderms, fish, lichens, insects and annelids.

On the top of the shore lichens *Xanthoria parietina*, black lichen *Verrucaria maura*, sea ivory *Ramalina siliquosa* and orange sea lichen *Caloplaca marina* were dominant. On the upper shore the dominant species were spiralled wrack *F. spiralis*, channelled wrack *P. canaliculata*, and *Catenella caespitosa*, amphipods and littorinids. On the mid-shore knotted wrack *A. nodosum* was abundant along with *Fucus vesiculosus*, *Ulva* spp, littorinids, beadlet anemone *Actinia equina*, sponge *Hymeniacidon perlevis* and dog whelk *Nucella lapillus*. On the mid-lower shore *F. vesiculosus*, green seaweeds such as *Ulva prolifera* and *Acrosiphonia arcta* and red seaweeds such as *Mastocarpus*, *Rhodothamniella floridula* and *Osmundea pinnatifida* were present. Underboulder communities contributed to high faunal diversity and species included sponges *H. perlevis* and *Halichondria panicea*, ascidian *Aplidium punctum*, hydroid *Clava multicornis* and molluscs *Patella vulgata*, *N. lapillus* and *Littorina littorea*. Crustaceans such as barnacle *Semibalanus balanoides*, shore crab *Carcinus maenas* and common starfish *Asterias rubens* were also present. The lower shore was formed by a dense mixed kelp (*L. digitata* and sugar kelp *S. latissima*) with occasional non-native Japanese wireweed *S. muticum* and diverse underboulder communities. There was a very high diversity of encrusting fauna and sponges including: *Halisarca dujardini*, *Leuconia nivea*, *Sycon ciliatum*, *Oscarella lobularis*, and *Ophlitaspongia papilla*. Ascidians were also common, including baked bean ascidian *Dendrodoa grossularia*, orange flake ascidian *A. punctum* and *Lissoclinum perforatum*. Bryozoans were prevalent also, with species such as sea mat *Electra pilosa* and *Alcyonidium hirsutum*. There was a rich diversity

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

of gastropod molluscs such as keyhole limpet *Diodora graeca*, white tortoiseshell limpet *Tectura virginea*, *Ocenebra erinacea*, painted top shell *Calliostoma zizphinum*, and grey top shell *Steromphala cineraria*. Echinoderms such as common sea urchin *Echinus esculentus*, green sea urchin *Psammechinus miliaris* and common brittlestar *Ophiothrix fragilis*.

Communities and biotopes

Eleven biotopes were identified at this site: ‘Yellow and grey lichens on supralittoral rock’, ‘*Verucaria maura* on very exposed to very sheltered upper littoral fringe rock’, ‘*Fucus spiralis* on full salinity sheltered upper eulittoral rock’, ‘*Pelvetia canaliculata* on sheltered littoral fringe rock’, ‘*Fucus vesiculosus* on mid eulittoral mixed substrata’; ‘*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata’, ‘*Fucus serratus* and under-boulder fauna on lower eulittoral boulders’, ‘*Laminaria digitata*, ascidians and bryozoans on tide-swept sublittoral fringe rock’; ‘*Laminaria digitata* and underboulder fauna on sublittoral fringe boulders’ and ‘Mixed kelp and red seaweed on infralittoral boulders cobbles and gravel in tidal rapids’.

The biotope composition correlated with previous surveys.

Site condition assessment

Based on the results from the 2016 DAERA survey, the listed habitat feature at Audley’s Castle Rocks is considered to be in favourable condition (Table 3). Further details are shown in ANNEX 1 (condition assessment tables); Table 1.2.

Table 3 Audley’s Castle condition assessment

List of marine interest features	Condition
Intertidal rock and underboulder communities	Favourable

Bar Hall Bay

Survey details

Site description	<p>A sheltered site on the eastern shore at the entrance to Strangford Lough (Figure 7).</p> <p>The intertidal area is composed of gravelly, sandy mud from the upper to lower shore with abundant <i>A. marina</i> and <i>L. conchilega</i> worm casts and a saltmarsh zone. Scattered boulders and shingle on the mid-shore and lower shore bedrock support species-rich communities.</p>
Survey date	10/06/2016

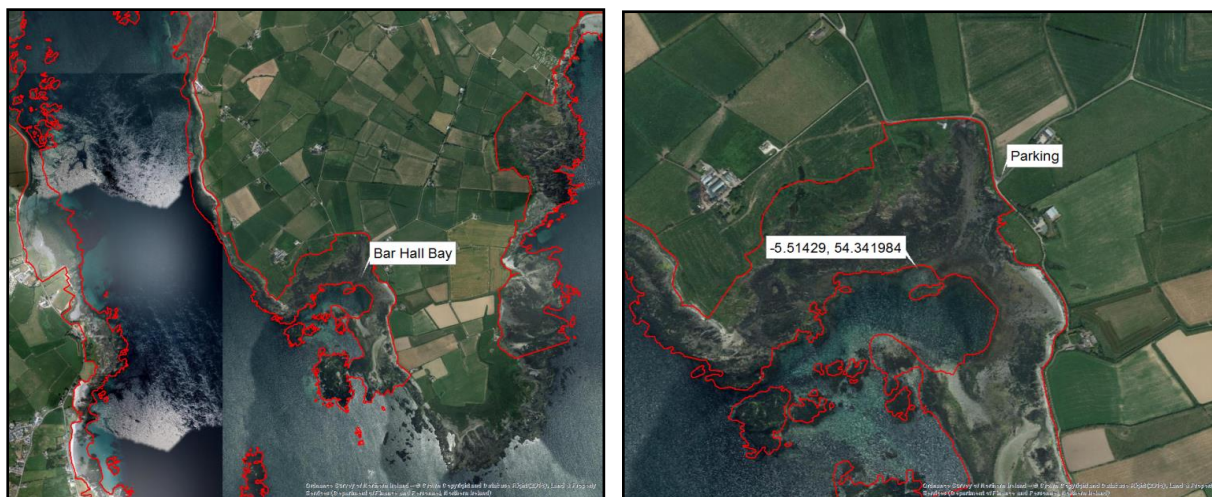


Figure 7 Bar Hall Bay 2016 survey location

ASSI features assessed

Table 4 List of marine interest features on Bar Hall Bay

List of marine interest features	Previous surveys
Intertidal mudflats and sandflats	NILS (1986)
Intertidal rock and underboulder communities	None

Results

Aerial photography (Figure 7) and general condition photographs (**Error! Reference source not found.**) showed no change in the extent of the ‘intertidal mudflats and sandflats’ in the area.

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

The intertidal sediment area was a mixed substratum composed largely of gravelly, sandy mud with abundant *A. marina* casts (Figure 9a), correlating with the previous visual description of the sediment type. Boulders, cobbles and pebbles supporting clumps of algae, *Fucus serratus* and *A. nodosum* in particular, were found scattered throughout the mid-shore (Figure 9b). Average opportunistic green algae (OGA) cover within the quadrats was high: 66%. There was no anoxic layer present.

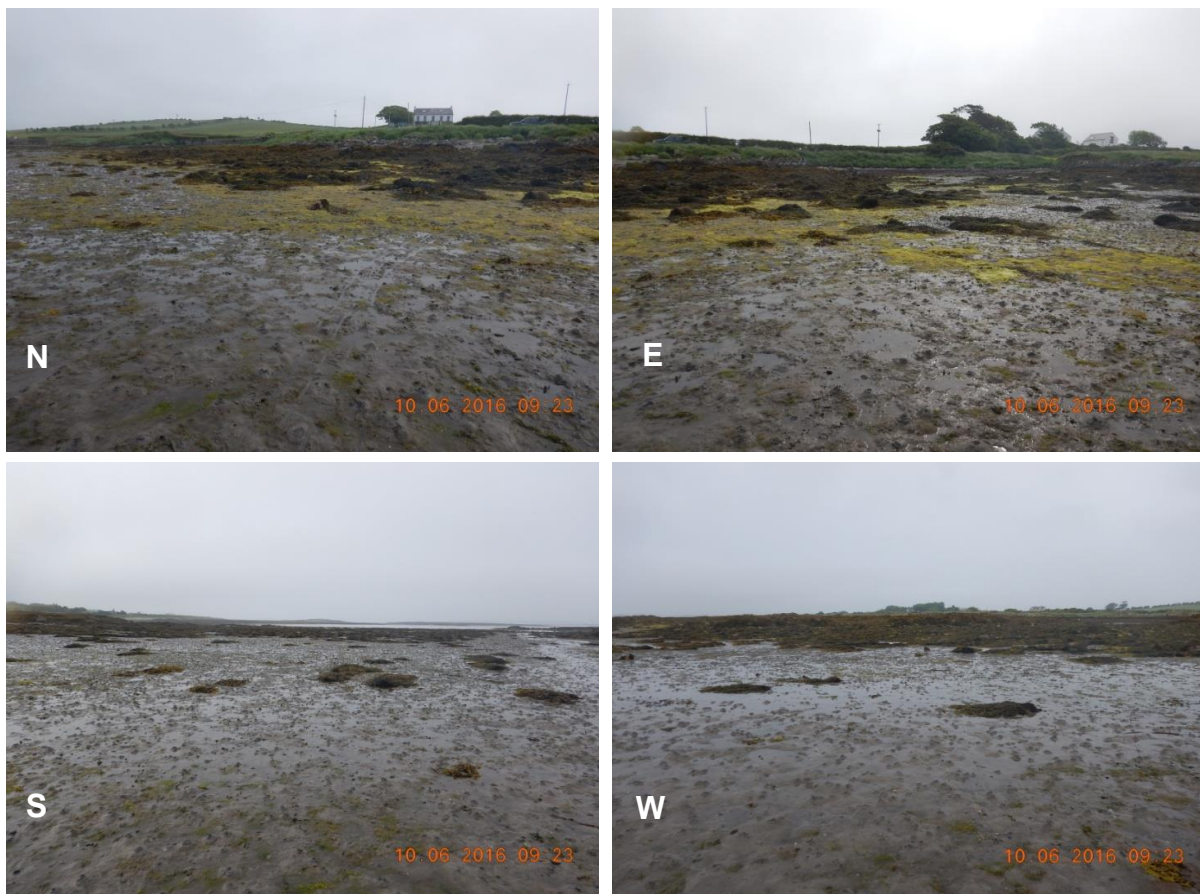


Figure 8 North, East, South and West facing photos taken at Bar Hall Bay in 2016

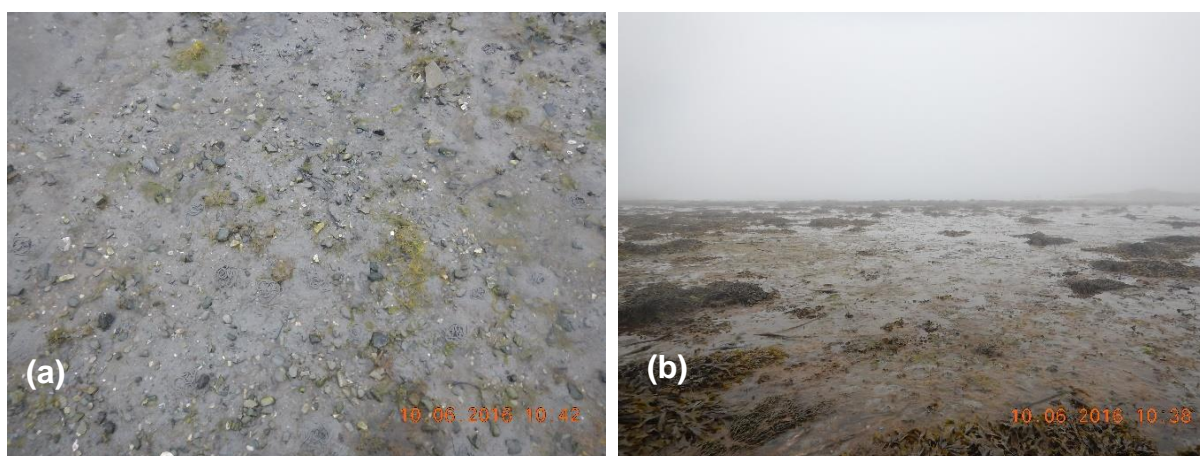


Figure 9 General condition photos taken at Bar Hall Bay in 2016

The 'intertidal rock and underboulder communities' habitat was characterised by sharply ridged bedrock (greywacke shales). Beneath a lichen-dominated upper shore (Figure 10a) was a zone of eulittoral bedrock and rockpools dominated by brown algae, barnacle and limpet communities (Figure 10b). The lower shore supported abundant algae species and a diversity of ascidians, sponges and underboulder communities (Figure 10c). *Laminaria* spp. cloaked the sublittoral fringe of boulders and bedrock (Figure 10Error! Reference source not found.d). The overall description of this site was found to be consistent with previous surveys.

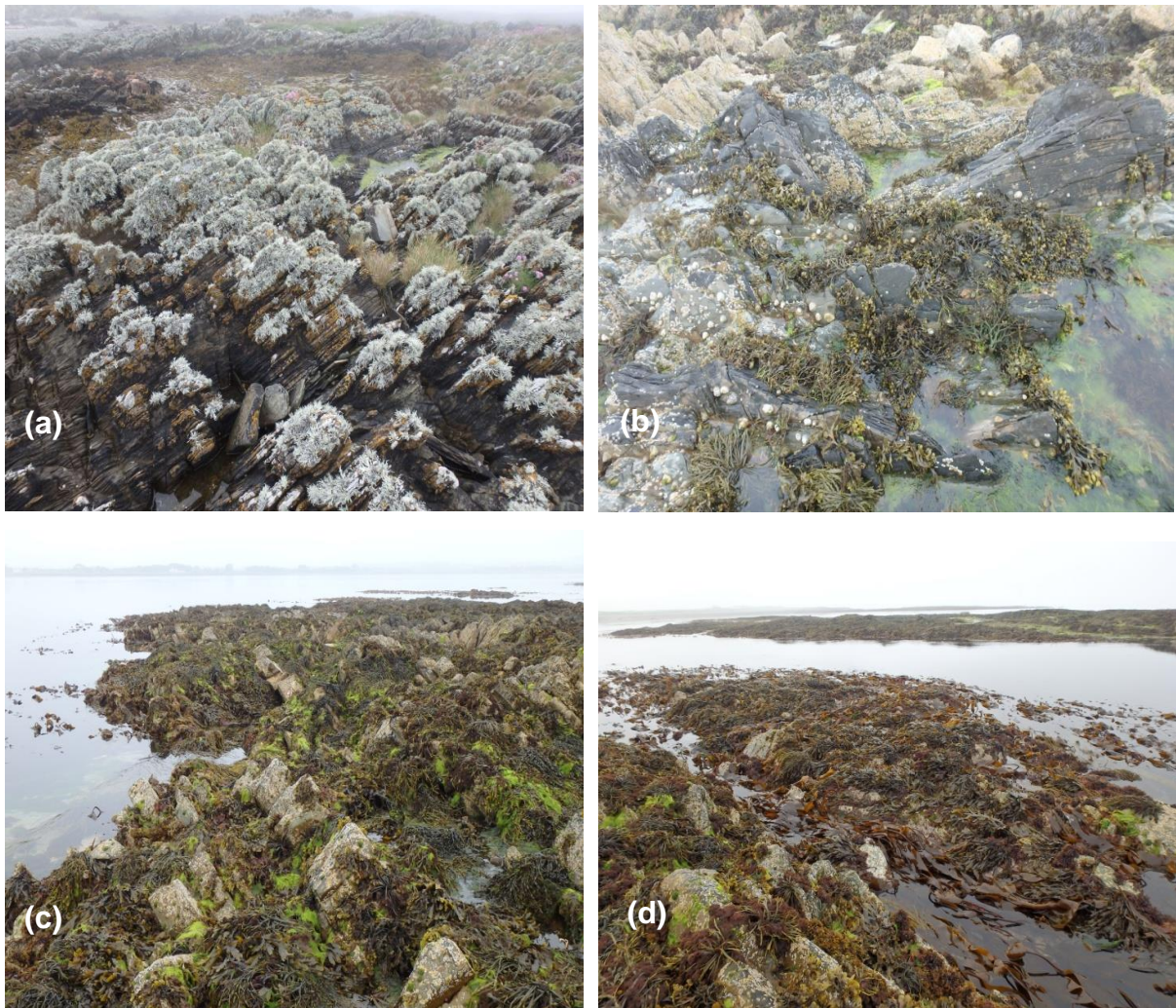


Figure 10 General photos of Bar Hall Bay intertidal rock zone in 2016 showing (a) lichen-dominated bedrock on the upper shore, (b) limpet and barnacle communities on upper/mid shore bedrock and rockpools, (c) *Ascophyllum nodosum* and (d) *Fucus serratus* dominated shore

Distinctive species and taxon richness

The conspicuous species composition in the 'intertidal mudflats and sandflats' was similar to that reported before. The species list was largely dominated by worms and seaweed but some molluscs and crustaceans were also present.

A. marina and *L. conchilega* were particularly abundant at the surface, whilst core samples were dominated by oligochaetes (*Tubificoides* sp.) and Nematodes. Cirratulidae also occurred in all cores. *A. nodosum*, *Chorda filum* and *F. serratus* were the dominant algae, while the non-native species *C. peregrina* was also present.

In the 'intertidal rock and underboulder communities' the species list was largely dominated by algae, lichens and mollusc gastropods. The dominant algae species were the fucoids, *P. canaliculata*, *A. nodosum*, *L. digitata* and *Laminaria hyperborea* and various red algae including *Mastocarpus stellatus*, *Palmaria palmata* and encrusting Corallines. Three barnacle species were recorded: *S. balanoides*, *Balanus* and *Verruca stroemia* and the gastropods *P. vulgata*, *N. lapillus* and *Littorina* spp. were also common. Underboulder communities included the sponges *H. panacea* and *H. perlevis* along with five species of ascidians including *Aplidium* spp. and *Clavelina lepadiformis*. The non-native species *S. muticum* was recorded at the site.

Communities and biotopes

Two biotopes occurred at the 'intertidal mudflats and sandflats': '*Hediste diversicolor*, Cirratulids and *Tubificoides* spp. in littoral gravelly sandy mud' with transition to '*Hediste diversicolor* and *M. balthica* in littoral sandy mud (Figure 11)'. Slight biotope differences were attributed to sampling location variation.

A total of 10 biotopes were recorded in the 'intertidal rock' zone at Bar Hall Bay: 'saltmarsh', 'yellow and grey lichens on supralittoral rock', '*Pelvetia canaliculata* on sheltered littoral fringe rock', '*Semibalanus balanoides*, *P. vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock', 'Seaweeds in sediment-floored eulittoral rockpools', '*Ascophyllum nodosum* on full salinity mid eulittoral rock', '*Fucus serratus* on sheltered lower eulittoral rock'; '*Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata', '*Himanthalia elongata* and red seaweeds on exposed to moderately exposed lower eulittoral rock' and 'Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids'.

These biotopes will provide a baseline of the biotope composition for comparison in future surveys (**Error! Reference source not found.**; **Error! Reference source not found.**). Of these, the biotope 'Saltmarsh' is a NI PMF habitat.

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

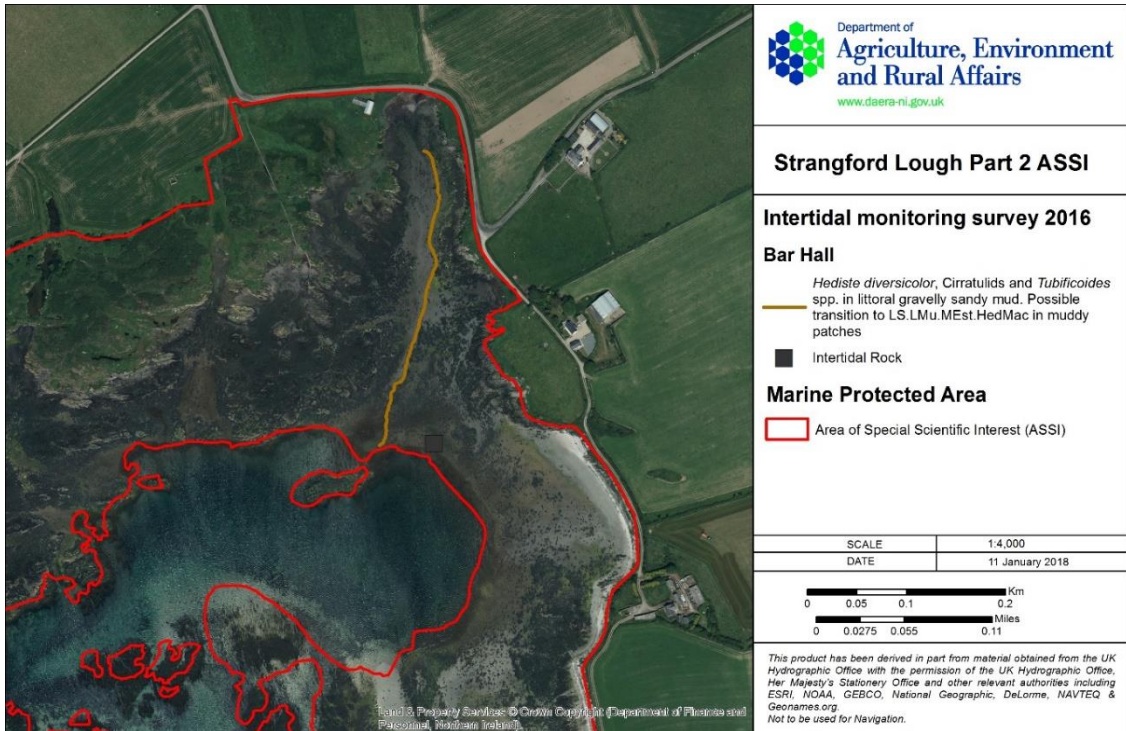


Figure 11 Position of transect line and biotopes surveyed at Bar Hall Bay

Site condition assessment

Based on the results of this survey, the listed habitat features at Bar Hall Bay are considered to be in favourable condition (Table 5). Further details are shown in ANNEX 1 (condition assessment tables); Table 1.1 and Table 1.2.

Table 5 Bar Hall Bay condition assessment

List of marine interest features	Condition
Intertidal mudflats and sandflats	Favourable
Intertidal rock and underboulder communities	Favourable

Granagh Bay

Survey details

<p>Site description</p>	<p>An exposed site on the eastern shore of the entrance to Strangford Lough with strong tidal currents due to the tidal race that exists between the site and an offshore island (Error! Reference source not found.).</p> <p>The intertidal zone is characterised by mixed sediments interspersed with algae-dominated sandstone bedrock ridges and cobbles. Poorly sorted gravelly sand, fine sand and muddy patches from the upper to mid-shore support abundant <i>A. marina</i>.</p> <p>Dense beds of algae dominate the sandstone, with an extensive zone of <i>A. nodosum</i> on the lower shore surrounding interstitial rockpools. A sublittoral fringe of bedrock, pebbles, gravel and shell is dominated by mixed kelps, red seaweeds and supports diverse underboulder communities.</p>
<p>Survey date</p>	<p>11/05/2016</p>



Figure 12 Granagh Bay 2016 survey location

ASSI features assessed

Table 6 List of marine interest features on Bar Hall Bay

List of marine interest features	Previous surveys
Intertidal mudflats and sandflats	NILS (1986) DAERA (1986)
Intertidal rock and underboulder communities	NILS (1986) DAERA (2013)

Results

Aerial photography (Figure 12) and general condition photographs (Figure 13) showed no change in the extent of the ‘mudflats and sandflats’ in the area. Various substrates were present from the mid to upper shore, with intertidal rock (bedrock, cobbles and pebbles) interspersed with mixed sediments from poorly sorted gravelly, muddy sand to fine sand and muddy patches (Figure 13). The sediment description correlated with that described before. The mud and sand zones were dominated by *A. marina*. The depth of the anoxic layer on the lower shore was 12-25mm. This value didn’t deviate from the expected range for sandy muds to muddy sand sediments.

The ‘intertidal rock and underboulder communities’ zone showed the expected rock zonation. Beneath a lichen-dominated zone on the top shore (Figure 14a), narrow bands of *P. canaliculata* and *F. spiralis* dominated bedrock on the upper shore along with dense barnacle communities (Figure 14b). Angled bedrock in the mid-eulittoral zone was dominated by an extensive area of *A. nodosum* separated by species-rich rockpools (Figure 14c). The sublittoral fringe was characterised by bedrock, cobbles, pebbles, gravel and dead shell dominated by kelps, mixed red algae and diverse underboulder communities (Figure 14d).



Figure 13 General north, east, south and west facing photos taken at Granagh Bay in 2016

The overall description of this site was found to be consistent with previous surveys.

Distinctive species and taxon richness

The species list in the ‘intertidal mudflats and sandflats’ was dominated by annelid worms. The most common species were oligochaetes e.g. *Tubificoides* sp. and *A. marina*. The species common to both surveys included *Nephtys* spp., *Nicomache lumbricalis*, *A. marina*, *L. conchilega*, *Pygospio elegans*, *Scoloplos* (Annelida) and *Corophium* sp. (Arthropoda). The non-native species *S. muticum* was recorded at the mudflats of Granagh Bay.

The species composition in the ‘intertidal rock and underboulder communities’ was dominated by algae and molluscs. Red algae species included *Polysiphonia nigra* and *Lomentaria articulata*. The dominant brown algae were *A. nodosum*, *F. serratus*, *L. digitata* and *Himanthalia elongata*. The lower shore supported a diverse range of fauna, particularly gastropods (*Steromphala* spp., *Littorina fabalis* and *P. vulgata*), sponges (*H. panicea* and *Cliona celata*) and hydroids (*C. multicornis* and *Dynamena pumila*). The species list also included the NI PMF species *L. muelleri*. The non-native barnacle *A. modestus* was recorded in both the 2013 and 2016 surveys.



Figure 14 The rock zone at Granagh Bay in 2016 showing (a) lichen-dominated upper shore, (b) upper/mid-shore fucoid and *P. canaliculata* bands, (c) *Ascophyllum nodosum* zone on lower shore and (d) kelp-dominated sublittoral fringe

Communities and biotopes

One biotope was assigned for the intertidal mudflats and sandflats at Granagh Bay in 2016: ‘*Tubificoides benedii* and other oligochaetes in littoral mud’ (**Error! Reference source not found.; Error! Reference source not found.** and Figure 15).

A total of 12 biotopes were recorded in the intertidal rock zone in 2016 (**Error! Reference source not found.; Error! Reference source not found.** and Figure 15**Error! Reference source not found.**). On the top of the shore, ‘Saltmarsh’ and ‘Yellow and grey lichens on supralittoral rock’ were recorded. On the upper shore ‘*Pelvetia canaliculata* on sheltered littoral fringe rock’ and ‘*Fucus spiralis* on full salinity sheltered upper eulittoral rock’ were recorded.

On the mid-shore ‘*Ascophyllum nodosum* on full salinity mid eulittoral rock’ and ‘Seaweeds in sediment-floored eulittoral rockpools’; was recorded.

On the lower shore, ‘Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids’; ‘*Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders’; ‘*Himanthalia elongata* and red seaweeds on exposed to moderately exposed lower eulittoral rock’; ‘*Fucus serratus*, sponges and ascidians on tide-swept lower eulittoral rock’; ‘*Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata’ and ‘*Fucus serratus* on sheltered lower eulittoral rock’ were recorded.

The NI PMF habitat coastal saltmarsh biotope was also listed in the 2016 survey. However, no species or feature extent information was collected.

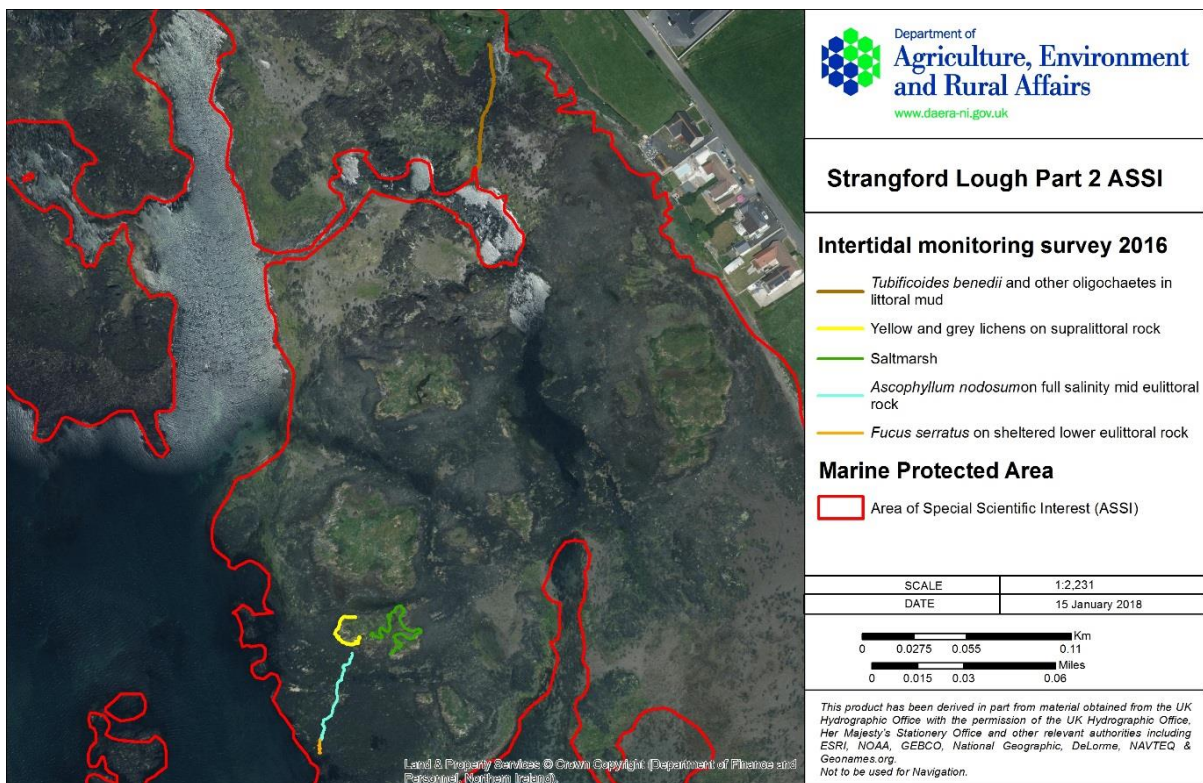


Figure 15 Position of transect line and biotopes surveyed at Granagh Bay

Site condition assessment

Based on the results from the 2016 survey of Granagh Bay the listed habitat features are considered to be in favourable condition (Table 7). Further details are shown in ANNEX 1 (condition assessment tables); Table 1.1 and Table 1.2.

Table 7 Granagh Bay condition assessment

List of marine interest features	Condition
Intertidal mudflats and sandflats	Favourable
Intertidal rock and underboulder communities	Favourable

WFD water body monitoring and condition assessment

The Department carried out an interim WFD classification of Strangford Lough North and Strangford Lough South water bodies in 2018. The surface water status of Strangford South was classified as ‘moderate’. The classification of each of the quality elements used for this assessment is summarised in Table 8. The ‘moderate’ status of Strangford Lough South is due to specific pollutants and hazardous substances. Chemical pollutants such as the pesticides, cypermethrin and permethrin were responsible for the ‘moderate’ status of Strangford Lough South; this suggests that catchment based inputs may be responsible.

Table 8 WFD 2018 interim classification for Strangford Lough (South) water body

	Strangford Lough (S)
Biological Quality Elements	
Phytoplankton	High
Macroalgae	High
Angiosperms	
Benthic invertebrates	High
<i>Supporting Quality Elements</i>	
Dissolved oxygen	High
Dissolved inorganic nitrogen	High
Specific pollutants	Moderate
Hydromorphology	High
High impact invasive species	Good
Ecological Status	Moderate
Chemical Status	<Good
Surface Water Status	Moderate

The biological QEs for phytoplankton and macroalgae were classified as 'High'. The physico-chemical QE for dissolved oxygen and dissolved inorganic nitrogen were also classified as 'High'. The hydromorphological QE and high impact non-native species were classified as 'Good'. The failure of the chemical status was due to the Annexe X Priority hazardous substances. It should be noted that, apart from the macroalgae and *Zostera* assessments in the intertidal area, all QEs are based on samples obtained from either the benthos or surface waters. The results of WFD monitoring contributes towards the identification of significant water management issues in Northern Ireland and also the establishment of programmes of measures under River Basin Management Plans to improve the water quality of Northern Ireland's surface and ground waters.

Uses and activities information and condition assessment

Activities currently known to occur within Strangford Lough Part 2 ASSI can be seen on the Department's [MapViewer](#). Additionally, information on any new activities, threats or impacts occurring in the area are recorded by Department during SIM surveys and patrols carried out by the MPA site officer on a regular basis.

Activities logged in Strangford Lough Part 2 ASSI and surrounding area include recreational water-based activities such as jet-skis, kite-surfing, power boats, sail boats, canoes and kayaks, as well as walking and trekking, dog walking, use of quads and motorcycles, horse riding, picnic areas, flying drones, ferry access, diving access, cycling, power cable maintenance and/or decommission (access), shellfish collection and farming. A sustainable outdoor recreation plan has been developed by Strangford Lough and Lecale Partnership (SLLP).

Although no significant adverse biological impacts from activities were identified in the ASSI during this assessment, a degree of anthropogenic litter was present on the shore at most locations sampled in the ASSI. Chemical (pesticide) pollution is thought to be a high risk pressure and threat for the mudflats and sandflats in NI. Mudflats and sandflats in Strangford are located adjacent to areas of intensive agriculture. Additionally, the proximity to Portaferry and Strangford sewage outfalls and pumping stations exposes the intertidal habitats in this ASSI to higher levels of urban pollution than other intertidal areas and there is therefore, a risk of damage to the listed habitat if current levels were to increase.

Unregulated shellfish harvesting (periwinkle and native oyster) has been reported to the Department by the National Trust and members of the public. There are ongoing investigations by the Department on the potential threats and vulnerabilities to be able to assess the level of risk to the designated features. Additionally, AFBI (2019) have investigated the potential for a minimum landing size or closed seasons to periwinkle harvesting within Strangford Lough. Strategic management is under development in order to continue to achieve the ASSI and SAC conservation objectives. The Department works together with the Gangmasters and Labour Abuse

Authority (GLAA) to report possible breaches of the ‘The Gangmasters (Licensing) Act 2004 in NI’ in order to manage this activity.

Further sensitivity and vulnerability assessments to determine the risk of damage to the habitats from existing activities in the ASSI should be developed in order to inform management plans.

Discussion

Condition assessment

Based on the findings of the 2016 intertidal site condition survey, supporting evidence from other intertidal surveys in the area from 2013-2018, SIM, WFD water body monitoring results and comparison of biological attributes with evidence from previous surveys and assessments, ‘intertidal mudflats and sandflats’ and ‘intertidal rock and underboulder communities’ were deemed to be in favourable condition in Strangford Lough ASSI Part 2 and overlapping intertidal area of the SAC.

Overall condition of the MPA and designated features is shown in Table 9. Results for the intertidal site condition monitoring and assessment survey in Strangford Lough Part 2 ASSI are summarised in Table 10. Further details of the general features condition in Strangford Lough Part 2 ASSI and the overlapping intertidal area of the SAC and site assessment details can be found in ANNEX 1 (condition assessment tables).

Harbour seal is reported and assessed separately within the subtidal SAC assessment.

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Table 9 Feature condition assessment of designated features in Strangford Lough Part 2 ASSI

ASSI Features	SAC Features	Condition Assessment 2019
Intertidal mudflats and sandflats	Mudflats and sandflats not covered by seawater at low tide	Favourable
Intertidal rock and underboulder communities	Reef	Favourable
Common seal (Harbour seal)	<i>Phoca vitulina</i>	Unfavourable - Declining (Reported within condition assessment for entire SAC)

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific

Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Table 10 Strangford Lough ASSI Part 2 and intertidal SAC site condition assessment and number of biotopes and species recorded between 2013 and 2018

Site	ASSI Features (sub-features)	SAC Feature(s)	No. species	No. biotopes	Condition Assessment
Audley's Castle Rocks	Intertidal rock and underboulder communities	Reef	98	10	Favourable
Bar Hall Bay	Intertidal mudflats and sandflats	Mudflats and sandflats not covered by seawater at low tide	23	1	Favourable
	Intertidal rock and underboulder communities	Reef	99	10	Favourable
Granagh Bay	Intertidal mudflats and sandflats	Mudflats and sandflats not covered by seawater at low tide	21	1	Favourable
	Intertidal rock and underboulder communities	Reef	93	12	Favourable

Species

A total of 435 species (which in some cases were only identified to genus) were recorded at the intertidal ASSI and SAC in this reporting cycle (Table 11), which is around 38% of the total species ever recorded in the ASSI. Lower total number of species and fewer PMF species and non-native species were recorded in this reporting cycle. Species diversity is slightly lower but overall is considered to be maintained at the site if compared with the species composition recorded in the ASSI from 1968 up to the reporting cycle (Figure 16), and most likely this is due to survey effort in the area. Moreover, taxonomic richness (Figure 17) and taxonomic evenness are also considered retained (Figure 16 and Figure 17).



Figure 16 Diversity index and taxonomic evenness compared to previous years (1968-2012)

Table 11 Comparisons with existing species data (1968-2013)

	1968-2012	2013-2018
Total No. species	723	435
No. PMF species	26	12
No. non-native species	11	9
Taxa richness	22	18

Algae and molluscs were still the dominant groups. The species list in this period was made up of algae (32.2%), molluscs (27.6%), crustaceans (6.4%), porifera

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

(5.7%), annelids (5.5%), cnidarians (5.3%), tunicates (3.7%), bryozoans (3.2%), echinoderms (3%), fish (2.8%), lichens (1.6%), angiosperms (0.7%), mammals (0.7%), nemertea (0.5%), platyhelminthes (0.5%), hexapods (0.2%), nematods (0.2%) and sipunculids (0.2%). The differences in groups such as annelids is attributed to the level of effort in sedimentary sites in this ASSI within the reporting cycle.

The full list of species and diversity indexes values are listed in in ANNEX 2 (species lists); Table 2.1,

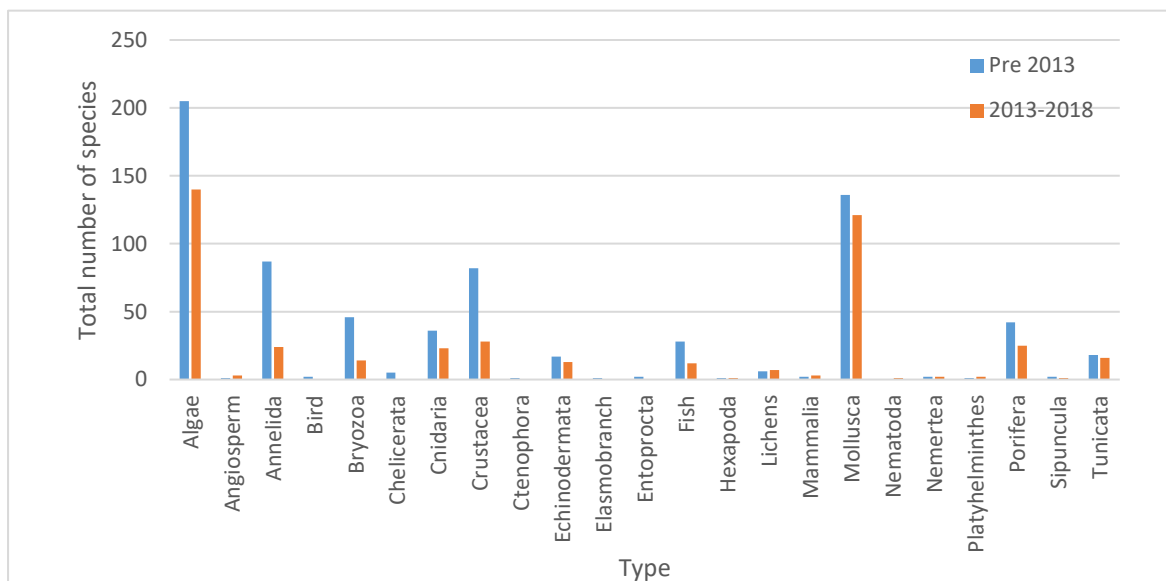


Figure 17 Total number of species recorded compared to previous years and taxonomic types recorded

Table 2.2 and

Table 2.3.

A total of 392 species previously recorded in the ASSI were not recorded in this reporting cycle. On the other hand, 90 species were newly recorded in this reporting cycle (Table 12). There were two new PMF species recorded in this reporting cycle for the first time, however, 16 PMF species, previously recorded, were missing. While six non-native species were not recorded in this cycle, four new non-native species were recorded in this period for the first time.

Table 12 Species missing and species recorded for the first time in this reporting cycle (monitoring years 2013-2018)

	Species recorded in both periods	No. species NOT recorded after 2013	No. of NEW species recorded after 2013
Total no. species	331	392	104
No. PMF species	9	16	2
No. non-native species	5	6	4

A full list of missing and new PMF and non-native species is listed in **Error! Reference source not found.**;

Table 2.4, Table 2.5 and Table 2.6. Data suggests that bird and fish species have been either submitted to other databases, other than Marine Recorder⁶, or not submitted at all. In the case of *Spartina*, this has probably been submitted to the terrestrial recorder before. Further investigation on this data is suggested.

Overall species diversity and PMF species composition is considered to be retained.

Future monitoring programmes could be focused on PMFs and conspicuous species rather than full species list, so that the data and methodologies can be standardised long term, using minimum resources. This would also require lower levels of expertise and skill transfer would be facilitated. Further research regarding the appropriate taxonomic level required and standard methodologies for feature condition assessment is suggested. Other novel techniques, such as eDNA should be explored as they could facilitate the assessment of this attribute. The development of a DNA barcode library for marine species in Northern Ireland and specifically for priority species would allow the use of eDNA techniques for rapid surveys.

Biotope and communities

A total of 26 biotopes were recorded at Strangford Lough Part 2 ASSI and intertidal SAC between 2013 and 2018. Within this ASSI 35% of the biotopes recorded were

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

NI PMF habitats. Although the biotope list indicates some decrease in the total number of biotopes recorded at the site if compared with the biotopes recorded in the ASSI from 1968 up to the reporting cycle (Table 13), the general biotope and communities composition within designated habitats is considered similar to the ones described before. Besides no habitat loss was noted. The differences in numbers are attributed to survey effort, changes in methodology and different positioning, yet further investigation is recommended in order to identify potential changes and trends and additional consideration is suggested for future survey design. Nevertheless the presence of PMF habitats is considered to be retained over time.

The full list of biotopes and PMF habitats is listed in ANNEX 3 (biotopes); Table 3.1 and Table 3.2.

Table 13 Comparisons with existing biotope data (1968-2013)

	1968-2012	2013-2018
Total No. biotopes	41	26
No. PMF biotopes	13	9

Four PMF biotopes previously recorded in the ASSI were not recorded in this reporting cycle. On the other hand, 4 new PMF biotopes were recorded for the first time within the ASSI. However, there is no sign of PMF habitats loss or change over time, and biotope differences are attributed to the selection of sampling sites and expertise interpretation. Full details are shown in **Error! Reference source not found.**; Table 3.3 and Table 3.4.

Intertidal mudflats and sandflats and sub-features

No loss of 'intertidal mudflats and sandflats' area was observed from either aerial photography, general condition pictures, or transect area. Biotope mapping of sites, georeferenced line transects and digitised mudflat polygons are available for the next condition assessment to enable assessment of quantitative changes in the extent of the feature.

Visual description of the sediment character correlates with previous descriptions. Quantitative sampling of sediment content using cores and/or box quadrats and PSA is recommended for future detailed surveys in the event of any impacts to the feature or suspected change to unfavourable condition. Additionally, no deviation from expected values of the anoxic layer was observed at any sites, although Granagh Bay showed a significant decrease of black layer depth compared to previous surveys. Further investigation is recommended to determine if these changes are due to a natural event or due to an increase of organic input from sources such as farming in the area.

Comparison of the biotope, communities and species descriptions and composition of the mudflats and sandflats data from the 2016 survey and other available surveys in the reporting cycle with previous years does not indicate any significant changes

in the condition of this feature at any of the sites. However, a slight change in the mud biotope and species composition was noted in Bar Hall. While this may simply be a result of differing positions of the transect line or surveyor interpretation, it is possible that this may indicate a biotope composition change, and it should be considered in future surveys. The presence of OGA on the lower shore may also result from local eutrophication due to close proximity of the site with farm land and sewage discharges. It is also recommended to take this into account in future surveys in order to assess if this variation is due to natural changes or other pressures in the area (i.e. farming run-off, sewage or storms). The reduction in species richness in all sites is attributed to differing survey effort and interpretation as opposed to any significant loss in diversity.

Enhanced compliance checks and mitigation to protect against accidental discharges, chemical pesticide pollution and proper drainage plans should be considered to improve the WFD classification of Strangford Lough North and ultimately to protect against diffuse run off that may be affecting mudflats and sandflats.

Coastal saltmarsh

The ASSI designated feature ‘coastal saltmarsh’, which is also a NI PMF habitat, was identified within the mudflat feature at the upper shore of both Bar Hall Bay and Granagh Bay during the 2016 survey, although no extent or species data was recorded. Coastal saltmarsh was also recorded as part of the WFD saltmarsh survey in different areas of the Strangford Lough South water body overlapping with Part 2 ASSI in 2015. The broad condition of the coastal saltmarsh in the ASSI is assessed separately along with other terrestrial features by NIEA under the [coastal saltmarsh action plan](#). Condition assessments in this region of the lough in 2003 considered saltmarsh to be in unfavourable condition. Elsewhere in the lough, saltmarsh condition is also considered to be poor due to the encroachment of the non-native *Spartina sp.* It is recommended that future WFD and condition assessment saltmarsh surveys are extended to include Bar Hall Bay in order to monitor the condition of the saltmarsh feature and the spread of the non-native species *Spartina*. Further information on the coastal saltmarsh habitat can be found in the [Department's coastal saltmarsh guide](#). The latest assessments of the NI priority and PMF feature can be requested by contacting NIEA by [email](#).

A new survey of the coastal saltmarsh biotope between High Water Mark (HWM) and Low Water Mark (LWM) to establish baseline of extent is suggested. Further investigation on the use of the WFD saltmarsh tool and other potential efficient ways of mapping areas of saltmarsh (i.e. drone) is suggested for Northern Ireland.

Intertidal rock and underboulder communities

No loss of ‘intertidal rock and underboulder communities’ was observed and no significant changes on biological and biotope zones were recorded. Moreover, the species and biotope compositions described in 2016 were found to closely correlate

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

with those described by the NILS and previous assessments and therefore, this feature is considered to be in favourable condition.

The retention of abundant *A. nodosum*, at Audley's Castle rocks, is a further indicator of favourable condition. SLECI surveys carried out in 2003/04 found a general decline in macroalgae (and *A. nodosum* in particular) from a number of sites within Strangford Lough Part 2 ASSI since the NILS. A similar phenomenon has been reported from other sites on the Atlantic coast, including North America, yet this was not considered to indicate bad condition of the sub-feature. Meanwhile, the 2016 and WFD macroalgae surveys have provided a baseline for the biotopes and species composition of the intertidal rock feature at Bar Hall Bay, allowing for a comparative baseline for future surveys.

PMFs

Seventeen NI PMFs were recorded across Strangford Lough Part 2 ASSI and intertidal area of the SAC. These included five PMF habitats: intertidal mudflats, sheltered muddy gravels, coastal saltmarsh, intertidal underboulder communities and tide-swept channels and 12 PMF species: *A. nodosum* var. *mackayi*, *C. smithii*, *H. gammarus*, *A. phylactica*, *L. muelleri*, *O. eperlanus*, *H. grypus*, *P. vitulina*, *A. opercularis*, *M. varia*, *P. maximus* and *T. marmorea*.

Z. marina was recorded in the ASSI by Strangford Lough Ulster Museum Littoral Surveys and Seasearch (2016) although this was not recorded as a bed (PMF habitat). No *Zostera* spp. were recorded in Granagh Bay in 2016 and therefore whether or not this is a sub-feature of the site remains unknown.

L. muelleri is a northern species which has been recorded several times throughout the Northern Irish coast, however, few records have been made from within Strangford Lough itself. Moreover, PMF species recorded in the ASSI by Strangford Lough Ulster Museum Littoral Surveys and Seasearch: *C. smithii* (2015 and 2016), and *L. muelleri* (2016). *T. marmorea* is found only in the northern part of Ireland and Britain. NI holds the entire Irish population and it is believed to be common in Strangford Lough. It had been previously recorded in 1985, however, is thought to be in decline as a result of climate change. Due to their vulnerability, it is important that future surveys within the ASSI pay special attention to the occurrence of these priority species in order to monitor population trends.

Further protection of representative intertidal PMFs without direct protection should be considered.

Non-native species

Nine non-native species were recorded in total in the ASSI: the algae *C. peregrina* (oyster thief), *C. fragile atlanticum*, *G. vermiculophylla*, *B. hamifera*, the wire weed *S. muticum*, *S. anglica*, *M. arenaria*, the acorn barnacle *A. modestus* and the orange-tipped sea squirt *C. eumyota*.

The largest population of cordgrass *Spartina* in Ireland is in Strangford Lough, where it was introduced as a mud-binder in the 1940s. *Spartina* was recorded and assessed in the ASSI through the WFD programme and [The National Plant Monitoring Scheme](#). This is a highly invasive species that causes extensive ecological damage to intertidal habitats, outcompeting and replacing important habitats such as the native *Zostera* spp beds. Attempts have been made at various times to control or even eradicate locally this plant from all its Strangford Lough sites. These included digging up the plants, covering with opaque polythene sheets, burying under silt and applying herbicides. While the total eradication of *Spartina* in Strangford Lough may be unrealistic, it is generally agreed that control measures are most likely to be effective in areas where colonisation is at a relatively early stage.

C. peregrina is native to the Pacific Ocean but was introduced to France along with juvenile eastern oysters and subsequently to the British Isles in the early 20th century. *G. vermiculophylla* presence in the intertidal mudflats could be a sign of organic enrichment of the sediment. *S. muticum* was first recorded in Ireland in 1995 and is now particularly abundant in Strangford Lough. It was recorded in all the sampled sites indicating that this non-native species is now widespread throughout Strangford Lough Part 2 ASSI. *S. muticum* has a rapid growth rate, which can lead to the displacement of native species through overgrowing and shading. *C. peregrina*, native to the Pacific Ocean, was also not recorded in 1986, however this species is now known throughout British and Irish coasts and is thought to have negligible effects on its surrounding environment. *A. modestus* was introduced to the British Isles from Australasia in the early 1940s and has since spread rapidly. *A. modestus* was recorded at the ASSI in both the 2013 and 2016 surveys. *A. modestus* was not present in 1986, however it is now known to have spread throughout the British Isles, with several records from around Ireland. *C. eumyota* was first recorded in Northern Irish waters in 2006 and has since spread rapidly, being recorded from all parts of the coast with suitable habitat by 2012. *C. eumyota* may have an impact on the abundance and habitat occupancy of other native sessile invertebrates, however, the degree of potential impact is not yet known. There is however, a concern regarding the economic impacts of *C. eumyota* as a result of fouling on mussel or oyster gear.

While all these non-native species appear to be already well established within Strangford Lough, it is important that their distribution, extent and potential impacts on native communities continue to be monitored closely.

It is recommended that current monitoring and management of non-native species is sustained and further developed.

Conclusion

Previous MPA condition assessments have been poorly integrated with all other existing marine environmental information and monitoring efforts. Furthermore, indicators for conservation status of designated habitats and species in Northern Ireland have been generally based on an evaluation of whether the taxonomic

results of each reporting cycle are better or worse than those recorded in the previous six years and are mostly descriptive and driven by expert judgment. There is also an increasing demand for biodiversity assessments of the marine environment to include not just taxonomic measures of biodiversity but also quantifiable indicators and the overall ecosystem function. Long term integrated monitoring programmes of biodiversity, site integrity, activity and impact surveillance should continue in order to be able to assess long-term change and adapt management measures to achieve conservation objectives of the site.

Further development and refining of the Strangford Lough seabed habitat map on the intertidal area is still required in order to be able to assess long term change. Exposed coastal rocky reef and intertidal mudflat ecosystems are particularly challenging habitats to monitor due mostly to their topography and ecological variability in space and time. Unmanned Aerial Vehicles (UAVs) may be an ideal tool for sampling these habitats over broad spatial scales, while maintaining sufficient resolution for species, genus, or functional group taxonomic resolution. Long-term monitoring of these important habitats to observe local or global-scale changes may benefit greatly from well-timed deployments of this technology, and therefore, should be considered in future monitoring programmes and strategies.

Further research and work to gather quantitative data and include ecosystem services is also suggested in order to make this evaluation process more consistent between observations and reporting periods and in order to be able to identify not just taxonomic and environmental change but also climate and anthropogenic changes based on a simple and reliable approach.

Recommendations

Table 14 Recommendations and suggested actions for Strangford Lough Part 2 ASSI and the overlapping intertidal area of the SAC

Recommendations	Actions	Assignment	Timeline
Continued monitoring, assessment and reporting of the MPA and feature condition, including NI PMFs occurring at the different sites	<ul style="list-style-type: none"> - To continue site monitoring and condition assessment programmes for the six years reporting cycle - To develop a consistent long-term monitoring strategy along a risk gradient (inside and outside the exclusion zone) to be able to detect long term change - To contribute to the development of biodiversity indicators 	DAERA Marine Monitoring and Assessment team, DAERA Marine Conservation and Reporting Team and DAERA Natural Environment Division (NED)	2019-2025
Continued integrity monitoring and management of on-site activities	<ul style="list-style-type: none"> - To review and implement the existing Strangford Lough Management plan - Consider the introduction of a shellfish gathering byelaw 	DAERA Marine Conservation and Reporting Team DAERA Natural Environment Division (NED), Strangford Lough & Lecale Partnership (SLLP)	
	<ul style="list-style-type: none"> - SIM surveys and patrols carried out by the MPA site officer on a regular basis - Annual SIM undertaken by helicopter 	DAERA Marine Conservation and Reporting Team and National Trust and DAERA NED Regional Operations	
	<ul style="list-style-type: none"> - Marine licensing and EIA to assess the likely risks from new infrastructure, operations or 	DAERA Marine Licensing team	

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

	activities to the designated habitat		
Further development and refining of the Strangford Lough seabed habitat map on the intertidal area	<ul style="list-style-type: none"> - To carry out further ground-truthing surveys of the intertidal habitat - To incorporate the use of LiDAR on coastal mapping - Further spatial analysis and habitat mapping and assess extent and change of features more accurately 	DAERA Marine Conservation and Reporting Team and AFBI	
Further sensitivity and vulnerability assessments to determine the risk of damage to the habitats from existing activities	<ul style="list-style-type: none"> - To develop risk assessments to measure potential impacts and feed into future management plans 	AFBI and DAERA Marine Conservation and Reporting Team	
Continued monitoring and management of levels of litter	<ul style="list-style-type: none"> - To continue to implement the Northern Ireland Marine Litter Strategy - To support Keep Northern Ireland Beautiful and other NGOs to carry out Marine Litter surveys and research on the issue - To promote public awareness 	DAERA Marine Strategy Team, DAERA Marine Conservation and Reporting Team and National Trust	
Continued monitoring and management of unregulated shellfish harvesting	<ul style="list-style-type: none"> - To introduce strategic management to remove threats to listed features - To adopt recommendations from the Inshore fisheries strategy to introduce fisheries regulations with closed areas and seasonal closures 	DAERA Marine Conservation and Reporting Team, DAERA Aquaculture and Fish health and National Trust	

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

	- To continue to engage with the Gangmasters and Labour Abuse Authority (GLAA) in Northern Ireland		
Continued monitoring and management of non-native species	- To continue to carry out non-native spp monitoring and management programmes - To continue to carry out the <i>Spartina</i> control programme	DAERA Marine Monitoring and Assessment team, DAERA Marine Conservation and Reporting Team and DAERA NED	
Survey of the coastal saltmarsh biotope between High Water Mark (HWM) and Low Water Mark (LWM) to establish baseline of extent	- To carry out a targeted survey/project or include survey target in existing survey programmes	DAERA Marine Monitoring and Assessment team, DAERA Marine Conservation and Reporting Team and DAERA NED and National Trust	
Reduce marine pollution from agricultural activities surrounding the ASSI and SAC	- To reduce nutrient enrichment in the area under the Water Framework Directive, Farming Scheme and Nitrates directive. - To consider specific agricultural policy for farmland surrounding the ASSI and SAC	DAERA Marine Licensing team and Strategy team	
Improvement of WFD classification within the SAC surrounding the ASSI	--To meet WFD targets and improve the most recent classification from Moderate to Good, focusing on specific pollutants and invasive species	DAERA Marine Licensing team and Strategy team, DAERA Marine Monitoring and Assessment team	

ANNEX 1 (condition assessment tables)

Table 1.1 Strangford Lough Part 2 ASSI – Intertidal mudflats and sandflats – Condition assessment table

Attribute	Target - Based on NILS (baseline), ASSI citation, SLECI and UMLS	Method of assessment	Results	Condition	Comments
*Extent	No loss of mudflat area Unknown	Aerial Photography (NIEA Coastal Survey 2006). General condition photography of different zones. Line transects. Mudflats and sandflats digitized and clipped to the ASSI polygon.	No loss of mudflat area observed 166.75ha	Favourable	Biotope mapping of sites, line transects and digitised mudflats available for next condition assessment.
*Sediment character	No change of sediment character. Visual description only: Bar Hall Bay (NILS 1986): pebbles, granules, coarse sand and muddy sand Granagh Bay (NILS 1986): muddy sand and mud between rock outcrops and boulders	<i>In situ</i> coarse assessment of sediment characteristics and comparison with earlier descriptions.	No significant changes observed. Bar Hall Bay: gravelly, sandy mud, scattered boulders and shingle. Granagh Bay: poorly sorted gravelly sand, fine sand and muddy patches	Favourable	Quantitative sampling of sediment content using cores and/or box quadrats recommended for future surveys.

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific

Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

			interspersed with bedrock ridges and cobbles		
Anoxic layer (lower shore)	<p>No deviation from a range of values, giving depth of the redox layer in millimetres from the surface. For sandy muds the anoxic layer should be at 250mm depth. For muds the anoxic layer should be at 10-30mm depth.</p> <p>Bar Hall Bay (NILS 1986): Not assessed Granagh Bay (NILS 1986): 0-80mm</p>	<p>Depth of the black layer below the surface of the sediment measured using a ruler (mm).</p>	<p>No significant changes observed but depth of anoxic layer shallower than recorded previously.</p> <p>Bar Hall Bay: 0mm Granagh Bay: 12-25mm</p>	Favourable	<p>Predominantly taken as a baseline for comparison with future monitoring programmes. A change in the presence/absence of the anoxic layer can indicate a shift in the dynamics of the littoral sediment. Such a change will have a knock-on effect on the infaunal communities present.</p>
*Biotope composition	<p>Maintain the variety of biotopes identified at the site, whilst allowing for natural succession/known cyclical change (and surveyor interpretation).</p> <p>Bar Hall Bay (NILS 1986):</p>	<p>Identification of biotopes along transect lines through intertidal zone.</p> <p>Co-ordinates recorded for Start and End of biotopes.</p>	<p>No significant changes recorded. Biotope composition similar to 1986 assignments (and subject to survey methods and</p>	Favourable	<p>Changes in distribution and extent may indicate long term changes in the physical conditions.</p>

Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

	<p>LS.LMu.MEst.HedMac; LS.LSa.MuSa.MacAre; LS.LMu.UEst.Hed.Str; LR.LLR.F.Fves.X</p> <p>Granagh Bay (NILS 1986): LR.LLR.F.Fves.X; LS.LSa.FiSa.Po; LS.LSa.MuSa.Lan</p>		<p>interpretation).</p> <p>Bar Hall Bay: LS.LMx.GvMu.Hed Mx.Cir with possible transition to LS.LMu.MEst.Hed Mac</p> <p>Granagh Bay: LS.Lmu.UEst.Tben</p> <p>PMF habitats: ‘Intertidal mudflats’ and ‘Sheltered muddy gravels’ and ‘coastal saltmarsh’.</p> <p>Non-native species: <i>Sargassum muticum, Gracilaria vermiculophylla and Spartina anglica</i></p>		
<p>*Species composition of selected biotopes at monitoring sites</p>	<p>Maintain the species diversity and representative species identified at the site, whilst allowing for natural succession/known cyclical</p>	<p>Presence/absence/S ACFOR of expected species in each zone along transect. Quantitative sampling of sediment content</p>	<p>The reduction in species is most likely attributable to different methodologies between surveys</p>	<p>Favourable</p>	<p>Similar conspicuous species recorded and general species composition</p>

Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

	change	<p>using handheld cores and quadrats. Post-survey laboratory analysis of core samples. Post-survey photographic identification of species.</p>	<p>(as opposed to a decline in species richness as a result of environmental conditions or anthropogenic pressures). PMF species: <i>Pecten maximus</i> Non-native species: <i>Sargassum muticum</i>, <i>Gracilaria vermiculophylla</i>, <i>Spartina anglica</i> and <i>Mya arenaria</i>.</p>		<p>between surveys. The retention of representative species and PMFs allows for any changes/trends to be monitored in future.</p>
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*= Primary attribute. One failure among primary attribute = unfavourable condition

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Table 1.2 Strangford Lough Part 2 ASSI – Intertidal rock and underboulder communities – Condition assessment table

Attribute	Target - Based on NILS+ASSI citation+SLECI+UMLS	Method of assessment	Results	Condition	Comments
Extent	No change in extent. unknown	Aerial Photography (NIEA Coastal Survey 2006). General condition photography of different zones. Line transects.	No loss of rock observed. unknown	Favourable	Biotope mapping of sites and line transects required in the next reporting cycle
*Biotope composition	Maintain the variety of biotopes identified at the site, whilst allowing for natural succession/known cyclical change. Audley's Castle Rocks: 1986 NILS: IR.MIR.KR.Ldig.Bo; LR.HLR.MusB.Sem; LR.LLR.F.Asc.FS; LR.LLR.F.Fspi.FS; LR.LLR.FVS.PeIVS; LR.MLR.BF.Fser.Bo; LR.FLR.CvOv; LR.FLR.Rkp.Cor.Cor; 2005 DAERA:	Biotopes identified and mapped along line transect through intertidal rock zone, using handheld GPS Trimble. Presence/absence/ SACFOR of expected species recorded.	The biotopes assigned in 2016 correlated with previous surveys (allowing for differences due to transect location and surveyor interpretation). Audley's Castle Rocks: IR.MIR.KT.XKTX; IR.MIR.KR.Ldig.Bo; IR.MIR.KT.LdigT; LR.LLR.Fves.X; LR.LLR.F.Asc.X; LR.LLR.F.Fspi.FS;	Favourable	Biotope composition and distribution information provide a baseline for comparison with future surveys and continued site monitoring

	<p>LR.HLR.MusB.Sem.Sem ; IR.MIR.KR.Ldig; LR.LLR.F.Pel; LR.LLR.F.Fspi; LR.LLR.F.Asc.X; LR.LLR.F.Fves; LR.MLR.BF.F.ser; LR.FLR.Eph.Ent; Bar Hall: Unknown Granagh Bay (NILS 1986): IR.MIR.KR.Ldig LR.FLR.Lic.Pra LR.FLR.RKP.FK LR.FLR.RKP.G LR.HLR.MusB.Sem.Sem LR.LLR.F.Asc.FS LR.LLR.F.Fspi LR.LLR.F.Pel LR.MLR.BF.Fser.R</p>		<p>LR.LLR.F.Pel; LR.MLR.BF.Fser.Bo ; LR.FLR.Lic.YG; LR.FLR.Lic.Ver.Ver Bar Hall Bay: LR.HLR.FR.Him; IR.MIR.KT.XKTX; LR.LLR.F.Fser; LR.HLR.FT.FserTX; LR.LLR.F.Asc.FS; LR.FLR.Rkp.SwSed; LR.HLR.MusB.Sem.Sem; LR.LLR.F.Pel; LR.FLR.Lic.YG; LS.LMp.Sm Granagh Bay: IR.MIR.KT.XKTX; IR.MIR.KR.Ldig.Bo; LS.Lmu.UEst.Tben; LR.FLR.Lic.YG; LR.FLR.Rkp.SwSed; LR.LLR.F.Pel; LR.LLR.F.Fspi.FS; LR.LLR.F.Asc.FS; LR.HLR.FR.Him;</p>		
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			<p>LR.HLR.FT.FserT; LR.HLR.FT.FserTX; LR.LLR.F.Fser; LS.LMp.Sm</p> <p>PMF habitats: 'Intertidal underboulder communities', 'Tide swept channels' and 'Coastal saltmarsh'.</p>		
<p>*Presence and absence/or abundance of specified or representative species</p>	<p>Maintain the species diversity identified at the site, whilst allowing for natural succession/known cyclical change.</p>	<p>Presence/absence/SACF OR of expected species in each zone along a transect. Post-survey photographic identification of species.</p>	<p>The reduction in species is attributed to different survey methodologies (as opposed to a reduction in species richness due to environmental conditions or anthropogenic pressures).</p> <p>PMF species: <i>Ascophyllum nodosum var. mackayi</i>, <i>Caryophyllia (Caryophyllia) smithii</i>, <i>Aequipecten opercularis</i>, <i>Pecten</i></p>	<p>Favourable</p>	<p>Similar conspicuous species recorded and general species composition between surveys. The retention of representative species and PMFs allows for any changes/trends to be monitored in future.</p>

			<p><i>maximus,</i> <i>Mimachlamys varia,</i> <i>Homarus</i> <i>gammarus,</i> <i>Leptasterias</i> <i>(Leptasterias)</i> <i>muelleri,</i> <i>Osmerus</i> <i>eperlanus,</i> <i>Halichoerus grypus,</i> <i>Phoca vitulina,</i> and <i>Tocinella marmoreal</i></p> <p>Non-native species: <i>Sargassum muticum,</i> <i>Bonnemaisonia hamifera,</i> <i>Codium fragile atlanticum,</i> <i>Colpomenia peregrina,</i> <i>Austrominius modestus</i> and <i>Corella eumyota.</i></p>		
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<p>*Spatial distribution of biotopes at specified locations</p>	<p>No significant change whilst allowing for natural succession/known cyclical change.</p>	<p>Biotopes identified and mapped along transect through intertidal rock zone using handheld GPS Trimble.</p>	<p>Zones and biotopes correlate with descriptions from previous surveys. No significant changes observed.</p>	<p>Favourable</p>	<p>Biotope maps provide a baseline for future monitoring of site condition.</p>
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*= Primary attribute. One failure among primary attribute = bad condition

ANNEX 2 (species lists)

Table 2.1 Total number of species and type of species recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Type	Total no. species	% of total species
Algae	140	32.2
Angiosperm	3	0.7
Annelida	24	5.5
Bryozoa	14	3.2
Cnidaria	23	5.3
Crustacea	28	6.4
Echinodermata	13	3
Fish	12	2.8
Hexapoda	1	0.2
Lichens	7	1.6
Mammalia	3	0.7
Mollusca	120	27.6
Nematoda	1	0.2
Nemertea	2	0.5
Platyhelminthes	2	0.5
Porifera	25	5.7
Sipuncula	1	0.2
Tunicata	16	3.7
TOTAL	435	
Total no. PMF species	12	2.8
Total no. non-native species	9	2.1

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Table 2.2 Diversity indexes changes

Years	Pre-2013	2013-2018
Species richness	723	435
Taxonomic richness	22	18
Shannon Weiner Diversity Index (0 - no diversity to 4.6 - infinite diversity)	2.17	2.04
Shannon Weiner Equitability (Taxonomic evenness) (0 - all taxa are equally present to 1 - one taxon dominates the community completely)	0.70	0.71

Table 2.3 List of species/genera recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Key	
Northern Ireland PMF species	
Non-native species	
Taxonomic group	Species
Algae	<i>Acinetospora crinita</i>
Algae	<i>Acrochaetium parvulum</i>
Algae	<i>Acrosiphonia arcta</i>
Algae	<i>Aglaothamnion hookeri</i>
Algae	<i>Aglaothamnion pseudobyssoides</i>
Algae	<i>Ahnfeltia plicata</i>
Algae	<i>Ascophyllum nodosum</i>
Algae	<i>Ascophyllum nodosum var. mackayi</i>
Algae	<i>Asperococcus bullosus</i>
Algae	<i>Asperococcus fistulosus</i>
Algae	<i>Bifurcaria bifurcata</i>
Algae	<i>Blidingia</i>
Algae	<i>Boergeseniella thuyoides</i>
Algae	<i>Bonnemaisonia hamifera</i>
Algae	<i>Bryopsis plumosa</i>
Algae	<i>Catenella caespitosa</i>
Algae	<i>Ceramium botryocarpum</i>
Algae	<i>Ceramium ciliatum</i>
Algae	<i>Ceramium pallidum</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Algae	<i>Ceramium virgatum</i>
Algae	<i>Chaetomorpha ligustica</i>
Algae	<i>Chaetomorpha mediterranea</i>
Algae	<i>Chlorochytrium cohnii</i>
Algae	<i>Chondria dasyphylla</i>
Algae	<i>Chordaria flagelliformis</i>
Algae	<i>Chylocladia verticillata</i>
Algae	<i>Cladophora laetevirens</i>
Algae	<i>Cladophora rupestris</i>
Algae	<i>Cladophora sericea</i>
Algae	<i>Cladostephus spongiosus</i>
Algae	<i>Codium fragile atlanticum</i>
Algae	<i>Codium tomentosum</i>
Algae	<i>Colpomenia peregrina</i>
Algae	<i>Corallina officinalis</i>
Algae	<i>Cryptopleura ramosa</i>
Algae	<i>Cystoclonium purpureum</i>
Algae	<i>Cystoseira baccata</i>
Algae	<i>Cystoseira nodicaulis</i>
Algae	<i>Cystoseira tamariscifolia</i>
Algae	<i>Delesseria sanguinea</i>
Algae	<i>Desmarestia aculeata</i>
Algae	<i>Dictyosiphon foeniculaceus</i>
Algae	<i>Dictyota dichotoma</i>
Algae	<i>Dilsea carnosa</i>
Algae	<i>Dumontia contorta</i>
Algae	<i>Dynamena pumila</i>
Algae	<i>Ectocarpus</i>
Algae	<i>Elachista fucicola</i>
Algae	<i>Ellisolandia elongata</i>
Algae	<i>Erythrodermis traillii</i>
Algae	<i>Erythrotrichia carnea</i>
Algae	<i>Eudesme virescens</i>
Algae	<i>Feldmannia</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Algae	<i>Fucus ceranoides</i>
Algae	<i>Fucus serratus</i>
Algae	<i>Fucus spiralis</i>
Algae	<i>Fucus vesiculosus</i>
Algae	<i>Furcellaria lumbricalis</i>
Algae	<i>Gastroclonium ovatum</i>
Algae	<i>Gastroclonium reflexum</i>
Algae	<i>Gayliella flaccida</i>
Algae	<i>Gelidium crinale</i>
Algae	<i>Gelidium pulchellum</i>
Algae	<i>Gelidium pusillum</i>
Algae	<i>Gelidium spinosum</i>
Algae	<i>Gracilaria gracilis</i>
Algae	<i>Gracilaria vermiculophylla</i>
Algae	<i>Halidrys siliquosa</i>
Algae	<i>Halochlorococcum moorei</i>
Algae	<i>Halurus flosculosus</i>
Algae	<i>Heterosiphonia plumosa</i>
Algae	<i>Hildenbrandia rubra</i>
Algae	<i>Himanthalia elongata</i>
Algae	<i>Hypoglossum hypoglossoides</i>
Algae	<i>Laminaria digitata</i>
Algae	<i>Laminaria hyperborea</i>
Algae	<i>Laurencia pyramidalis</i>
Algae	<i>Leathesia marina</i>
Algae	<i>Lithothamnion</i>
Algae	<i>Lomentaria articulata</i>
Algae	<i>Lomentaria clavellosa</i>
Algae	<i>Mastocarpus stellatus</i>
Algae	<i>Melobesia membranacea</i>
Algae	<i>Membranoptera alata</i>
Algae	<i>Mesophyllum lichenoides</i>
Algae	<i>Osmundea hybrida</i>
Algae	<i>Osmundea osmunda</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Algae	<i>Osmundea pinnatifida</i>
Algae	<i>Osmundea truncata</i>
Algae	<i>Palmaria palmata</i>
Algae	<i>Pelvetia canaliculata</i>
Algae	<i>Petalonia fascia</i>
Algae	<i>Phycodrys rubens</i>
Algae	<i>Phyllophora crispa</i>
Algae	<i>Phyllophora pseudoceranooides</i>
Algae	<i>Plocamium cartilagineum</i>
Algae	<i>Plocamium maggsiae</i>
Algae	<i>Plumaria plumosa</i>
Algae	<i>Polyides rotunda</i>
Algae	<i>Polysiphonia fucoides</i>
Algae	<i>Polysiphonia nigra</i>
Algae	<i>Porphyra umbilicalis</i>
Algae	<i>Prasiola stipitata</i>
Algae	<i>Pterocладиella capillacea</i>
Algae	<i>Pterosiphonia parasitica</i>
Algae	<i>Ptilota gunneri</i>
Algae	<i>Punctaria latifolia</i>
Algae	<i>Pylaiella littoralis</i>
Algae	<i>Pyropia leucosticta</i>
Algae	<i>Ralfsia</i>
Algae	<i>Rhizoclonium tortuosum</i>
Algae	<i>Rhodochorton purpureum</i>
Algae	<i>Rhodomela confervoides</i>
Algae	<i>Rhodothamniella floridula</i>
Algae	<i>Rhodymenia pseudopalmata</i>
Algae	<i>Saccharina latissima</i>
Algae	<i>Saccorhiza polyschides</i>
Algae	<i>Sargassum muticum</i>
Algae	<i>Scinaia furcellata</i>
Algae	<i>Scytosiphon lomentaria</i>
Algae	<i>Sphacelaria cirrosa</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Algae	<i>Spongomorpha aeruginosa</i>
Algae	<i>Spongomorpha arcta</i>
Algae	<i>Spongonema tomentosum</i>
Algae	<i>Stictyosiphon tortilis</i>
Algae	<i>Titanoderma pustulatum</i>
Algae	<i>Ulothrix implexa</i>
Algae	<i>Ulva clathrata</i>
Algae	<i>Ulva compressa</i>
Algae	<i>Ulva gigantea</i>
Algae	<i>Ulva intestinalis</i>
Algae	<i>Ulva lactuca</i>
Algae	<i>Ulva linza</i>
Algae	<i>Ulva prolifera</i>
Algae	<i>Ulva pseudocurvata</i>
Algae	<i>Ulva rigida</i>
Algae	<i>Urospora penicilliformis</i>
Algae	<i>Vertebrata lanosa</i>
Angiosperm	<i>Armeria maritima</i>
Angiosperm	<i>Spartina anglica</i>
Angiosperm	<i>Zostera (Zostera) marina</i>
Annelida	<i>Alentia gelatinosa</i>
Annelida	<i>Amphitrite</i>
Annelida	<i>Arenicola marina</i>
Annelida	<i>Capitella capitata</i>
Annelida	<i>Cirratulidae</i>
Annelida	<i>Eupolymnia nebulosa</i>
Annelida	<i>Filograna implexa</i>
Annelida	<i>Hediste diversicolor</i>
Annelida	<i>Lanice conchilega</i>
Annelida	<i>Lepidonotus clava</i>
Annelida	<i>Nephtys</i>
Annelida	<i>Nicomache lumbricalis</i>
Annelida	<i>Perinereis</i>
Annelida	<i>Phyllodoce lamelligera</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Annelida	<i>Pygospio elegans</i>
Annelida	<i>Sabella pavonina</i>
Annelida	<i>Scoloplos</i>
Annelida	<i>Serpula vermicularis</i>
Annelida	<i>Spirobranchus lamarcki</i>
Annelida	<i>Spirobranchus triqueter</i>
Annelida	<i>Spirorbis (Spirorbis) spirorbis</i>
Annelida	<i>Syllidae</i>
Annelida	<i>Terebellidae</i>
Annelida	<i>Tubificoides</i>
Bryozoa	<i>Alcyonidium diaphanum</i>
Bryozoa	<i>Alcyonidium gelatinosum</i>
Bryozoa	<i>Bowerbankia imbricata</i>
Bryozoa	<i>Bryozoa indet crusts</i>
Bryozoa	<i>Bugula</i>
Bryozoa	<i>Cellepora</i>
Bryozoa	<i>Celleporella hyalina</i>
Bryozoa	<i>Crisia</i>
Bryozoa	<i>Disporella hispida</i>
Bryozoa	<i>Electra pilosa</i>
Bryozoa	<i>Escharoides coccinea</i>
Bryozoa	<i>Flustrellidra hispida</i>
Bryozoa	<i>Membranipora membranacea</i>
Bryozoa	<i>Oshurkovia littoralis</i>
Cnidaria	<i>Actinia equina</i>
Cnidaria	<i>Actinothoe sphyrodeta</i>
Cnidaria	<i>Alcyonium digitatum</i>
Cnidaria	<i>Anemonia viridis</i>
Cnidaria	<i>Aurelia aurita</i>
Cnidaria	<i>Caryophyllia (Caryophyllia) smithii</i>
Cnidaria	<i>Cerianthus lloydii</i>
Cnidaria	<i>Clava multicornis</i>
Cnidaria	<i>Corynactis viridis</i>
Cnidaria	<i>Cyanea capillata</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Cnidaria	<i>Epizoanthus couchii</i>
Cnidaria	<i>Halecium halecinum</i>
Cnidaria	<i>Halopteris catharina</i>
Cnidaria	<i>Nemertesia antennina</i>
Cnidaria	<i>Nemertesia ramosa</i>
Cnidaria	<i>Obelia geniculata</i>
Cnidaria	<i>Obelia longissima</i>
Cnidaria	<i>Rhizostoma pulmo</i>
Cnidaria	<i>Sagartia elegans</i>
Cnidaria	<i>Sagartia troglodytes</i>
Cnidaria	<i>Sertularia argentea</i>
Cnidaria	<i>Tubularia</i>
Cnidaria	<i>Urticina felina</i>
Crustacea	<i>Austrominius modestus</i>
Crustacea	<i>Balanus balanus</i>
Crustacea	<i>Balanus crenatus</i>
Crustacea	<i>Cancer pagurus</i>
Crustacea	<i>Caprellidae</i>
Crustacea	<i>Carcinus maenas</i>
Crustacea	<i>Copepoda</i>
Crustacea	<i>Corophium</i>
Crustacea	<i>Echinogammarus marinus</i>
Crustacea	<i>Echinogammarus obtusatus</i>
Crustacea	<i>Galathea strigosa</i>
Crustacea	<i>Gammarus lacustris</i>
Crustacea	<i>Gammarus locusta</i>
Crustacea	<i>Homarus gammarus</i>
Crustacea	<i>Hyas</i>
Crustacea	<i>Isopoda</i>
Crustacea	<i>Jaera (Jaera) prae-hirsuta</i>
Crustacea	<i>Janira maculosa</i>
Crustacea	<i>Ligia oceanica</i>
Crustacea	<i>Liocarcinus depurator</i>
Crustacea	<i>Necora puber</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Crustacea	<i>Ostracoda</i>
Crustacea	<i>Pagurus bernhardus</i>
Crustacea	<i>Pilumnus hirtellus</i>
Crustacea	<i>Pisidia longicornis</i>
Crustacea	<i>Porcellana platycheles</i>
Crustacea	<i>Semibalanus balanoides</i>
Crustacea	<i>Verruca stroemia</i>
Echinodermata	<i>Amphipholis squamata</i>
Echinodermata	<i>Antedon bifida</i>
Echinodermata	<i>Asterias rubens</i>
Echinodermata	<i>Asterina gibbosa</i>
Echinodermata	<i>Asterina phylactica</i>
Echinodermata	<i>Echinus esculentus</i>
Echinodermata	<i>Henricia oculata</i>
Echinodermata	<i>Leptasterias (Leptasterias) muelleri</i>
Echinodermata	<i>Ophiocomina nigra</i>
Echinodermata	<i>Ophiothrix fragilis</i>
Echinodermata	<i>Ophiura</i>
Echinodermata	<i>Pawsonia saxicola</i>
Echinodermata	<i>Psammechinus miliaris</i>
Fish	<i>Callionymus lyra</i>
Fish	<i>Conger conger</i>
Fish	<i>Gobiidae</i>
Fish	<i>Labrus bergylta</i>
Fish	<i>Limanda limanda</i>
Fish	<i>Lipophrys pholis</i>
Fish	<i>Nerophis lumbriciformis</i>
Fish	<i>Osmerus eperlanus</i>
Fish	<i>Pholis gunnellus</i>
Fish	<i>Pomatoschistus minutus</i>
Fish	<i>Trisopterus luscus</i>
Fish	<i>Trisopterus minutus</i>
Hexapoda	<i>Anurida maritima</i>
Lichens	<i>Caloplaca marina</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Lichens	<i>Grey lichens</i>
Lichens	<i>Ochrolechia parella</i>
Lichens	<i>Ramalina siliquosa</i>
Lichens	<i>Verrucaria maura</i>
Lichens	<i>Verrucaria mucosa</i>
Lichens	<i>Xanthoria parietina</i>
Mammalia	<i>Halichoerus grypus</i>
Mammalia	<i>Lutra lutra</i>
Mammalia	<i>Phoca vitulina</i>
Mollusca	<i>Acanthochitona crinita</i>
Mollusca	<i>Acanthodoris pilosa</i>
Mollusca	<i>Adalaria proxima</i>
Mollusca	<i>Aegires punctilucens</i>
Mollusca	<i>Aeolidia filomenae</i>
Mollusca	<i>Aeolidia papillosa</i>
Mollusca	<i>Aeolidiella glauca</i>
Mollusca	<i>Aequipecten opercularis</i>
Mollusca	<i>Alvania punctura</i>
Mollusca	<i>Anomia ephippium</i>
Mollusca	<i>Auriculinella bidentata</i>
Mollusca	<i>Berthella plumula</i>
Mollusca	<i>Bittium reticulatum</i>
Mollusca	<i>Boreotrophon truncatus</i>
Mollusca	<i>Buccinum undatum</i>
Mollusca	<i>Calliostoma zizyphinum</i>
Mollusca	<i>Callochiton septemvalvis</i>
Mollusca	<i>Cerastoderma edule</i>
Mollusca	<i>Cerithiopsis tubercularis</i>
Mollusca	<i>Chamelea striatula</i>
Mollusca	<i>Cingula trifasciata</i>
Mollusca	<i>Clausinella fasciata</i>
Mollusca	<i>Crisilla semistriata</i>
Mollusca	<i>Diodora graeca</i>
Mollusca	<i>Doris pseudoargus</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Mollusca	<i>Dosinia exoleta</i>
Mollusca	<i>Doto dunnei</i>
Mollusca	<i>Doto fragilis</i>
Mollusca	<i>Doto maculata</i>
Mollusca	<i>Eatonina fulgida</i>
Mollusca	<i>Eledone cirrhosa</i>
Mollusca	<i>Emarginula fissura</i>
Mollusca	<i>Ensis ensis</i>
Mollusca	<i>Ensis magnus</i>
Mollusca	<i>Facelina bostoniensis</i>
Mollusca	<i>Flabellina lineata</i>
Mollusca	<i>Flabellina pedata</i>
Mollusca	<i>Gari tellinella</i>
Mollusca	<i>Goniodoris nodosa</i>
Mollusca	<i>Heteranomia squamula</i>
Mollusca	<i>Hiatella arctica</i>
Mollusca	<i>Janolus cristatus</i>
Mollusca	<i>Jorunna tomentosa</i>
Mollusca	<i>Kellia suborbicularis</i>
Mollusca	<i>Kurtiella bidentata</i>
Mollusca	<i>Lacuna crassior</i>
Mollusca	<i>Lacuna pallidula</i>
Mollusca	<i>Lacuna parva</i>
Mollusca	<i>Lacuna vincta</i>
Mollusca	<i>Lamellaria latens</i>
Mollusca	<i>Lasaea adansoni</i>
Mollusca	<i>Lepidochitona (Lepidochitona) cinerea</i>
Mollusca	<i>Leptochiton asellus</i>
Mollusca	<i>Limacia clavigera</i>
Mollusca	<i>Littorina compressa</i>
Mollusca	<i>Littorina fabalis</i>
Mollusca	<i>Littorina littorea</i>
Mollusca	<i>Littorina obtusata</i>
Mollusca	<i>Littorina saxatilis</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Mollusca	<i>Lucinoma borealis</i>
Mollusca	<i>Lutraria sp.</i>
Mollusca	<i>Macoma balthica</i>
Mollusca	<i>Margarites helycinus</i>
Mollusca	<i>Melarhaphe neritoides</i>
Mollusca	<i>Mimachlamys varia</i>
Mollusca	<i>Modiolus modiolus</i>
Mollusca	<i>Moerella donacina</i>
Mollusca	<i>Monia patelliformis</i>
Mollusca	<i>Musculus subpictus</i>
Mollusca	<i>Mya arenaria</i>
Mollusca	<i>Mya truncata</i>
Mollusca	<i>Mytilus edulis</i>
Mollusca	<i>Nassarius incrassatus</i>
Mollusca	<i>Nucella lapillus</i>
Mollusca	<i>Nucula sp</i>
Mollusca	<i>Ocenebra erinaceus</i>
Mollusca	<i>Odostomia carrozzai</i>
Mollusca	<i>Odostomia eulimoides</i>
Mollusca	<i>Odostomia turrita</i>
Mollusca	<i>Odostomia unidentata</i>
Mollusca	<i>Omalogyra atomus</i>
Mollusca	<i>Onoba aculeus</i>
Mollusca	<i>Onoba semicostata</i>
Mollusca	<i>Ostrea edulis</i>
Mollusca	<i>Palliolum tigrinum</i>
Mollusca	<i>Parvicardium exiguum</i>
Mollusca	<i>Patella pellucida</i>
Mollusca	<i>Patella ulyssiponensis</i>
Mollusca	<i>Patella vulgata</i>
Mollusca	<i>Pecten maximus</i>
Mollusca	<i>Peringia ulvae</i>
Mollusca	<i>Phorcus lineatus</i>
Mollusca	<i>Polititapes rhomboides</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Mollusca	<i>Pusillina inconspicua</i>
Mollusca	<i>Pusillina sarsii</i>
Mollusca	<i>Rissoa lilacina</i>
Mollusca	<i>Rissoa parva</i>
Mollusca	<i>Rissoella diaphana</i>
Mollusca	<i>Rissoella globularis</i>
Mollusca	<i>Rissoella opalina</i>
Mollusca	<i>Scrobicularia plana</i>
Mollusca	<i>Skeneopsis planorbis</i>
Mollusca	<i>Spisula solida</i>
Mollusca	<i>Spisula subtruncata</i>
Mollusca	<i>Steromphala cineraria</i>
Mollusca	<i>Steromphala umbilicalis</i>
Mollusca	<i>Tectura virginea</i>
Mollusca	<i>Testudinalia testudinalis</i>
Mollusca	<i>Thracia phaseolina</i>
Mollusca	<i>Timoclea ovata</i>
Mollusca	<i>Tonicella marmorea</i>
Mollusca	<i>Tricolia pullus</i>
Mollusca	<i>Tritonia plebeia</i>
Mollusca	<i>Trivia arctica</i>
Mollusca	<i>Trivia monacha</i>
Mollusca	<i>Turtonia minuta</i>
Mollusca	<i>Turritella communis</i>
Mollusca	<i>Turtonia minuta</i>
Mollusca	<i>Velutina velutina</i>
Mollusca	<i>Venerupis corrugata</i>
Mollusca	<i>Venus casina</i>
Nematoda	<i>Nematoda</i>
Nemertea	<i>Lineus longissimus</i>
Nemertea	<i>Lineus ruber</i>
Platyhelminthes	<i>Leptoplana tremellaris</i>
Platyhelminthes	<i>Polycera quadrilineata</i>
Porifera	<i>Aplysilla rosea</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Porifera	<i>Aplysilla sulfurea</i>
Porifera	<i>Ciocalypta penicillus</i>
Porifera	<i>Clathria (Microciona) atrasanguinea</i>
Porifera	<i>Clathrina coriacea</i>
Porifera	<i>Cliona celata</i>
Porifera	<i>Dysidea fragilis</i>
Porifera	<i>Grantia compressa</i>
Porifera	<i>Halichondria (Halichondria) panicea</i>
Porifera	<i>Haliclona (Rhizoniera) indistincta</i>
Porifera	<i>Haliclona (Rhizoniera) viscosa</i>
Porifera	<i>Halisarca dujardini</i>
Porifera	<i>Hymeniacion perlevis</i>
Porifera	<i>Leuconia nivea</i>
Porifera	<i>Leucosolenia complicata</i>
Porifera	<i>Lissoclinum perforatum</i>
Porifera	<i>Ophlitaspongia papilla</i>
Porifera	<i>Oscarella lobularis</i>
Porifera	<i>Pachymatisma johnstonia</i>
Porifera	<i>Polymastia mamillaris</i>
Porifera	<i>Suberites ficus</i>
Porifera	<i>Sycon ciliatum</i>
Porifera	<i>Terpios fugax</i>
Porifera	<i>Terpios gelatinosa</i>
Porifera	<i>Tethya citrina</i>
Sipuncula	<i>Phascolion (Phascolion) strombus strombus</i>
Tunicata	<i>Aplidium nordmanni</i>
Tunicata	<i>Aplidium punctum</i>
Tunicata	<i>Aplidium turbinatum</i>
Tunicata	<i>Ascidia conchilega</i>
Tunicata	<i>Ascidiella aspersa</i>
Tunicata	<i>Ascidiella scabra</i>
Tunicata	<i>Botrylloides leachii</i>
Tunicata	<i>Botryllus schlosseri</i>
Tunicata	<i>Ciona intestinalis</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Tunicata	<i>Clavelina lepadiformis</i>
Tunicata	<i>Corella eumyota</i>
Tunicata	<i>Corella parallelogramma</i>
Tunicata	<i>Dendrodoa grossularia</i>
Tunicata	<i>Didemnum fulgens</i>
Tunicata	<i>Diplosoma spongiforme</i>
Tunicata	<i>Morchellium argus</i>

Table 2.4 List of PMF species NOT recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Taxonomic group	Species
Algae	<i>Cruoria cruoriiformis</i>
Algae	<i>Stenogramma interruptum</i>
Bird	<i>Phalacrocorax aristotelis</i>
Bird	<i>Podiceps auritus</i>
Bryozoan	<i>Bugula turbinata</i>
Cnidarian	<i>Edwardsia timida</i>
Cnidarian	<i>Haliclystus auricula</i>
Elasmobranch	<i>Scyliorhinus canicula</i>
Fish	<i>Anguilla anguilla</i>
Fish	<i>Gadus morhua</i>
Fish	<i>Pleuronectes platessa</i>
Fish	<i>Scomber scombrus</i>
Mollusc	<i>Crenella decussata</i>
Porifera	<i>Biemna variantia</i>
Porifera	<i>Mycale (Carmia) subclavata</i>
Porifera	<i>Myxilla (Myxilla) rosacea</i>

Table 2.5 List of non-native species NOT recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Taxonomic group	Species
Algae	<i>Griffithsia corallinoides</i>
Algae	<i>Heterosiphonia japonica</i>
Algae	<i>Neosiphonia harveyi</i>

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Bryozoa	<i>Bugula fulva</i>
Crustacea	<i>Caprella mutica</i>
Crustacea	<i>Monocorophium insidiosum</i>

Table 2.6 List of PMF species NEWLY recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Taxonomic group	Species
Algae	<i>Ascophyllum nodosum var. mackayi</i>
Fish	<i>Osmerus eperlanus</i>

Table 2.7 List of non-native species NEWLY recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Taxonomic group	Species
Algae	<i>Gracilaria vermiculophylla</i>
Angiosperm	<i>Spartina anglica</i>
Mollusc	<i>Mya arenaria</i>
Tunicate	<i>Corella eumyota</i>

ANNEX 3 (biotopes)

Table 3.1 Total number of biotopes and type of PMF habitats recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Type		Total no. biotopes	% of total biotopes
PMF habitats	Coastal saltmarsh	1	3.85
	Intertidal underboulder communities	5	19.23
	Intertidal mudflats	1	3.85
	Sheltered muddy gravels	1	3.85
	Tide-swept channels	3	11.54
Other habitats	Other biotopes	17	65.38
TOTAL no. of biotopes		26	
Total no. of PMF biotopes		9	34.62
Total no. of PMF habitats		5	

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

Table 3.2 Biotopes recorded between 2013-2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Biotope code	Biotope description	EUNIS code	EUNIS level	Designated Annex I	PMF habitat
IR.MIR.KR.Ldig.Bo	<i>Laminaria digitata</i> and under-boulder fauna on sublittoral fringe boulders	A3.2112	6	Reefs	Yes - Intertidal underboulder communities
IR.MIR.KT.LdigT	<i>Laminaria digitata</i> , ascideans and bryozoans on tide-swept sublittoral fringe rock	A3.221	5	Reefs & Large shallow inlets and bays	Yes - Intertidal underboulder communities
IR.MIR.KT.XKTX	Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids	A3.223	5	Reefs & Large shallow inlets and bays	Yes - Tide swept channels
LR.FLR.Lic.Ver.Ver	<i>Verucaria maura</i> on very exposed to very sheltered upper littoral fringe rock	B3.1132	6	Reefs	
LR.FLR.Lic.YG	Yellow and grey lichens on supralittoral rock	B3.111	5	Reefs & Large shallow inlets and bays	
LR.FLR.Rkp.SwSed	Seaweeds in sediment-floored eulittoral rockpools	A1.413	5	Reefs	
LR.HLR.FR.Him	<i>Himantalia elongata</i> and red seaweeds on exposed to moderately exposed lower eulittoral rock	A1.123	5	Reefs	
LR.HLR.FT.FserT	<i>Fucus serratus</i> , sponges and ascidians on tide-swept lower eulittoral rock	A1.152	5	Reefs & Large shallow inlets and bays	Yes - Tide-swept channels and intertidal

Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific Interest (ASSI) and Intertidal Special Area of Conservation (SAC)

					under boulder communities
LR.HLR.FT.FserTX	<i>Fucus serratus</i> with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata	A1.153	5	Reefs & Large shallow inlets and bays	Yes - Tide-swept channels and intertidal under boulder communities
LR.HLR.MusB.Sem.Sem	<i>Semibalanus balanoides</i> , <i>Patella vulgata</i> and <i>Littorina</i> spp. on exposed to moderately exposed or vertical sheltered eulittoral rock	A1.1131	6	Reefs	
LR.LLR.F.Asc.FS	<i>Ascophyllum nodosum</i> on full salinity mid eulittoral rock	A1.3141	6	Reefs & Large shallow inlets and bays	
LR.LLR.F.Asc.X	<i>Ascophyllum nodosum</i> on full salinity mid eulittoral mixed substrata	A1.3142	6	Reefs & Large shallow inlets and bays	
LR.LLR.F.Fserr	<i>Fucus serratus</i> on sheltered lower eulittoral rock	A1.315	5	Reefs & Large shallow inlets and bays	
LR.LLR.F.Fserr.FS	<i>Fucus serratus</i> on full salinity sheltered lower eulittoral rock	A1.3151	6	Reefs & Large shallow inlets and bays	
LR.LLR.F.Fspi	<i>Fucus spiralis</i> on sheltered upper eulittoral rock	A1.312	5	Reefs & Large shallow inlets and bays	
LR.LLR.F.Fves.X	<i>Fucus vesiculosus</i> on mid eulittoral mixed substrata	A1.3132	6	Reefs & Large shallow inlets and bays	
LR.LLR.F.Pel	<i>Pelvetia canaliculata</i> on sheltered littoral fringe rock	A1.311	5	Reefs	

**Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific
Interest (ASSI) and Intertidal Special Area of Conservation (SAC)**

LR.MLR.BF.Fser.Bo	<i>Fucus serratus</i> and under-boulder fauna on lower eulittoral boulders	A1.2142	6	Reefs	Yes - Intertidal underboulder communities
LR.MLR.BF.FspiB	<i>Fucus spiralis</i> on exposed to moderately exposed upper eulittoral rock	A1.212	5	Reefs	
LS.LMp.Sm	Saltmarsh	A2.5	3	Annual vegetation of drift lines / <i>Salicornia</i> and other annuals colonising mud and sand / Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>) / Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>) / <i>Spartina</i> swards (<i>Spartina maritimae</i>) & Large shallow inlets and bays	Yes - Coastal saltmarsh
LS.LMu.UEst.Tben	<i>Tubificoides benedii</i> and other oligochaetes in littoral mud	A2.323	5	Mudflats and sandflats not covered by seawater at low tide	Yes - Intertidal mudflats
LS.LMx.GvMu.HedMx.Cir	<i>Hediste diversicolor</i> , cirratulids and <i>Tubificoides</i> spp. in littoral gravelly sandy mud	A2.4114	6		Yes - Sheltered muddy gravels
MS	Mixed seaweeds	Seasearch			
SAT	Short animal turf on rocks	Seasearch			
SLA	Sediment with life apparent	Seasearch			
TAT	Tall animal turf on rocks	Seasearch			

**Condition Assessment 2019 – Strangford Lough Part 2 Area of Special Scientific
Interest (ASSI) and Intertidal Special Area of Conservation (SAC)**

Table 3.3 List of PMF biotopes NOT recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Biotope code	Biotope description	EUNIS code	EUNIS level	Designation Annex I	PMF habitat
LR.HLR.FT.AscT	<i>Ascophyllum nodosum</i> , sponges and ascidians on tide-swept mid eulittoral rock	A1.151	5	Reefs	Tide swept channels
LS.LSa.MuSa.HedMacEte	<i>Hediste diversicolor</i> , <i>Macoma balthica</i> and <i>Eteone longa</i> in littoral muddy sand	A2.243	5	Mudflats and sandflats not covered by seawater at low tide	Intertidal mudflats
LS.LSa.MuSa.Lan	<i>Lanice conchilega</i> in littoral sand	A2.245	5	Mudflats and sandflats not covered by seawater at low tide	Intertidal mudflats
LS.LSa.MuSa.MacAre	<i>Macoma balthica</i> and <i>Arenicola marina</i> in littoral muddy sand	A2.241	5	Mudflats and sandflats not covered by seawater at low tide	Intertidal mudflats

Table 3.4 List of PMF biotopes NEWLY recorded between 2013 and 2018 at Strangford Lough Part 2 ASSI and intertidal area of the SAC

Biotope code	Biotope description	EUNIS code	EUNIS level	Designation Annex I	PMF habitat
IR.MIR.KT.LdigT	<i>Laminaria digitata</i> , ascideans and bryozoans on tide-swept sublittoral fringe rock	A3.221	5	Reefs & Large shallow inlets and bays	Intertidal underboulder communities
IR.MIR.KT.XKTX	Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids	A3.223	5	Reefs	Tide swept channels
LR.HLR.FT.FserTX	<i>Fucus serratus</i> , sponges and ascidians on tide-swept lower eulittoral rock	A1.152	5	Reefs	Tide-swept channels and intertidal under boulder communities
LS.LMx.GvMu.HedMx.Cir	<i>Hediste diversicolor</i> , cirratulids and Tubificoides spp. in littoral gravelly sandy mud	A2.4114	6		Sheltered muddy gravels

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