

National Parks and Wildlife Service

Conservation Objectives Series

The Murrough Wetlands SAC 002249



An Roinn Tithíochta,
Rialtais Áitiúil agus Oidhreachta
Department of Housing,
Local Government and Heritage

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Citation:

**NPWS (2021) Conservation Objectives: The Murrrough Wetlands SAC 002249.
Version 1. National Parks and Wildlife Service, Department of Housing, Local
Government and Heritage.**

**Series Editors: Rebecca Jeffrey and Christina Campbell
ISSN 2009-4086**

Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

** indicates a priority habitat under the Habitats Directive*

002249	The Murrrough Wetlands SAC
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1210	Annual vegetation of drift lines
1220	Perennial vegetation of stony banks
1330	Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>)
1410	Mediterranean salt meadows (<i>Juncetalia maritimi</i>)
7210	Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> *
7230	Alkaline fens

Please note that this SAC overlaps with The Murrrough SPA (004186). See map 2. The conservation objectives for this site should be used in conjunction with those for the overlapping site as appropriate.

Supporting documents, relevant reports & publications

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

NPWS Documents

Year :	2007
Title :	Saltmarsh Monitoring Project 2006
Author :	McCorry, M.
Series :	Unpublished report to NPWS
Year :	2009
Title :	Ireland Red List No. 2: Non-marine molluscs
Author :	Byrne, A.; Moorkens, E.A.; Anderson, R.; Killeen, I.J.; Regan, E.C.
Series :	Ireland Red List series, NPWS
Year :	2009
Title :	Coastal Monitoring Project 2004-2006
Author :	Ryle, T.; Murray, A.; Connolly, K.; Swann, M.
Series :	Unpublished report to NPWS
Year :	2009
Title :	Saltmarsh monitoring project 2007-2008
Author :	McCorry, M.; Ryle, T.
Series :	Unpublished report to NPWS
Year :	2010
Title :	Ireland Red List No. 4: Butterflies
Author :	Regan, E.C.; Nelson, B.; Aldwell, B.; Bertrand, C.; Bond, K.; Harding, J.; Nash, D.; Nixon, D.; Wilson, C.J.
Series :	Ireland Red List series, NPWS
Year :	2011
Title :	Monitoring and condition assessment of populations of <i>Vertigo geyeri</i> , <i>Vertigo angustior</i> and <i>Vertigo moulinsiana</i> in Ireland
Author :	Moorkens, E.; Killeen, I.
Series :	Irish Wildlife Manuals, No. 55
Year :	2012
Title :	Ireland Red List No. 8: Bryophytes
Author :	Lockhart, N.; Hodgetts, N.; Holyoak, D.
Series :	Ireland Red List series, NPWS
Year :	2013
Title :	Monitoring survey of Annex I sand dune habitats in Ireland
Author :	Delaney, A.; Devaney, F.M.; Martin, J.M.; Barron, S.J.
Series :	Irish Wildlife Manuals, No. 75
Year :	2013
Title :	The status of EU protected habitats and species in Ireland. Volume 2. Habitats assessments
Author :	NPWS
Series :	Conservation assessments
Year :	2016
Title :	Ireland Red List No. 10: Vascular Plants
Author :	Wyse Jackson, M.; FitzPatrick, Ú.; Cole, E.; Jebb, M.; McFerran, D.; Sheehy Skeffington, M.; Wright, M.
Series :	Ireland Red Lists series, NPWS

Year :	2017
Title :	Survey and assessment of vegetated shingle and associated habitats at 30 coastal sites in Ireland
Author :	Martin, J.R.; Daly, O.H.; Devaney F.M.
Series :	Irish Wildlife Manuals, No. 98
Year :	2019
Title :	Monitoring of sites and habitat for three Annex II species of whorl snail (<i>Vertigo</i>)
Author :	Long, M.P.; Brophy, J.T.
Series :	Irish Wildlife Manuals, No. 104
Year :	2019
Title :	Monitoring of sites and habitat for three Annex II species of whorl snail (<i>Vertigo</i>). Appendix VI <i>Vertigo moulinsiana</i> site reports
Author :	Brophy, J.T.; Long, M.P.
Series :	Irish Wildlife Manuals, No. 104
Year :	2019
Title :	Saltmarsh Monitoring Project 2017-2018
Author :	Brophy, J.T.; Perrin, P.M.; Penk, M.R.; Devaney, F.M.; Leyden, K.J.
Series :	Irish Wildlife Manuals, No. 108
Year :	2019
Title :	Checklists Protected and Threatened Species in Ireland 2019
Author :	Nelson, B.; Cummins, S.; Fay, L.; Jeffrey, R.; Kelly, S.; Kingston, N.; Lockhart, N.; Marnell, F.; Tierney, D.; Wyse Jackson, M.
Series :	Irish Wildlife Manuals, No. 116
Year :	2021
Title :	Checklists Protected and Threatened Species in Ireland. Version 2.1. 3 December 2021
Author :	Nelson, B.; Cummins, S.; Fay, L.; Jeffrey, R.; Kelly, S.; Kingston, N.; Lockhart, N.; Marnell, F.; Tierney, D.; Wyse Jackson, M.
Series :	Irish Wildlife Manuals, No. 116
Year :	2021
Title :	The Murrrough Wetlands SAC (site code: 2249) Conservation objectives supporting document - coastal habitats V1
Author :	NPWS
Series :	Conservation objectives supporting document
Year :	in prep.
Title :	Scoping study and pilot survey of fens
Author :	O'Neill, F.H.; Perrin, P.M.; Denyer, J.; Martin, J.R.; Daly, O.H.; Brophy, J.T.
Series :	Irish Wildlife Manuals

Other References

Year :	2008
Title :	The phytosociology and conservation value of Irish sand dunes
Author :	Gaynor, K.
Series :	Unpublished Ph.D. Thesis, National University of Ireland, Dublin
Year :	2011
Title :	Review and revision of empirical critical loads and dose-response relationships. Proceedings of an expert workshop, Noordwijkerhout, 23-25 June 2010
Author :	Bobbink, R.; Hettelingh, J.P.
Series :	RIVM report 680359002, Coordination Centre for Effects, National Institute for Public Health and the Environment (RIVM)

Year : 2011
Title : The Fen Management Handbook
Author : McBride, A.; Diack, I.; Droy, N.; Hamill, B.; Jones, P.; Schutten, J.; Skinner, A.; Street, M. (eds.)
Series : Scottish Natural Heritage, Perth

Year : 2012
Title : The County Wicklow Wetland Survey II
Author : Wilson, F.; Crushell, P.; Curtis, T.; Foss, P.J.
Series : Report prepared for Wicklow County Council and The Heritage Council

Year : 2018
Title : Irish Vegetation Classification: Technical Progress Report No. 4
Author : Perrin, P.
Series : Report submitted to National Biodiversity Data Centre

Year : 2019
Title : Murrough sand dunes assessment
Author : Martin, J.R.
Series : Unpublished Report by BEC Consultants Ltd. for Wicklow County Council

Spatial data sources

Year :	2019
Title :	Martin (2019) Murrrough sand dunes assessment
GIS Operations :	QIs selected; clipped to SAC boundary; Expert opinion used as necessary to resolve any issues arising
Used For :	1210, 1220 (map 3)
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Year :	Revision 2010
Title :	Saltmarsh Monitoring Project 2007-2008. Version 1
GIS Operations :	QIs selected; clipped to SAC boundary; Expert opinion used as necessary to resolve any issues arising
Used For :	1330 (map 4)
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Year :	2019
Title :	Saltmarsh Monitoring Project 2017-2018
GIS Operations :	QIs selected; clipped to SAC boundary; Expert opinion used as necessary to resolve any issues arising
Used For :	1330, 1410 (maps 4 and 5)
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Year :	2012
Title :	Wilson et al. (2012) The County Wicklow Wetland Survey II
GIS Operations :	QIs selected; clipped to SAC boundary; Expert opinion used as necessary to resolve any issues arising
Used For :	7210, 7230 (map 6)
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1210 Annual vegetation of drift lines

To restore the favourable conservation condition of Annual vegetation of drift lines in The Murrough Wetlands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession	Annual vegetation of drift lines was surveyed and mapped in The Murrough Wetlands SAC by Martin (2019) to give a total estimated area of c.5.2ha. See map 3. The habitat is very difficult to measure in view of its dynamic nature which means that it can appear and disappear within a site from year to year. See The Murrough Wetlands SAC conservation objectives supporting document for coastal habitats for further details. It is important to note that due to natural coastal processes, area and distribution are dynamic and subject to change from year to year
Habitat distribution	Occurrence	No decline, subject to natural processes, including erosion and succession. See map 3 for the habitat recorded by Martin (2019)	Distribution based on data from Martin (2019). See the coastal habitats supporting document for further details. It is important to note that due to natural coastal processes, area and distribution are dynamic and subject to change from year to year
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Restore the natural circulation of sediment and organic matter, without any physical obstructions	Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. Physical barriers will affect sediment supply at these sites. See the coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Attribute and target based on Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). See the coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain the presence of species-poor communities with typical species: sea rocket (<i>Cakile maritima</i>), sea sandwort (<i>Honckenya peploides</i>), prickly saltwort (<i>Salsola kali</i>) and orache (<i>Atriplex</i> spp.)	Attribute and target based on Ryle et al. (2009) and Delaney et al. (2013). See the coastal habitats supporting document for further details
Vegetation composition: native negative indicator species	Percentage	Native negative indicator species cover in any individual monitoring stop should not be more than 25%; no negative indicator species should be present in more than 60% of monitoring stops; cover of negative indicator species across the whole site should not be more than 5%	Attribute and target based on Delaney et al. (2013), where the list of native negative indicator species is listed. Negative indicators include species indicative of changes in nutrient status and species not considered characteristic of the habitat. See the coastal habitats supporting document for further details
Vegetation composition: non-native species	Percentage	Non-native species should not be present in more than 20% of monitoring stops	Attribute and target based on Delaney et al. (2013). See the coastal habitats supporting document for further details

1220 Perennial vegetation of stony banks

To restore the favourable conservation condition of Perennial vegetation of stony banks in The Murrrough Wetlands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession	Perennial vegetation of stony banks was surveyed and mapped in The Murrrough Wetlands SAC by Martin (2019) to give a total estimated area of c.13ha. See map 3. See The Murrrough Wetlands SAC conservation objectives supporting document for coastal habitats for further details. It is important to note that due to natural coastal processes, area and distribution are dynamic and subject to change from year to year
Habitat distribution	Occurrence	No decline in habitat distribution, subject to natural processes, including erosion and succession. See map 3 for the habitat recorded by Martin (2019)	Distribution based on data from Martin (2019). See the coastal habitats supporting document for further details. It is important to note that due to natural coastal processes, area and distribution are dynamic and subject to change from year to year
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Restore the natural circulation of sediment and organic matter, without any physical obstructions	Attribute and target based on Martin et al. (2017). See the coastal habitats supporting document for further details
Physical structure: disturbance	Percentage	No more than 20% of the habitat affected by disturbance	Attribute and target based on Martin et al. (2017). Disturbance can include damage from heavy trampling, vehicle damage and removal of substrate. See the coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats, including transitional zones, subject to natural processes, including erosion and succession	Attribute and target based on Martin et al. (2017). See the coastal habitats supporting document for further details
Vegetation composition: communities and typical species	Percentage	Maintain the typical species within the range of vegetated shingle communities	Attribute and target based on Martin et al. (2017) where information on the vegetated shingle communities and associated typical species lists are presented. See the coastal habitats supporting document for details on the pioneer, grassland and scrub communities of the habitat recorded by Martin (2019) in The Murrrough Wetlands SAC
Vegetation composition: native negative indicator species	Percentage	Native negative indicator species cover in any individual monitoring stop should not be more than 25%; no negative indicator species should be present in more than 60% of monitoring stops	Attribute and target based on Martin et al. (2017) where the list of negative indicator species for the habitat is also presented. Negative indicators include species indicative of changes in nutrient status and species not considered characteristic of the habitat. See the coastal habitats supporting document for further details
Vegetation composition: non-native species	Percentage	Non-native species cover in any individual monitoring stop should not be more than 1%; non-native species should not be present in more than 20% of monitoring stops; cover of non-native species across the whole site should not be more than 1%	Attribute and target based on Martin et al. (2017). See the coastal habitats supporting document for further details

Conservation Objectives for : The Murrrough Wetlands SAC [002249]

1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

To restore the favourable conservation condition of Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) in The Murrrough Wetlands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession	As part of the Saltmarsh Monitoring Project 2017-2018 (Brophy et al., 2019), the sub-site Broad Lough (site code SMP0135) within The Murrrough Wetlands SAC was surveyed and mapped, with an area of 16.57ha of Atlantic salt meadows (ASM) habitat recorded. As part of the baseline Saltmarsh Monitoring Project 2006-2008 (McCorry, 2007; McCorry and Ryle, 2009), an area of 0.07ha of ASM was recorded within the northern boundary of the SAC at the sub-site Kilcoole (SMP0036) by McCorry and Ryle (2009). Thus, the total area of the habitat in the SAC is estimated to be 16.64ha. See map 4. Habitat loss was noted by Brophy et al. (2019) due to construction of a track associated with drainage works at the Broad Lough sub-site. See The Murrrough Wetlands SAC conservation objectives supporting document for coastal habitats for further details. It is important to note that due to natural coastal processes, area and distribution are dynamic and subject to change from year to year
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 4	Distribution based on data from Brophy et al. (2019) and McCorry and Ryle (2009). See the coastal habitats supporting document for further details. It is important to note that due to natural coastal processes, area and distribution are dynamic and subject to change from year to year
Physical structure: hydrology	Occurrence of human disturbance to hydrology (including impacts on creeks and pans)	No human disturbance	Attribute and target based on Brophy et al. (2019). In this SAC, drainage works were noted in the habitat in the sub-site Broad Lough (site code SMP0135) by Brophy et al. (2019). See the coastal habitats supporting document for further details
Vegetation structure: plant height	Standard deviation of median of maximum leaf height from four quadrants of a representative number of 2m x 2m monitoring plots	Standard deviation of median plant height more than 5	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Vegetation structure: disturbed ground	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of disturbed ground less than 5%	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Vegetation structure: zonation	Number of zones covering 1% or more of the habitat	Adequate number of zones present, depending on geographical type of saltmarsh	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Vegetation structure: transitions	Occurrence of natural transitions to semi-natural terrestrial habitats on landward margin	No loss of natural transitions	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Vegetation composition: typical species	Frequency of typical species within a representative number of 2m x 2m monitoring plots	Minimum of twelve typical species recorded across all plots	Attribute and target based on Brophy et al. (2019), where the list of typical species for this habitat is presented. See the coastal habitats supporting document for further details

Vegetation composition: negative species	Occurrence in habitat; percentage cover of <i>Spartina</i> spp. within 5m radius of the centre of a representative number of monitoring stops	<i>Spartina</i> spp. have not been recorded in the habitat in this SAC and establishment should be prevented	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Other negative indicators	Occurrence at a representative number of 2m x 2m monitoring plots	No signs of infilling, reclamation, turf-cutting or pollution or other negative indicators	Attribute and target based on Brophy et al. (2019). In the habitat in the sub-site Broad Lough (site code SMP0135), disturbance due to use of a mechanical digger and deposition of dredged materials was recorded by Brophy et al. (2019). See the coastal habitats supporting document for further details
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat	Attribute and target based on Brophy et al. (2019). The locally distinctive sea couch (<i>Elytrigia atherica</i>) was recorded in the habitat in the Broad Lough sub-site (SMP0135) by Brophy et al. (2019). See the coastal habitats supporting document for further details

Conservation Objectives for : The Murrrough Wetlands SAC [002249]

1410 Mediterranean salt meadows (*Juncetalia maritimi*)

To restore the favourable conservation condition of Mediterranean salt meadows (*Juncetalia maritimi*) in The Murrrough Wetlands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area increasing, subject to natural processes, including erosion and succession	As part of the Saltmarsh Monitoring Project 2017-2018 (Brophy et al., 2019), the sub-site Broad Lough (site code SMP0135) within The Murrrough Wetlands SAC was surveyed and mapped, with an area of 5.17ha of Mediterranean salt meadows (MSM) habitat recorded. See map 5. See The Murrrough Wetlands SAC conservation objectives supporting document for coastal habitats for further details. It is important to note that due to natural coastal processes, range and area are dynamic and subject to change from year to year
Habitat distribution	Occurrence	No decline, subject to natural processes	Based on data from Brophy et al. (2019). See the coastal habitats supporting document for further details. It is important to note that due to natural coastal processes, range and area are dynamic and subject to change from year to year
Physical structure: hydrology	Occurrence of human disturbance to hydrology (including impacts on creeks and pans)	No human disturbance	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Vegetation structure: disturbed ground	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of disturbed ground less than 5%	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Vegetation structure: transitions	Distribution of natural transitions to semi-natural terrestrial habitats on landward margin	No loss of natural transitions	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Vegetation composition: typical species	Frequency of typical species within a representative number of 2m x 2m monitoring plots	Minimum of six typical species recorded across all plots; minimum two typical species in more than 25% of plots (excluding <i>Juncus maritimus</i>)	Attribute and target based on Brophy et al. (2019), where the list of typical species for this habitat is presented. See the coastal habitats supporting document for further details
Vegetation composition: negative species	Occurrence in habitat; percentage cover of <i>Spartina</i> spp. within 5m radius of the centre of a representative number of monitoring stops	<i>Spartina</i> spp. have not been recorded in the habitat in this SAC and establishment should be prevented	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details
Other negative indicators	Occurrence at a representative number of 2m x 2m monitoring plots	No signs of infilling, reclamation, turf-cutting or pollution or other negative indicators	Attribute and target based on Brophy et al. (2019). Infilling of the habitat in the sub-site Broad Lough (site code SMP0135) was recorded by Brophy et al. (2019). See the coastal habitats supporting document for further details
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat	Attribute and target based on Brophy et al. (2019). See the coastal habitats supporting document for further details

Conservation Objectives for : The Murrough Wetlands SAC [002249]

7210 Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae*

To restore the favourable conservation condition of Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae* in The Murrough Wetlands SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes	As part of the Wicklow Wetlands Survey (Wilson et al., 2012), Calcareous fens with <i>Cladium mariscus</i> and species of the Caricion davallianae* was mapped with an area of c.10.2ha, with a further 21.3ha mapped in mosaic with Alkaline fens (Annex I habitat code 7230). See map 6. This a minimum area estimate for the habitat in The Murrough Wetlands SAC. It is important to note that further unsurveyed areas may be present in the SAC. Although the area of fen was more extensive in the past, the SAC still contains one of the best examples of coastal fen in the country (NPWS internal files). See also the conservation objective for Alkaline fens (7230) in this volume
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 6	Distribution based on Wilson et al. (2012). It is important to note that further unsurveyed areas may be present in the SAC. In this SAC, fens occur mostly between Five Mile Point and Six Mile Point, particularly in the townland of Blackditch, and have also been reported from the Leamore, Grange, Castlegrange and Killoughter areas in the SAC (Wilson et al., 2012; NPWS internal files)
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil pH and nutrient status within natural ranges	Relevant nutrients and their natural ranges are yet to be defined. Increased nutrients can lead to changes in plant and invertebrate species through competition and subsequent structural changes to micro-habitats. These nutrients favour growth of grasses rather than forbs and mosses and leads to a higher and denser sward
Ecosystem function: peat formation	Percentage cover of peat-forming vegetation and water table levels	Maintain active peat formation, where appropriate	In order for peat to form, water levels need to be slightly below or above the soil surface for c.90% of the time
Ecosystem function: hydrology - groundwater levels	Water levels (centimetres); duration of levels; hydraulic gradients; water supply levels	Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Fen habitats require high groundwater levels (i.e. water levels at or above the ground surface) for a large proportion of the calendar year (i.e. duration of mean groundwater level). Fen groundwater levels are controlled by regional groundwater levels in the contributing catchment area (which sustain the hydraulic gradients of the fen groundwater table). Regional abstraction of groundwater may affect fen groundwater levels
Ecosystem function: hydrology - surface water flow	Drain density and form	Maintain, or where necessary restore, as close as possible to natural or semi-natural, drainage conditions	Drainage, either within or surrounding the fen habitat, can result in the drawdown of the groundwater table. The depth, geometry and density of drainage (hydromorphology) will indicate the scale and impact on fen hydrology. Drainage can result in loss of characteristic species and transition to drier habitats. In this SAC, some of the habitat has been damaged by drainage in the past (NPWS internal files)
Ecosystem function: water quality	Various	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	Fens receive natural levels of nutrients (e.g. iron, magnesium and calcium) from water sources. However, they are generally poor in nitrogen and phosphorus, with the latter tending to be the limiting nutrient under natural conditions. Water supply should be also relatively calcium-rich
Vegetation composition: cover of <i>Cladium mariscus</i>	Percentage cover at a representative number monitoring stops	Cover of <i>Cladium mariscus</i> at least 25%	Attribute and target based on O'Neill et al. (in prep.)

Vegetation composition: typical vascular plants	Percentage cover at a representative number of monitoring stops	Maintain adequate cover of typical vascular plant species	For lists of typical vascular plant species, including high quality indicators, see O'Neill et al. (in prep.)
Vegetation composition: native negative indicator species	Percentage cover at a representative number of monitoring stops	Cover of native negative indicator species at insignificant levels	Negative indicators include species not characteristic of the habitat and species indicative of undesirable activities such as overgrazing, undergrazing, nutrient enrichment, agricultural improvement or impacts on hydrology. Native negative indicators may include <i>Anthoxanthum odoratum</i> , <i>Epilobium hirsutum</i> , <i>Holcus lanatus</i> , <i>Juncus effusus</i> , <i>Phragmites australis</i> , <i>Ranunculus repens</i> and <i>Typha latifolia</i> . See O'Neill et al. (in prep.)
Vegetation composition: non-native species	Percentage cover at a representative number of monitoring stops	Cover of non-native species less than 1%	Attribute and target based on O'Neill et al. (in prep.). Non-native species can be invasive and have deleterious effects on native vegetation. A low target is set as non-native species can spread rapidly and are most easily dealt with when still at lower abundances
Vegetation composition: native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of scattered native trees and shrubs less than 10%	Attribute and target based on O'Neill et al. (in prep.). Scrub and trees will tend to invade if fen conditions become drier
Vegetation composition: algal cover	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of algae less than 2%	Attribute and target based on O'Neill et al. (in prep.). Algal cover is indicative of nutrient enrichment from multiple sources (McBride et al., 2011)
Vegetation structure: vegetation height	Percentage cover at a representative number of monitoring stops	At least 10% of live shoots more than 1m high	Attribute and target based on O'Neill et al. (in prep.)
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of disturbed bare ground not more than 10%	Attribute and target based on O'Neill et al. (in prep.). While grazing may be appropriate in this habitat, excessive areas of disturbed bare ground may develop due to unsuitable grazing regimes. Disturbance can include hoof marks, wallows, human footprints, vehicle and machinery tracks. Excessive disturbance can result in loss of characteristic species
Physical structure: tufa formations	Percentage cover in local vicinity of a representative number of monitoring stops	Disturbed proportion of vegetation cover where tufa is present is less than 1%	Attribute and target based on O'Neill et al. (in prep.)
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat; maintain features of local distinctiveness, subject to natural processes	This includes species on the Flora (Protection) Order, 2015 and species of flora and fauna on Red Lists (Byrne et al., 2009; Regan et al., 2010; Lockhart et al., 2012; Wyse Jackson et al., 2016, etc.; see Nelson et al., 2019, 2021). The Annex II listed and Endangered (Byrne et al., 2009) Desmoulin's whorl snail (<i>Vertigo moulinsiana</i>) has been recorded in <i>Cladium</i> fen and associated habitats in the SAC (Moorkens and Killeen, 2011; Long and Brophy, 2019; Brophy and Long, 2019)
Transitional areas between fen and adjacent habitats	Hectares; distribution	Maintain/restore adequate transitional areas to support/protect the <i>Cladium</i> fen habitat and the services it provides	In many cases, fens transition to other wetland habitats. It is important that the transitional areas between <i>Cladium</i> fen and other habitats are maintained in as natural condition as possible in order to protect the functioning of the fen. The habitat occurs in association with alkaline fens in this SAC (see the conservation objective for habitat 7320 in this volume) as well as common reed (<i>Phragmites australis</i>) beds and other swamp vegetation types, and wet woodland

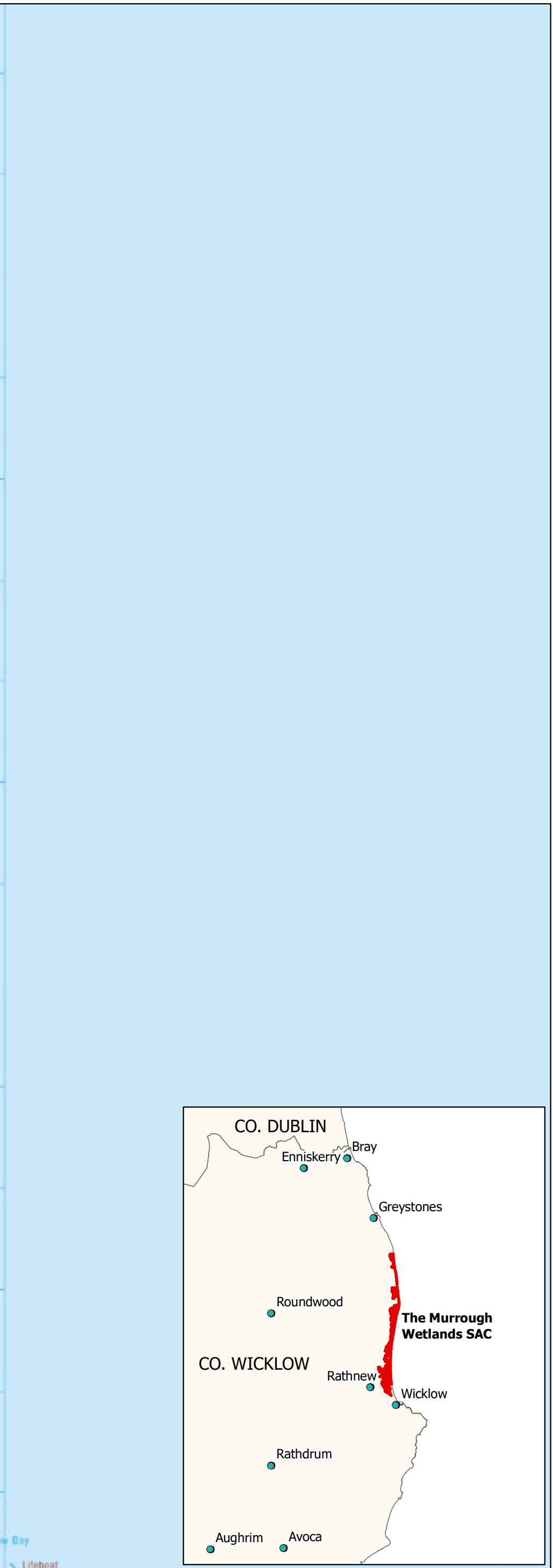
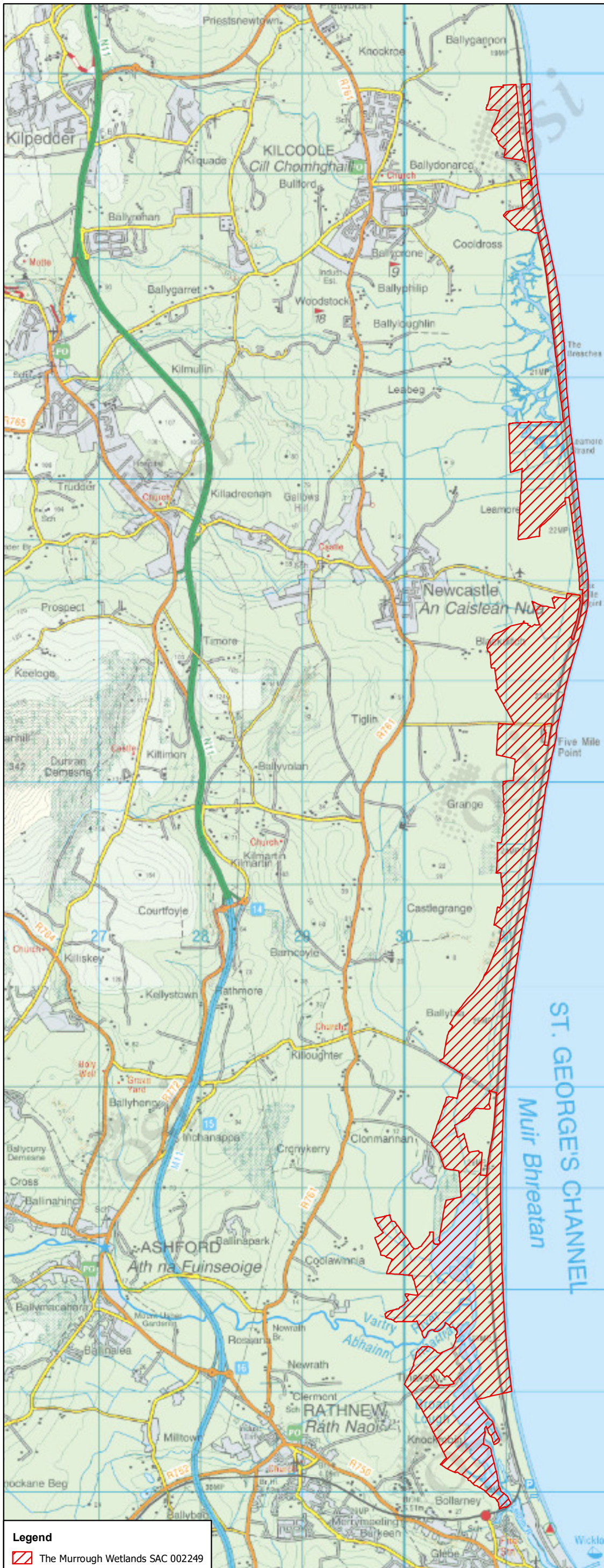
7230 Alkaline fens

To restore the favourable conservation condition of Alkaline fens in The Murrugh Wetlands SAC, which is defined by the following list of attributes and targets:

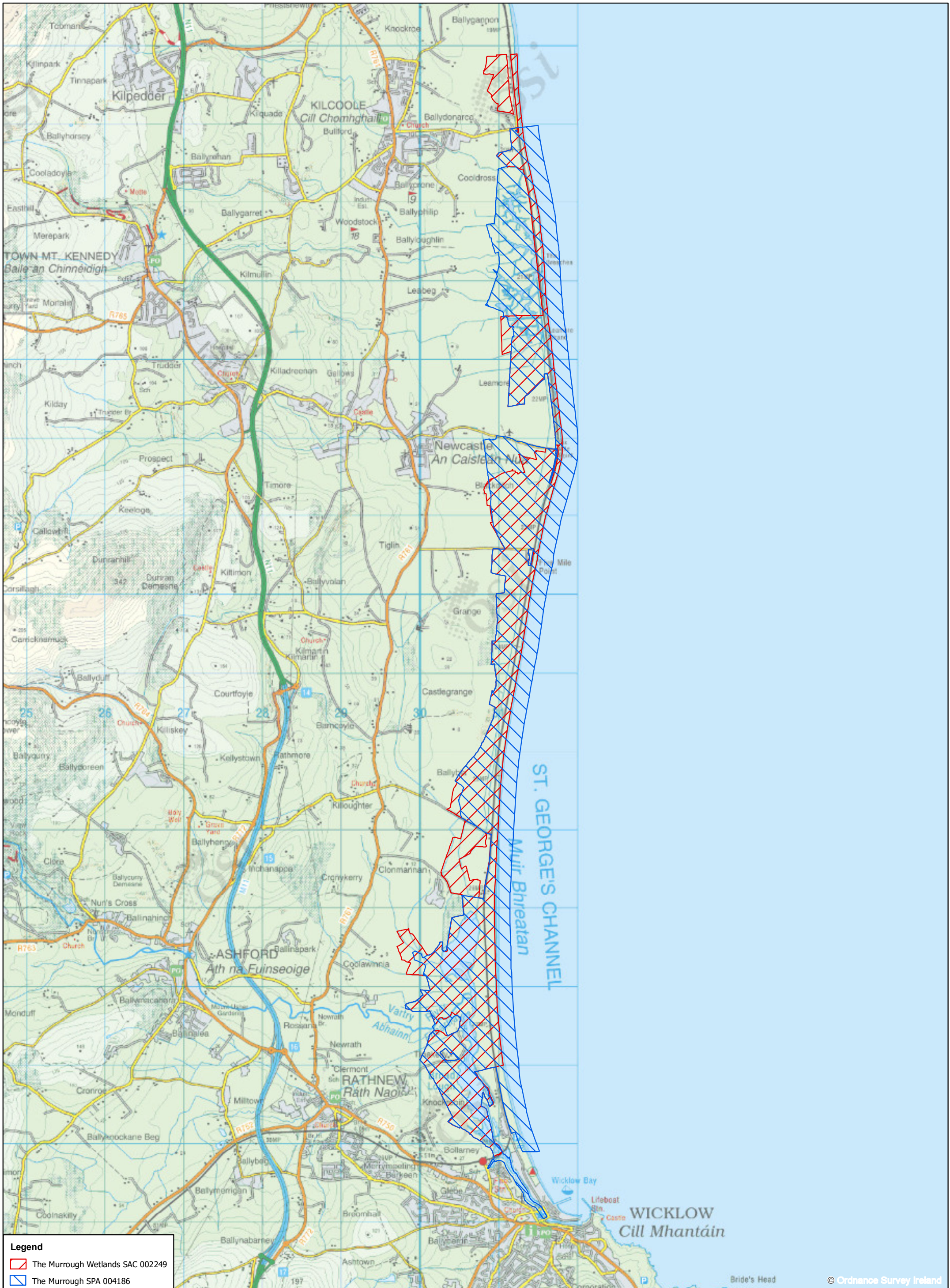
Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes	As part of the Wicklow Wetlands Survey (Wilson et al., 2012), Alkaline fen was mapped in mosaic with Calcareous fens with <i>Cladium mariscus</i> and species of the Caricion davallianae* with a minimum area of c.21.3ha in The Murrugh Wetlands SAC (see map 6). It is important to note that further unsurveyed areas may be present in the SAC. See also the conservation objective for Calcareous fens with <i>Cladium mariscus</i> and species of the Caricion davallianae* (habitat code 7210) in this volume. Although the area of fen was more extensive in the past, the SAC still contains one of the best examples of coastal fen in the country (NPWS internal files)
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 6	Distribution based on Wilson et al. (2012). It is important to note that further unsurveyed areas may be present in the SAC. In this SAC, fens occur mostly between Five Mile Point and Six Mile Point, particularly in the townland of Blackditch, and have also been reported from the Leamore, Grange, Castlegrange and Killoughter areas in the SAC (Wilson et al., 2012; NPWS internal files)
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil pH and nutrient status within natural ranges	Relevant nutrients and their natural ranges are yet to be defined. However, nitrogen deposition is noted as being relevant to this habitat in NPWS (2013). See also Bobbink and Hettelingh (2011). Increased nutrients can lead to changes in plant and invertebrate species through competition and subsequent structural changes to micro-habitats. These nutrients favour growth of grasses rather than forbs and mosses and leads to a higher and denser sward
Ecosystem function: peat formation	Percentage cover of peat-forming vegetation and water table levels	Maintain active peat formation, where appropriate	In order for peat to form, water levels need to be slightly below or above the soil surface for c.90% of the time
Ecosystem function: hydrology - groundwater levels	Water levels (centimetres); duration of levels; hydraulic gradients; water supply levels	Maintain, or where necessary restore, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Fen habitats require high groundwater levels (i.e. water levels at or above the ground surface) for a large proportion of the calendar year (i.e. duration of mean groundwater level). Fen groundwater levels are controlled by regional groundwater levels in the contributing catchment area (which sustain the hydraulic gradients of the fen groundwater table). Regional abstraction of groundwater may affect fen groundwater levels
Ecosystem function: hydrology - surface water flow	Drain density and form	Maintain, or where necessary restore, as close as possible to natural or semi-natural, drainage conditions	Drainage, either within or surrounding the fen habitat, can result in the drawdown of the groundwater table. The depth, geometry and density of drainage (hydromorphology) will indicate the scale and impact on fen hydrology. Drainage can result in loss of characteristic species and transition to drier habitats. In this SAC, some of the habitat has been damaged by drainage in the past (NPWS internal files)
Ecosystem function: water quality	Various	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	Fens receive natural levels of nutrients (e.g. iron, magnesium and calcium) from water sources. However, they are generally poor in nitrogen and phosphorus, with the latter tending to be the limiting nutrient under natural conditions. Water supply should be also relatively calcium-rich

Vegetation composition: community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	The entire diversity of alkaline fen vegetation communities present in the SAC is currently unknown. Information on the vegetation communities associated with alkaline fens is provided by O'Neill et al. (in prep.). See also the Irish Vegetation Classification (Perrin, 2018; www.biodiversityireland.ie/projects/ivc-classification-explorer)
Vegetation composition: typical brown mosses	Percentage cover at a representative number of monitoring stops	Maintain adequate cover of typical brown moss species	For lists of typical bryophyte species, including high quality indicator species, see O'Neill et al. (in prep.)
Vegetation composition: typical vascular plants	Percentage cover at a representative number of monitoring stops	Maintain adequate cover of typical vascular plant species	For lists of typical vascular plant species for the different vegetation communities, including high quality indicators, see O'Neill et al. (in prep.)
Vegetation composition: native negative indicator species	Percentage cover at a representative number of monitoring stops	Cover of native negative indicator species at insignificant levels	Negative indicators include species not characteristic of the habitat and species indicative of undesirable activities such as overgrazing, undergrazing, nutrient enrichment, agricultural improvement or impacts on hydrology. Native negative indicators may include <i>Anthoxanthum odoratum</i> , <i>Epilobium hirsutum</i> , <i>Holcus lanatus</i> , <i>Juncus effusus</i> , <i>Phragmites australis</i> and <i>Ranunculus repens</i> . See O'Neill et al. (in prep.)
Vegetation composition: non-native species	Percentage cover at a representative number of monitoring stops	Cover of non-native species less than 1%	Attribute and target based on O'Neill et al. (in prep.). Non-native species can be invasive and have deleterious effects on native vegetation. A low target is set as non-native species can spread rapidly and are most easily dealt with when still at lower abundances
Vegetation composition: native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of scattered native trees and shrubs less than 10%	Attribute and target based on O'Neill et al. (in prep.). Scrub and trees will tend to invade if fen conditions become drier
Vegetation composition: algal cover	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of algae less than 2%	Attribute and target based on O'Neill et al. (in prep.). Algal cover is indicative of nutrient enrichment from multiple sources (McBride et al., 2011)
Vegetation structure: vegetation height	Percentage cover at a representative number of monitoring stops	At least 50% of the live leaves/flowering shoots are more than either 5cm or 15cm above ground surface depending on community type	Attribute and target based on O'Neill et al. (in prep.). While grazing may be appropriate in this habitat, excessive grazing can reduce the ability of plant species to regenerate reproductively and maintain species diversity, especially if flowering shoots are cropped during the growing season
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of monitoring stops	Cover of disturbed bare ground not more than 10%	Attribute and target based on O'Neill et al. (in prep.). While grazing may be appropriate in this habitat, excessive areas of disturbed bare ground may develop due to unsuitable grazing regimes. Disturbance can include hoof marks, wallows, human footprints, vehicle and machinery tracks. Excessive disturbance can result in loss of characteristic species and presage erosion for peatlands
Physical structure: tufa formations	Percentage cover in local vicinity of a representative number of monitoring stops	Disturbed proportion of vegetation cover where tufa is present is less than 1%	Attribute and target based on O'Neill et al. (in prep.)
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat; maintain features of local distinctiveness, subject to natural processes	This includes species on the Flora (Protection) Order, 2015 and species of flora and fauna on Red Lists (Byrne et al., 2009; Regan et al., 2010; Lockhart et al., 2012; Wyse Jackson et al., 2016, etc.; see Nelson et al., 2019, 2021). A number of rare and threatened invertebrates have been recorded in the alkaline fen and associated habitats in the SAC, including the Annex II listed and Endangered (Byrne et al., 2009) Desmoulin's whorl snail (<i>Vertigo moulinsiana</i>) (Moorkens and Killeen, 2011; Long and Brophy, 2019; Brophy and Long, 2019)

Transitional areas between fen and adjacent habitats	Hectares; distribution	Maintain/restore adequate transitional areas to support/protect the alkaline fen habitat and the services it provides	In many cases, fens transition to other wetland habitats. It is important that the transitional areas between fens and other habitats are maintained in as natural condition as possible in order to protect the functioning of the fen. Alkaline fen occurs in association with <i>Cladium</i> fen (see the conservation objective for the priority habitat 7120 in this volume), swamp vegetation types and wet woodland in the SAC
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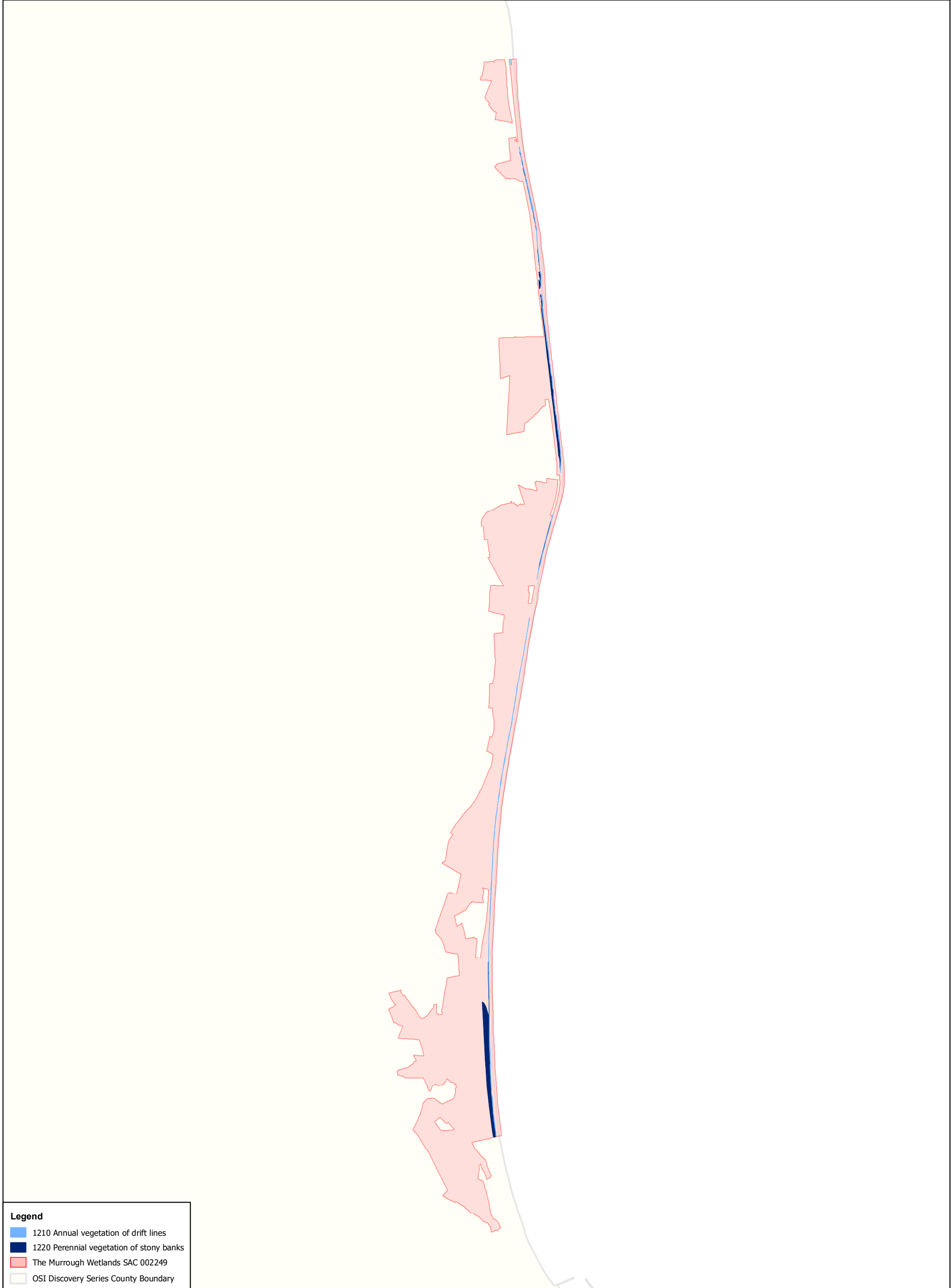


Legend
 The Murrough Wetlands SAC 002249



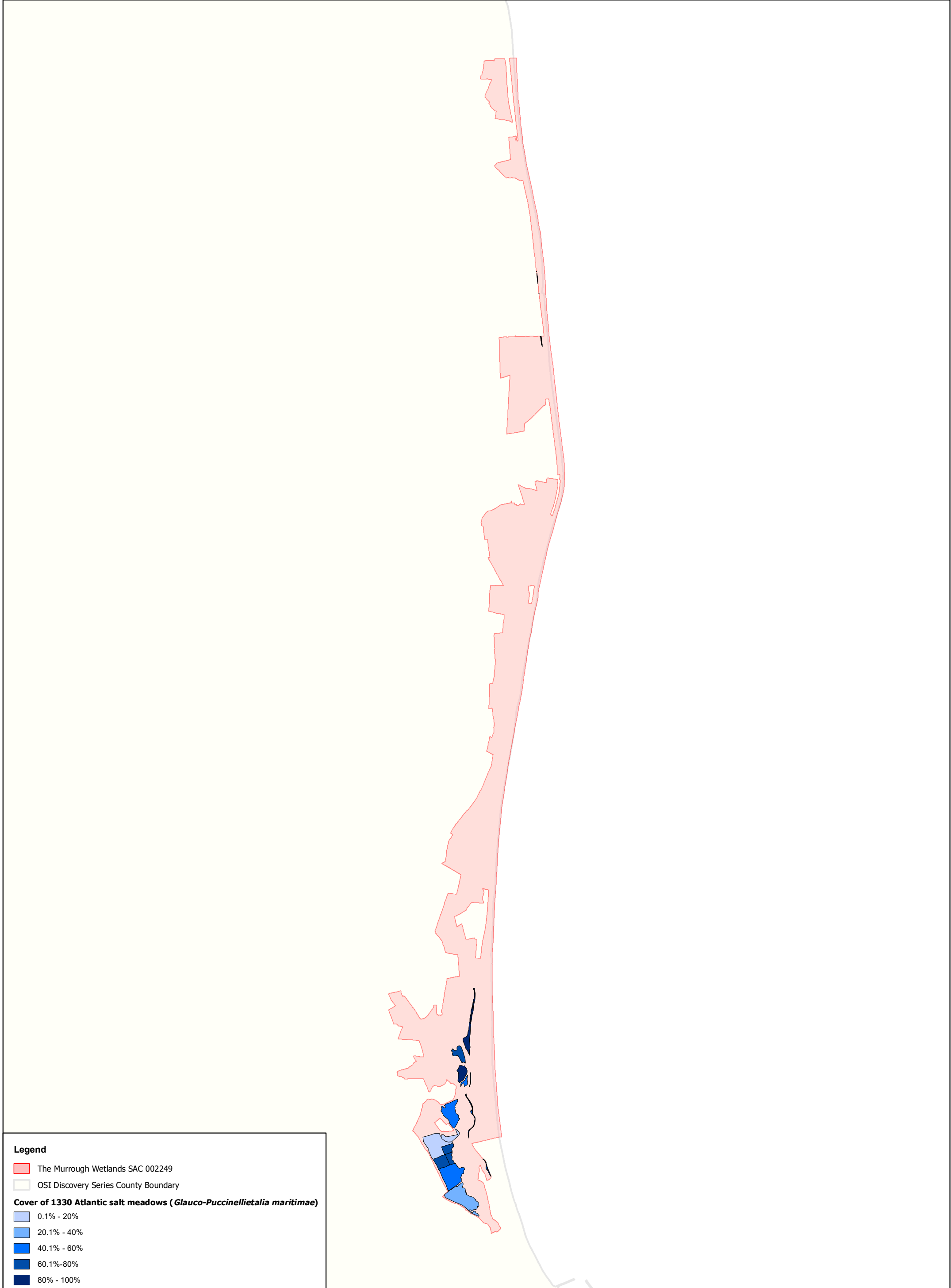
Legend

- The Murrough Wetlands SAC 002249
- The Murrough SPA 004186



Legend

- 1210 Annual vegetation of drift lines
- 1220 Perennial vegetation of stony banks
- The Murrough Wetlands SAC 002249
- OSI Discovery Series County Boundary

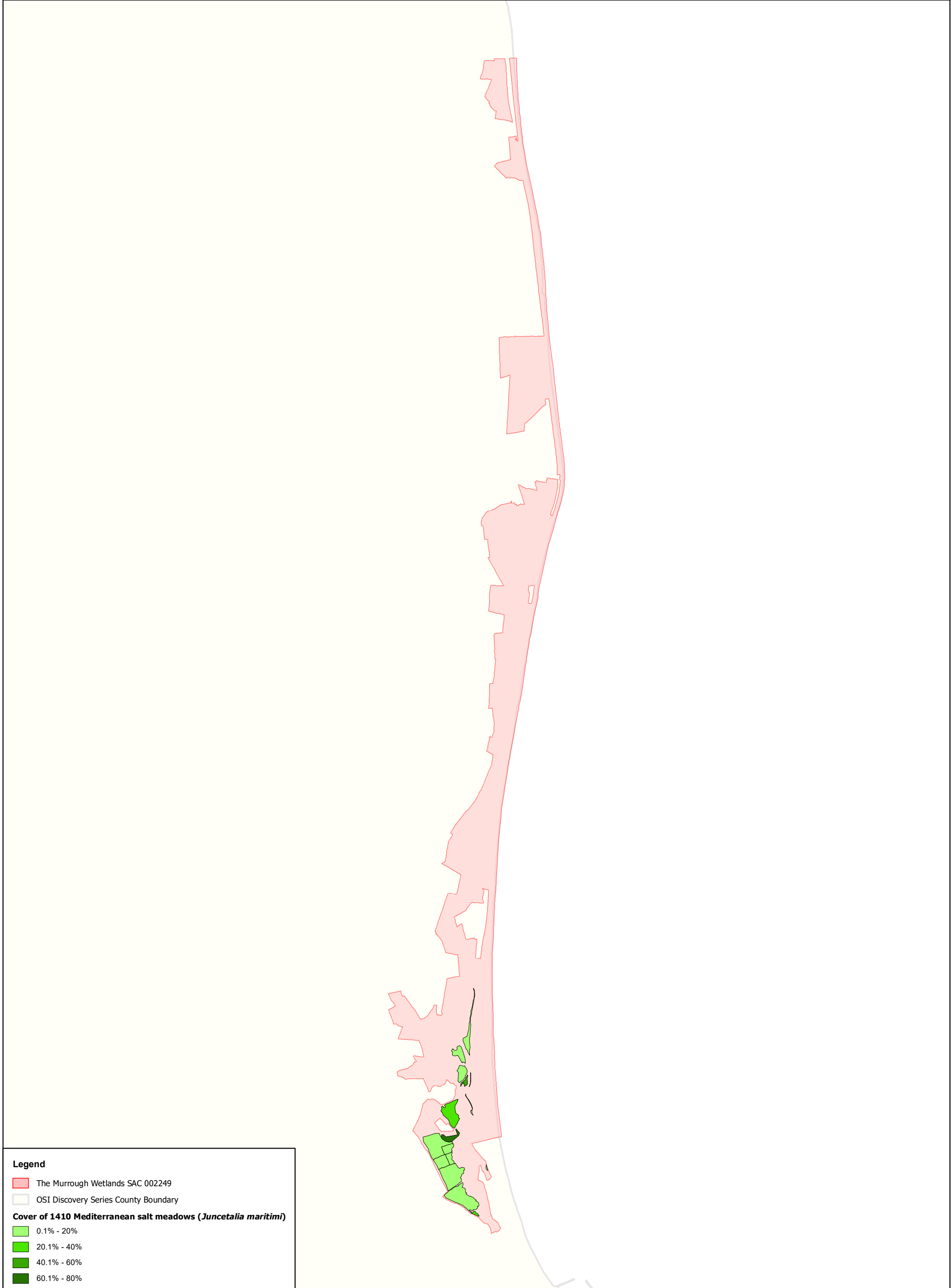


Legend

- The Murrough Wetlands SAC 002249
- OSI Discovery Series County Boundary

Cover of 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

- 0.1% - 20%
- 20.1% - 40%
- 40.1% - 60%
- 60.1%-80%
- 80% - 100%

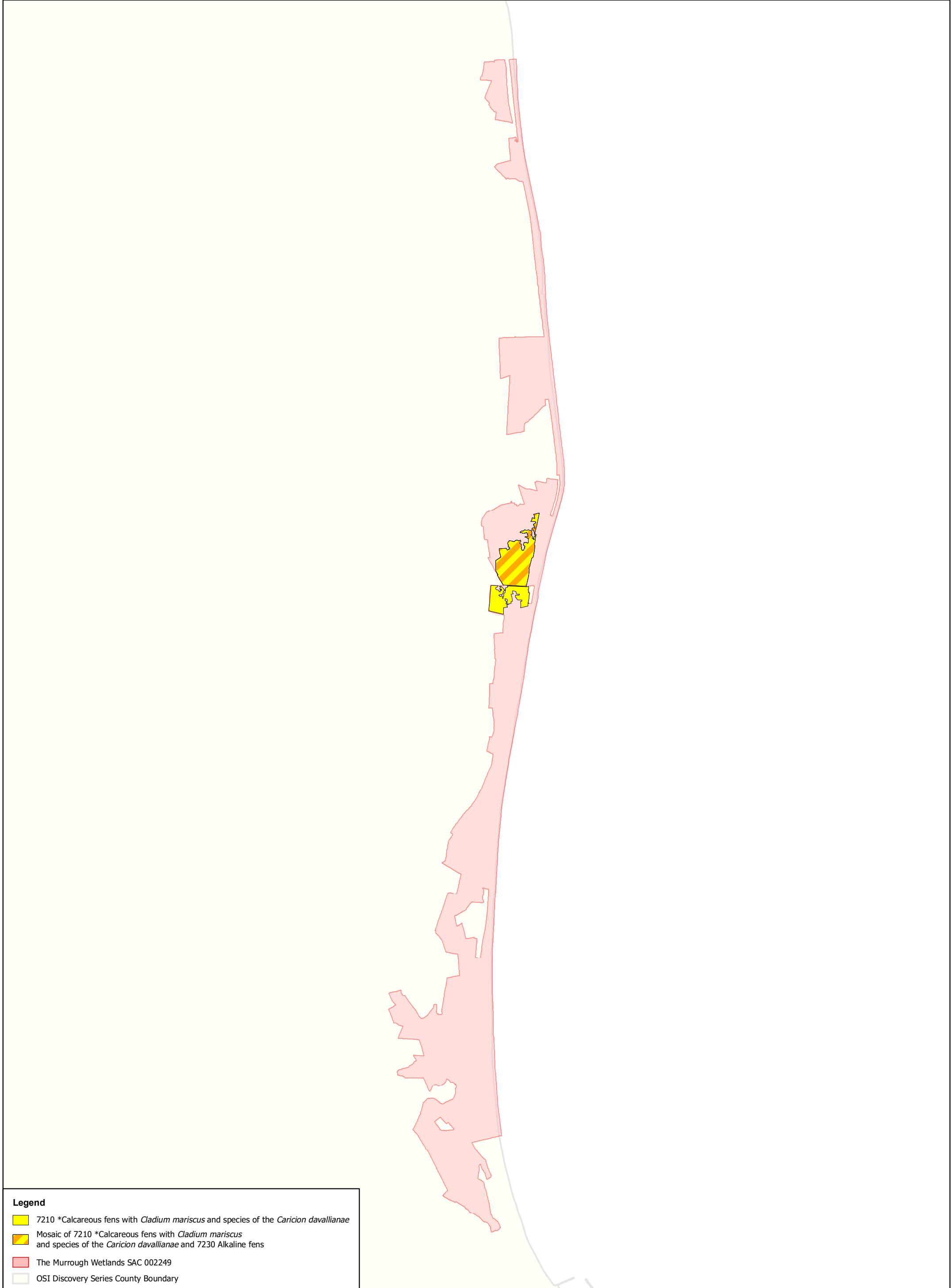


Legend

- The Murrough Wetlands SAC 002249
- OSI Discovery Series County Boundary

Cover of 1410 Mediterranean salt meadows (*Juncetalia maritimi*)

- 0.1% - 20%
- 20.1% - 40%
- 40.1% - 60%
- 60.1% - 80%



Legend

- 7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
- Mosaic of 7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* and 7230 Alkaline fens
- The Murrrough Wetlands SAC 002249
- OSI Discovery Series County Boundary