ISSN 2009-4086

National Parks and Wildlife Service

Conservation Objectives Series

Lough Carra/Mask Complex SAC 001774

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

National Parks and Wildlife Service,
Department of Housing, Local Government and Heritage,

90 King Street North, Dublin 7, D07 N7CV, Ireland.

Web: www.npws.ie
E-mail: natureconservation@housing.gov.ie

Citation:

NPWS (2021) Conservation Objectives: Lough Carra/Mask Complex SAC 001774. 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***

001774	Lough Carra/Mask Complex SAC
1303	Lesser Horseshoe Bat *Rhinolophus hipposideros*
1355	Otter *Lutra lutra*
3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)
3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoëto-Nanojuncetea
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
4030	European dry heaths
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)
6216	Slender Green Feather-moss *Hamatocaulis vernicosus*
7210	Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae*
7230	Alkaline fens
8240	Limestone pavements*
91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)*

Please note that this SAC overlaps with Lough Carra SPA (004051) and Lough Mask SPA (004062). See map 2. The conservation objectives for this site should be used in conjunction with those for the overlapping sites 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 :	1975
Title :	A Study of Certain Aspects of the Vegetation of Lough Carra, Co. Mayo
Author :	Shackleton, J.
Series :	Unpublished report
Year :	1978
Title :	An Interim Report on the State of Knowledge of the Natural History of an Area in South Mayo
Author :	Bonham, F.R.H.
Series :	Unpublished report
Year :	1979
Title :	A Preliminary Report on Areas of Scientific Interest in County Mayo
Author :	Goodwillie, R.N.
Series :	Unpublished report
Year :	1982
Title :	Pilot environmental impact assessment - Lough Carra East Vegetation Report
Author :	Lockhart, N.D.
Series :	Unpublished report
Year :	1984
Title :	The vegetation of Irish lakes
Author :	Heuff, H.
Series :	Unpublished report to NPWS
Year :	2006
Title :	Otter survey of Ireland 2004/2005
Author :	Bailey, M.; Rochford, J.
Series :	Irish Wildlife Manuals, No. 23
Year :	2006
Title :	Bat mitigation guidelines for Ireland
Author :	Kelleher, C.; Marnell, F.
Series :	Irish Wildlife Manuals, No. 25
Year :	2007
Title :	Grasslands monitoring project 2006
Author :	Dwyer, R.; Crowley, W.; Wilson, F.
Series :	Unpublished report to NPWS
Year :	2007
Title :	Supporting documentation for the Habitats Directive Conservation Status Assessment - backing documents. Article 17 forms and supporting maps
Author :	NPWS
Series :	Unpublished report to NPWS
Year :	2007
Title :	The orchids of Lough Carra: The current status and distribution of orchids around Lough Carra, Co. Mayo
Author :	Huxley, C. and Huxley, L.
Series :	Unpublished report to NPWS

Year :	2007
Title :	Changes in the distribution and abundance of the bulrush and common reed in Lough Carra Co. Mayo. December 2007.
Author :	Huxley, C.
Series :	Unpublished report to NPWS
Year :	2008
Title :	National survey of native woodlands 2003-2008
Author :	Perrin, P.M.; Martin, J.; Barron, S.; O'Neill, F.H.; McNutt, K.E.; Delaney, A.
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 :	2010
Title :	A provisional inventory of ancient and long-established woodland in Ireland
Author :	Perrin, P.M.; Daly, O.H.
Series :	Irish Wildlife Manuals, No. 46
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 :	2012
Title :	Ireland Red List No. 8: Bryophytes
Author :	Lockhart, N.; Hodgetts, N.; Holyoak, D.
Series :	Ireland Red List series, NPWS
Year :	2013
Title :	National otter survey of Ireland 2010/12
Author :	Reid, N.; Hayden, B.; Lundy, M.G.; Pietravalle, S.; McDonald, R.A.; Montgomery, W.I.
Series :	Irish Wildlife Manuals, No. 76
Year :	2013
Title :	Irish semi-natural grasslands survey 2007-2012
Author :	O'Neill, F.H.; Martin, J.R.; Devaney, F.M.; Perrin, P.M.
Series :	Irish Wildlife Manuals, No. 78
Year :	2013
Title :	National survey of limestone pavement and associated habitats in Ireland
Author :	Wilson, S.; Fernandez, F.
Series :	Irish Wildlife Manuals, No. 73
Year :	2013
Title :	A survey of the benthic macrophytes of three hard-water lakes: Lough Bunny, Lough Carra and Lough Owel
Author :	Roden, C.; Murphy, P.
Series :	Irish Wildlife Manuals, No. 70
Year :	2013
Title :	Results of a monitoring survey of old sessile oak woods and alluvial forests
Author :	O'Neill, F.H.; Barron, S.J.
Series :	Irish Wildlife Manuals, No. 71

Year :	2013
Title :	The status of EU protected habitats and species in Ireland. Volume 2. Habitats assessments
Author :	NPWS
Series :	Conservation assessments
Year :	2013
Title :	Article 17 assessment form and audit trail for *Najas flexilis*, the slender naiad (species code 1833). Backing document. April 2013
Author :	O Connor, Á.
Series :	Unpublished report by NPWS
Year :	2013
Title :	Irish semi-natural grasslands survey annual report No. 4: Western seaboard counties (Clare, Galway, Kerry, Limerick, Mayo) and County Tipperary
Author :	Devaney, F.M.; Martin, J.R.; O'Neill, F.H.; Delaney, A.
Series :	Unpublished report to NPWS
Year :	2015
Title :	Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site-specific conservation objectives and Article 17 reporting
Author :	O Connor, Á.
Series :	Unpublished document by NPWS
Year :	2015
Title :	Monitoring methods for *Hamatocaulis vernicosus* (Mitt.) Hedenäs (Slender green feather-moss) in the Republic of Ireland
Author :	Campbell, C.; Hodgetts, N.; Lockhart, N.
Series :	Irish Wildlife Manuals, No. 91
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 :	2018
Title :	Conservation objectives supporting document – lesser horseshoe bat (*Rhinolophus hipposideros*)
Author :	NPWS
Series :	Conservation objectives supporting document
Year :	2018
Title :	The Irish Juniper Monitoring Survey 2017
Author :	O'Neill, F.H.; Martin, J.R.
Series :	Irish Wildlife Manuals, No. 101
Year :	2018
Title :	The Irish Juniper Monitoring Survey 2017 - Appendices
Author :	O'Neill, F.H.; Martin, J.R.
Series :	Irish Wildlife Manuals, No. 101
Year :	2018
Title :	The monitoring and assessment of three EU Habitats Directive Annex I grassland habitats
Author :	Martin, J.R.; O'Neill, F.H.; Daly, O.H.
Series :	Irish Wildlife Manuals, No. 102

Year :	2018
Title :	A review of the Irish records for stoneworts (charophytes). Version 3, January 2018
Author :	Stewart, N.F.
Series :	Unpublished report to the National Parks and Wildlife Service
Year :	2019
Title :	The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments
Author :	NPWS
Series :	Conservation assessments
Year :	2019
Title :	The monitoring and assessment of *Hamatocaulis vernicosus* (Slender Green feather-moss) in the Republic of Ireland 2015–2017
Author :	Campbell, C.; Hodd, R.; O'Neill, F.
Series :	Irish Wildlife Manuals, No. 110
Year :	2020
Title :	Marl Lake (Habitat 3140) Survey and Assessment Methods Manual
Author :	Roden, C.; Murphy, P.; Ryan, J.; Doddy, P.
Series :	Irish Wildlife Manuals, No. 125
Year :	2020
Title :	Benthic vegetation in Irish marl lakes: monitoring habitat 3140 condition 2011 to 2018
Author :	Roden, C.; Murphy, P.; Ryan, J.
Series :	Irish Wildlife Manuals, No. 124
Year :	2020
Title :	Benthic vegetation in Irish marl lakes: monitoring habitat 3140 condition 2011 to 2018. Appendix III, Site Reports
Author :	Roden, C.; Murphy, P.; Ryan, J.
Series :	Irish Wildlife Manuals, No. 124
Year :	2020
Title :	Distribution of charophytes in Ireland. August 2020
Author :	Stewart, N.F.
Series :	Unpublished report to Botanical Society of Britain and Ireland and National Parks and Wildlife Service
Year :	in prep.
Title :	The monitoring and assessment of four EU Habitats Directive Annex I woodland habitats
Author :	Daly, O.H.; O'Neill, F.H.; Barron, S.J.
Series :	Irish Wildlife Manuals
Year :	in prep.
Title :	A study of lakes with Slender Naiad (*Najas flexilis*)
Author :	Roden, C.; Murphy, P.; Ryan, J.B.
Series :	Irish Wildlife Manuals
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 :	1906
Title :	On the Botany of Lough Carra
Author :	Praeger, R.L.
Series :	Irish Naturalist, 15: 207-214
Year :	1982
Title :	Otter survey of Ireland
Author :	Chapman, P.J.; Chapman, L.L.
Series :	Unpublished report to Vincent Wildlife Trust
Year :	1982
Title :	Eutrophication of waters. Monitoring assessment and control
Author :	OECD
Series :	OECD, Paris
Year :	1989
Title :	The genera *Scorpidium* and *Hamatocaulis*, gen. nov., in northern Europe
Author :	Hedenäs, L.
Series :	Lindbergia, 15: 8-36
Year :	1991
Title :	The spatial organization of otters (*Lutra lutra*) in Shetland
Author :	Kruuk, H.; Moorhouse, A.
Series :	Journal of Zoology, 224: 41-57
Year :	1996
Title :	A guide to the restoration of nutrient-enriched shallow lakes
Author :	Moss, B.; Madgwick, J.; G. Phillips
Series :	The Broads Authority, Norwich
Year :	1997
Title :	Irish wetland woods: the plant communities and their ecology
Author :	Kelly, D.L; Iremonger, S.F.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 97B: 1-32
Year :	2000
Title :	Colour in Irish lakes
Author :	Free, G.; Allott, N.; Mills, P.; Kennelly, C.; Day, S.
Series :	Verhandlungen Internationale Vereinigung für theoretische und angewandte Limnologie, 27: 2620-2623
Year :	2000
Title :	Baseline water quality investigations on Lough Carra, western Ireland, with reference to water chemistry, phytoplankton and aquatic plants
Author :	King, J.J.; Champ, W.S.T.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy 100B(1): 13-25
Year :	2002
Title :	Reversing the habitat fragmentation of British woodlands
Author :	Peterken, G.
Series :	WWF-UK, London
Year :	2002
Title :	Deterioration of Atlantic soft water macrophyte communities by acidification, eutrophication and alkalinisation
Author :	Arts, G.H.P.
Series :	Aquatic Botany, 73: 373-393

Year :	2003
Title :	LIFE-Nature Woodland Restoration Project Proposal 2003 - Ecologists Report
Author :	Dunford, B.
Series :	Unpublished internal report prepared for Coillte
Year :	2004
Title :	Shifts between clear and turbid states in a shallow lake: multi-causal stress from climate, nutrients and biotic interactions
Author :	Hargeby, A.; Blindow, I.; Hansson, L.-A.
Series :	Archiv für Hydrobiologie, 161(4): 433–454
Year :	2004
Title :	Ecology of Shallow Lakes
Author :	Scheffer, M.
Series :	Population and Community Biology Series. Springer, Dordrecht
Year :	2005
Title :	The Quaternary of Central Western Ireland: Field Guide
Author :	Coxon, P. (ed.)
Series :	Quaternary Research Association, London
Year :	2005
Title :	Using sediments to assess the resistance of a calcareous lake to diffuse nutrient loading
Author :	Hobbs, W.; Irvine, K.; Donohue, I.
Series :	Archiv für Hydrobiologie, 164(1): 109–125
Year :	2006
Title :	Otters - ecology, behaviour and conservation
Author :	Kruuk, H.
Series :	Oxford University Press
Year :	2006
Title :	A reference-based typology and ecological assessment system for Irish lakes. Preliminary investigations. Final report. Project 2000-FS-1-M1 Ecological assessment of lakes pilot study to establish monitoring methodologies EU (WFD)
Author :	Free, G.; Little, R.; Tierney, D.; Donnelly, K.; Coroni, R.
Series :	Environmental Protection Agency, Wexford
Year :	2008
Title :	The lesser horseshoe bat conservation handbook
Author :	Schofield, H.W.
Series :	The Vincent Wildlife Trust
Year :	2008
Title :	The Great Western Lakes: Ecology, Heritage and Management. The Proceedings of a Conference held at the Castlebar Campus of the Galway-Mayo Institute of Technology, 25-27 June 2004
Author :	Huxley, C.R.; Irivine, K. (eds)
Series :	Trinity College Dublin
Year :	2009
Title :	The identification, characterization and conservation value of isoetid lakes in Ireland
Author :	Free, G.; Bowman, J.; McGarrigle, M.; Little, R.; Coroni, R.; Donnelly, K.; Tierney, D.; Trodd, W.
Series :	Aquatic Conservation: Marine and Freshwater Ecosystems, 19(3): 264-273

Year :	2009
Title :	The marl lakes of the British Isles
Author :	Pentecost, A.
Series :	Freshwater Reviews, 2(1): 167-197
Year :	2009
Title :	Importance of night roosts for bat conservation: roosting behaviour of the lesser horseshoe bat *Rhinolophus hipposideros*
Author :	Knight, T.; Jones, G.
Series :	Endangered Species Research, 8: 79-86
Year :	2010
Title :	Otter tracking study of Roaringwater Bay
Author :	De Jongh, A.; O'Neill, L.
Series :	Unpublished draft report to NPWS
Year :	2010
Title :	Water Quality in Ireland 2007-2009
Author :	McGarrigle, M.; Lucey, J.; Ó Cinnéide, M.
Series :	Environmental Protection Agency, Wexford
Year :	2010
Title :	Rapid ecosystem recovery from diffuse pollution after the Great Irish Famine
Author :	Donohue, I.; Leira, M.; Hobbs, W.; León-Vintró, L.; O'Reilly, J.; Irvine, K.
Series :	Ecological Applications, 20(6): 1733–1743
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 :	2011
Title :	The Orchids of Lough Carra. The current status and distribution of orchids around Lough Carra, Co. Mayo. Modified version of reports to the National Parks and Wildlife Service
Author :	Huxley, C.; Huxley, L.
Series :	Lough Carra Catchment Association
Year :	2012
Title :	A survey of 25 Marl Lakes. Internal draft
Author :	Roden, C.; Murphy, P.
Series :	Unpublished report to NPWS
Year :	2013
Title :	Conservation of selected legally protected and Red Listed bryophytes in Ireland
Author :	Campbell, C.
Series :	Unpublished Ph.D. Thesis, Trinity College Dublin
Year :	2014
Title :	Facilitation of clear-water conditions in shallow lakes by macrophytes: differences between charophyte and angiosperm dominance
Author :	Blindow, I; Hargeby, A.; Hilt, S.
Series :	Hydrobiologia, 737: 99–110

Year :	2015
Title :	Water Quality in Ireland 2010-2012
Author :	Bradley, C.; Byrne, C.; Craig, M.; Free, G.; Gallagher, T.; Kennedy, B.; Little, R.; Lucey, J.; Mannix, A.; McCreesh, P.; McDermott, G.; McGarrigle, M.; Ní Longphuirt, S.; O'Boyle, S.; Plant, C.; Tierney, D.; Trodd, W.; Webster, P.; Wilkes, R.; Wynne, C.
Series :	Environmental Protection Agency, Wexford
Year :	2015
Title :	Lough Carra
Author :	Huxley, C.; Huxley, L.
Series :	Carra Books
Year :	2016
Title :	A narrative for conserving freshwater and wetland habitats in England
Author :	Mainstone, C.; Hall, R.; Diack, I.
Series :	Natural England Research Reports Number 064
Year :	2016
Title :	Irish Vegetation Classification: Technical Progress Report No. 2
Author :	Perrin, P.
Series :	Report submitted to National Biodiversity Data Centre
Year :	2016
Title :	Lake ecological assessment metrics in Ireland: relationships with phosphorus and typology parameters and the implications for setting nutrient standards
Author :	Free, G.; Tierney, D.; Little, R.; Kelly, F.L.; Kennedy, B.; Plant, C.; Trodd, W.; Wynne, C.; Caroni R.; Byrne, C.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 116B: 191-204
Year :	2016
Title :	A combined remote sensing and multi-tracer approach for localising and assessing groundwater-lake interactions
Author :	Wilson, J.; Rocha, C.
Series :	Journal of Applied Earth Observation and Geoinformation, 44: 195-204
Year :	2017
Title :	Water Quality in Ireland 2010-2015
Author :	Fanning, A.; Craig, M.; Webster, P.; Bradley, C.; Tierney, D.; Wilkes, R.; Mannix, A.; Treacy, P.; Kelly, F.; Geoghegan, R.; Kent, T.; Mageean, M.
Series :	Environmental Protection Agency, Wexford
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 :	The marl crusts of Lough Carra
Author :	Doddy, P.
Series :	Lough Carra Catchments Association
Year :	2019
Title :	Microbialite crusts in Irish limestone lakes reflect lake nutrient status
Author :	Doddy, P.; Roden, C.M.; Gammell, M.P.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 119(1): 1–11

Year :	2019
Title :	Nutrient-pollution degrades microbialites in Lough Carra, an Irish marl lake
Author :	Doddy, P.; Roden, C.M.; Gammell, M.P.
Series :	Aquatic Microbial Ecology, 83: 203–209
Year :	2019
Title :	A review of *Ochthebius nilssoni* Hebauer (Coleoptera: Hydraenidae) in western Ireland including a first report from Lough Carra
Author :	Nelson, B.; O Connor, Á.; Foster, G.N.; Doddy, P.; Roden, C.
Series :	Irish Naturalists' Journal, 36(2): 117–122
Year :	2020
Title :	Slender Naiad (*Najas flexilis*) habitat quality assessment
Author :	Gunn, I.D.M.; Carvalho, L.
Series :	CRW2018_27. Scotland's Centre of Expertise for Waters (CREW)
Year :	2020
Title :	Atlas of Water Beetles of Britain and Ireland – smaller families of Polyphaga
Author :	Foster, G.N.; Bilton, D.T.; Hammond, M.; Nelson, B.H.
Series :	Field Studies Council
Year :	2020
Title :	Charting a bright future for Lough Carra. Feasibility Study for a LIFE Project application. March 2020
Author :	Woodrow Sustainable Solutions Ltd.
Series :	Report to the Lough Carra Catchment Association

Spatial data sources

Year :	2008
Title :	OSi 1:5000 IG vector dataset
GIS Operations :	WaterPolygons feature class clipped to the SAC boundary. Expert opinion used to identify Annex I habitat and to resolve any issues arising
Used For :	3110, 3130, 3140 (map 3)
Year :	2013
Title :	Roden and Murphy. A survey of the benthic macrophytes of three hard-water lakes: Lough Bunny, Lough Carra and Lough Owel
GIS Operations :	Shapefile clipped to SAC boundary. Vegetation unit names classified. Expert opinion used as necessary to resolve any issues arising
Used For :	Lake vegetation units (map 4)
Year :	2013
Title :	Irish Semi-Natural Grassland Survey
GIS Operations :	Dataset clipped to the SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	6210 (map 5)
Year :	2006
Title :	Grassland Monitoring Project 2006
GIS Operations :	Dataset clipped to the SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	6210 (map 5)
Year :	2018
Title :	Grasslands Monitoring Survey 2015-2017
GIS Operations :	Dataset clipped to the SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	6210 (map 5)
Year :	2013
Title :	National Survey of Limestone Pavement and Associated Habitats in Ireland distribution data
GIS Operations :	Dataset clipped to the SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	6210, 8240 (maps 5 and 6)
Year :	Revision 2010
Title :	National Survey of Native Woodlands 2003-2008. Version 1
GIS Operations :	QIs selected; clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	91E0 (map 7)
Year :	2018
Title :	NPWS lesser horseshoe bat database
GIS Operations :	Roosts identified, clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	1303 (map 8)
Year :	2007
Title :	Forest Inventory and Planning System, (FIPS)
GIS Operations :	Dataset clipped to 2.5km buffer centred on roost location
Used For :	1303 (map 8)

Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	Creation of an 80m buffer on the marine side of the high water mark (HWM); creation of a 10m buffer on the terrestrial side of the HWM; combination of 80m and 10m HWM buffer datasets; creation of a 10m buffer on the terrestrial side of the river banks data; creation of 20m buffer applied to canal centreline data. These datasets are combined with the derived EPA WFD Waterbodies data and Coastal Lagoon data for the 1355 CO. Overlapping regions investigated and resolved; resulting dataset clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	1355 (map 9)
Year :	2010
Title :	EPA WFD Waterbodies data
GIS Operations :	Creation of a 20m buffer applied to river and stream centreline data; creation of 80m buffer on the aquatic side of lake data; creation of 10m buffer on the terrestrial side of lake data. These datasets are combined with the derived OSi data and Coastal Lagoon data for the 1355 CO. Overlapping regions investigated and resolved; resulting dataset clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	1355 (map 9)
Year :	2021
Title :	NPWS rare and threatened species database
GIS Operations :	Dataset created from spatial references in database records. Expert opinion used as necessary to resolve any issues arising
Used For :	6216 (map 10)

3110 Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)

To restore the favourable conservation condition of Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) in Lough Carra/Mask Complex 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	Lake habitat 3110 occurs in the western Kilbride arm of Mask (Roden et al., in prep.) and is likely to be widespread along the western and northern shoreline. It may also be found in smaller lakes and ponds on the siliceous geology to the north of Lough Mask. Lough Mask is a large, complex lake that also has habitat 3140 and possibly 3130 (see the conservation objectives for these habitats in this volume). Lough Mask is on the Water Framework Directive (WFD) monitoring programme and regular macrophyte survey is conducted by the Environmental Protection Agency (EPA). Two measures of extent should be used: 1. the area of the lake itself and; 2. the extent of the vegetation communities/zones that typify the habitat. Further information relating to all attributes is provided in the lake habitats supporting document for the purposes of site-specific conservation objectives and Article 17 reporting (O Connor, 2015)
Habitat distribution	Occurrence	No decline, subject to natural processes	As noted above, lake habitat 3110 occurs in Lough Mask in Lough Carra/Mask Complex SAC. Map 3 shows the indicative lake habitats
Vegetation composition: typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution	For lists of typical plant species, see the Article 17 habitat assessments for 3110 (NPWS, 2013, 2019) and the lake habitats supporting document (O Connor, 2015). Pillwort (*Pilularia globulifera*) occurs in Lough Mask (see, for example, Roden et al., in prep.). Pillwort (*Pilularia globulifera*) is classified as Vulnerable on the Irish Red List of Vascular Plants (Wyse Jackson et al., 2016) and is listed on the Flora (Protection) Order, 2015 (FPO)
Vegetation composition: characteristic zonation	Occurrence	All characteristic zones should be present, correctly distributed and in good condition	Further work is necessary to describe the characteristic zonation and other spatial patterns in lake habitat 3110 (see O Connor, 2015). Information on vegetation zonation may be available from EPA surveys and other sources
Vegetation distribution: maximum depth	Metres	Maintain maximum depth of vegetation, subject to natural processes	The maximum depth of vegetation is likely to be specific to the lake shoreline in question. Further work is necessary to develop indicative targets for lake habitat 3110. Maximum depth should be large in 3110 lakes; however, pressures such as eutrophication, overgrazing, forestry and peat-cutting can lead to reduced vegetation depth
Hydrological regime: water level fluctuations	Metres	Maintain appropriate hydrological regime necessary to support the habitat	Fluctuations in lake water level are typical in Ireland, but can be amplified by activities such as abstraction, drainage and overgrazing. Increased water level fluctuations can increase wave action, up-root vegetation, increase turbidity, alter the substratum and lead to release of nutrients from the sediment. The hydrological regime of the lakes must be maintained so that the area, distribution and depth of the lake habitat and its constituent/characteristic vegetation zones and communities are not reduced

Lake substratum quality	Various	Maintain appropriate substratum type, extent and chemistry to support the vegetation	Research is required to further characterise the substratum types (particle size and origin) and substratum quality (notably pH, calcium, iron and nutrient concentrations) favoured by each of the five Annex I lake habitats in Ireland. It is likely that lake habitat 3110 is associated with a range of nutrient-poor substrates, from stones, cobble and gravel, through sands, silt, clay and peat. Substratum particle size is likely to vary with depth and along the shoreline within a single lake. Data on lake substrata in the SAC may be available from EPA surveys and other sources. Significant loads of inorganic and organic fine sediments are likely to have entered Lough Mask after periods of severe overgrazing
Transparency	Metres	Maintain/restore appropriate Secchi transparency. There should be no decline in Secchi depth/transparency	Transparency relates to light penetration and, hence, to the depth of colonisation of vegetation. It can be affected by phytoplankton blooms, water colour and turbidity. Specific targets have yet to be established for lake habitat 3110 (O Connor, 2015). Habitat 3110 is associated with very clear water. The OECD fixed boundary system set transparency targets for oligotrophic lakes of ≥6m annual mean Secchi disk depth, and ≥3m annual minimum Secchi disk depth (OECD, 1982). Free et al. (2009) found high isoetid abundance in lakes with Secchi depths of more than 3m. Free et al. (2006) recorded a Secchi depth of 4.3m in Lough Mask. Roden et al. (2020) recorded a Secchi depth of 5.5m in Lough Mask
Nutrients	µg/l P; mg/l N	Maintain the concentration of nutrients in the water column at sufficiently low levels to support the habitat and its typical species	As a nutrient-poor habitat, oligotrophic and WFD 'high' status targets apply. Where a lake has nutrient concentrations that are lower than these targets, there should be no decline within class, i.e. no upward trend in nutrient concentrations. For lake habitat 3110, annual average total phosphorus (TP) concentration should be ≤10µg/l TP, average annual total ammonia concentration should be ≤0.040mg/l N and annual 95th percentile for total ammonia should be ≤0.090mg/l N. See also The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. Lough Mask passed the WFD TP target in 2007-09, 2010-12 and 2012-15 (high status) (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017)
Phytoplankton biomass	µg/l chlorophyll *a*	Maintain/restore appropriate water quality to support the habitat, including high chlorophyll *a* status	Oligotrophic and WFD 'high' status targets apply to lake habitat 3110. Where a lake has a chlorophyll *a* concentration that is lower than this target, there should be no decline within class, i.e. no upward trend in phytoplankton biomass. The average growing season (March-October) chlorophyll *a* concentration must be <5.8µg/l. The annual average chlorophyll *a* concentration should be <2.5µg/l and the annual peak chlorophyll *a* concentration should be ≤8.0µg/l. See also The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. Lough Mask passed the target, having high chlorophyll *a* status in 2007-09, 2010-12 and 2013-15 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017). Phytoplankton biomass may be affected by zebra mussels (*Dreissena polymorpha*) in Lough Mask
Phytoplankton composition	EPA phytoplankton composition metric	Maintain appropriate water quality to support the habitat, including high phytoplankton composition status	The EPA has developed a phytoplankton composition metric for nutrient enrichment of Irish lakes. As for other water quality indicators, lake habitat 3110 requires WFD high status
Attached algal biomass	Algal cover	Maintain trace/absent attached algal biomass (<5% cover)	Nutrient enrichment can favour epiphytic and epipelic algae that can out-compete the submerged vegetation. The cover abundance of attached algae in lake habitat 3110 should, therefore, be trace/absent (<5% cover)

Macrophyte status	EPA macrophyte metric (The Free Index)	Restore high macrophyte status	Nutrient enrichment can favour more competitive submerged macrophyte species that out-compete the typical and characteristic species for the lake habitat. The EPA monitors macrophyte status for WFD purposes using the 'Free Index'. The target for lake habitat 3110 is high status or an Ecological Quality Ratio (EQR) for lake macrophytes of ≥0.90, as defined in Table 8 of The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. Lough Mask failed the target, having high macrophyte status in 2007-09, but only good status in 2010-12 and 2013-15 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017)
Acidification status	pH units; mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes	Acidification can impact on species abundance and composition in soft water lake habitats. In Europe, acidification of isoetid lakes can lead to loss of isoetids and dominance by submerged bog mosses (*Sphagnum* spp.) and bulbous rush (*Juncus bulbosus*) (Arts, 2002). The specific requirements of lake habitat 3110, in terms of water and sediment pH, alkalinity and cation concentration, have not been determined. For lakes with habitat 3110, and adopting a precautionary approach based on Arts (2002), minimum pH should not be <5.5 pH units. Maximum pH should be <9.0 pH units, in line with the surface water standards established for soft waters (where water hardness is ≤100mg/l calcium carbonate). See also The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. Lough Mask passed the WFD metric in 2007-09, 2010-12 and 2013-15 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017)
Water colour	mg/l PtCo	Maintain/restore appropriate water colour to support the habitat	Increased water colour and turbidity decrease light penetration and can reduce the area of available habitat for lake macrophytes, particularly at the lower euphotic depths. The primary source of increased water colour in Ireland is disturbance to peatland. No habitat-specific or national standards for water colour currently exist. Studies have shown median colour concentrations in Irish lakes of 38mg/l PtCo (Free et al., 2000) and 33mg/l PtCo (Free et al., 2006). It is likely that the water colour in all Irish lake habitats would naturally be <50mg/l PtCo. Water colour can be very low (<20mg/l PtCo or even <10mg/l PtCo) in lakes with habitat 3110, where the peatland in the lake's catchment is intact. Free et al. (2006) reported colour of 22mg/l PtCo in Lough Mask. Damage to peatlands in the catchment is likely to have increased colour in Lough Mask
Dissolved organic carbon (DOC)	mg/l	Maintain/restore appropriate organic carbon levels to support the habitat	Dissolved (and particulate) organic carbon (OC) in the water column is linked to water colour and acidification (organic acids). Increasing DOC in water has been documented across the Northern Hemisphere, including afforested peatland catchments in Ireland. Damage and degradation of peatland, leading to decomposition of peat is likely to be the predominant source of OC in Ireland. OC in water promotes decomposition by fungi and bacteria that, in turn, releases dissolved nutrients. The increased biomass of decomposers can also impact directly on the characteristic lake communities through shading, competition, etc. Damage to peatlands in the catchment is likely to have increased DOC in Lough Mask

Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate unit	Maintain/restore appropriate turbidity to support the habitat	Turbidity can significantly affect the quantity and quality of light reaching rooted and attached vegetation and can, therefore, impact on lake habitats. The settlement of higher loads of inorganic or organic material on lake vegetation communities may also have impacts on sensitive, delicate species. Turbidity can increase as a result of re-suspension of material within the lake, higher loads entering the lake, or eutrophication. Turbidity measurement and interpretation is challenging. As a result, it is likely to be difficult to set habitat-specific targets for turbidity in lakes. Damage to peatlands in the catchment is likely to have increased turbidity in Lough Mask
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of lake habitat 3110	Most lake shorelines have fringing habitats of reedswamp, other swamp, fen, marsh or wet woodland that intergrade with and support the structure and functions of the lake habitat. In this SAC, the habitat fringing 3110 may include freshwater marsh, poor fen, flush, blanket bog, wet and dry heath, and a variety of native woodland and grassland types. Irish St. John's-wort (*Hypericum canadense*) and the Vulnerable marsh clubmoss (*Lycopodiella inundata*) (Wyse Jackson et al., 2016) are known from the northern and western shores of Lough Mask. The Near Threatened Irish Lady's Tresses (*Spiranthes romanzoffiana*) (Wyse Jackson et al., 2016) also occurs. All three species are listed on the FPO. Fringing habitats are dependent on the lake, particularly its water levels, and support wetland communities and species of conservation concern. Many of the fringing wetland habitats support higher invertebrate and plant species richness than the lake habitats themselves

3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoëto-Nanojuncetea

To restore the favourable conservation condition of Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea in Lough Carra/Mask Complex 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	A 2016 survey of the western Kilbride arm of Mask found it had lake habitat 3110, not 3130 (Roden et al., in prep.). Lake habitat 3130 may, however, occur in the main body of Lough Mask, a large lake on mixed-geology with habitat 3140 on the limestone in the east and south, and habitat 3110 on the siliceous rocks to the west. Habitat 3130 occurs in clear-water lakes of intermediate alkalinity where *Isoetes lacustris* and *Potamogeton perfoliatus/praelongus* co-occur and is characterised by high species richness and a deep-water flora that can include *Najas flexilis* (Roden et al., in prep.). The habitat was in poor deteriorating conservation status across Ireland in the 2 reporting periods, 2007-2018 (NPWS, 2013, 2019). The majority of lakes with 3130 appear to be damaged and high conservation value 3130 lakes in good condition are extremely rare (Roden et al., in prep.). The lake surface area is the simplest measure of extent and should be stable or increasing
Habitat distribution	Occurrence	No decline, subject to natural processes	As noted above, the occurrence of habitat 3130 in Lough Mask has not been confirmed or mapped. The habitat may exist at/near the boundary of calcareous and siliceous rocks in the main lake body. It may also occur in other smaller lakes within Lough Carra/Mask Complex SAC. See Roden et al. (in prep.), NPWS (2013, 2019) and O Connor (2013, 2015) for further information on the habitat and its typical species slender naiad (*Najas flexilis*)
Vegetation species richness	Occurrence	Maintain/restore appropriate species richness	There should be no decline in species richness (see Roden et al., in prep.). Roden et al. (in prep.) found that lake habitat 3130 has a varied and species-rich flora, with high conservation value examples having more than 30 species of aquatic macrophytes. Almost all lakes with more than 30 species had euphotic depths of more than 3m (Roden et al., in prep.). The number of species recorded increases with sampling effort (Roden et al., in prep.)
Vegetation composition: typical species	Occurrence	Maintain/restore typical species, in good condition, and demonstrating typical abundances and distribution	Roden et al. (in prep.) described the typical species of habitat 3130 and those present in lakes in good condition. Habitat 3130 has a varied and species-rich flora with several rare species that can include *Baldellia ranunculoides* subsp. *repens, Hydrilla verticillata, Isoetes echinospora, Najas flexilis, Pilularia globulifera, Fissidens fontanus*, also two uncertain charophyte taxa: *Chara muscosa; Nitella spanioclema*. See also NPWS (2013, 2019) and O Connor (2015)

Vegetation composition: characteristic zonation	Occurrence	Maintain/restore characteristic deep-water vegetation	The characteristic zonation (three or more zones) is described in Roden et al. (in prep.). Shallow water has a *Lobelia-Littorella* zone (0-1.5m), then an *Isoetes lacustris* zone (0.5-3m), both also typical of oligotrophic lakes and lake habitat 3110. The characteristic deep-water community is the most sensitive element and consists of some or all of *Callitriche hermaphroditica, Hydrilla verticillata, Najas flexilis, Potamogeton berchtoldii, P. perfoliatus, P. pusillus, Nitella confervacea, N. flexilis, N. translucens*. Full development is when a distinct deep-water zone is present, with one or more of its typical species having >25% cover
Vegetation distribution: maximum (euphotic) depth	Metres	Maintain/restore maximum depth of vegetation, subject to natural processes	Maximum depth of vegetation or euphotic depth ranged from 5.2m to 1.9m in lakes surveyed 2016-2018, and the target for maximum depth of vegetation colonisation (euphotic depth) in 3130 lakes was set as at least 3m (Roden et al., in prep.). Site-specific targets must be considered, however, as euphotic depths of more than 4m and 5m have been recorded in species-rich lakes in good condition. Maximum depth is considered to have declined in many lakes, owing to increased water colour. Lakes within undisturbed peatland catchments are expected to have clear water and large maximum vegetation depth
Hydrological regime: water level fluctuations	Metres	Maintain appropriate natural hydrological regime necessary to support the habitat	Roden et al. (in prep.) found that, in summer, the *Littorella* zone is typically submerged, and stated that if more than half is exposed, it is a matter of concern and water levels should never be lower than the top of the *Isoetes* zone. Fluctuations in lake water level are typical in Ireland, but can be amplified by activities such as abstraction, drainage and overgrazing. Increased water level fluctuations can increase wave action, up-root vegetation, increase turbidity, alter the substratum and lead to release of nutrients from the sediment. Groundwater inputs are likely to be important for the characteristic deep-water zone and *Najas flexilis* (Gunn and Carvalho, 2020). The hydrological regime of the lake must be maintained so that the area, distribution and depth of the lake habitat and its constituent/characteristic vegetation zones and communities are not reduced
Lake substratum quality	Various	Maintain appropriate substratum type, extent and chemistry to support the vegetation	Roden et al. (in prep.) found that the habitat is generally dominated by bedrock, sand and loose stones, silt mud or hard peat, and said that the appearance of large expanses of unconsolidated peat would indicate excessive sediment input. Groundwater inputs are likely to be important for the substratum of the characteristic deep-water zone and *Najas flexilis* (Gunn and Carvalho, 2020). Research is required to further characterise the chemical composition of the substratum

pH and Alkalinity	pH units; mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes	pH in Mask was 6.2-8.5 and alkalinity 96-99mg/l 2007-15 (Environmental Protection Agency (EPA) Water Framework Directive (WFD) data). Habitat 3130 is associated with intermediate alkalinity, largely between 20-80mg/l, but lower values may occur on Old Red Sandstone (Roden et al., in prep.). Surveyed lakes had average alkalinity of 25mg/l (range 5.5-73mg/l) (Roden et al., in prep.). In line with targets for *Najas flexilis*, median pH values should be greater than 7 pH units. Groundwater may influence sediment and water chemistry and be important for *Najas flexilis* and other characteristic flora, contributing base-poor water to obligate carbon dioxide photosynthesisers in more calcareous lakes and more base-rich water to highly oligotrophic lakes (ORS). Acidification by organic acids released from degraded peatland and conifer plantations may impact on the habitat. See also The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019
Nutrients	mg/l P; mg/l N	Maintain the concentration of nutrients in the water column at sufficiently low levels to support the habitat and its typical species	Average total phosphorus (TP) was 0.006-0.007mg/l in Mask between 2007-15 (EPA WFD data). Roden et al. (in prep.) found that the best quality 3130 lakes surveyed had average total phosphorus of <0.015mg/l TP. Lakes in good condition with high-frequency nutrient data had an overall average of 0.011mg/l TP (lake averages ranged 0.008-0.015mg/l TP). While Roden et al. (in prep.) suggested a target of <0.015mg/l TP, a precautionary target for good condition is set as ≤0.010mg/l or WFD High Status; however, vegetation attributes determine the overall conservation condition. See also The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019). WFD High Status targets for total ammonia (annual average ≤0.04mg/l N and annual 95th percentile ≤0.09mg/l N) may also be appropriate
Water colour	mg/l PtCo	Maintain/restore appropriate water colour to support the habitat	Free et al. (2006) reported water colour of 22mg/l PtCo in Mask. Lake habitat 3130 is found in clear water, and water colour (dissolved light-absorbing compounds) is negatively correlated with maximum vegetation (euphotic) depth; lakes with euphotic depth more than 3m had colour <40mg/l PtCo, while those with euphotic depth more than 3.5m had <35mg/l PtCo (Roden et al., in prep.). Water colour directly controls light penetration and, therefore, euphotic depth and vegetation extent. Roden et al. (in prep.) set good condition at <40mg/l PtCo; however; this was considered to be an impacted state some distance from reference condition. The primary source of increased colour in Ireland is peatland disturbance, e.g. through turf-cutting, overgrazing, plantation forestry. Further work is necessary to determine water colour in intact peatland catchments and sustainable levels for the habitat, which may be <30 or even <20mg/l PtCo
Dissolved organic carbon (DOC)	mg/l	Maintain/restore appropriate organic carbon levels to support the habitat	Dissolved organic carbon (DOC) in the water column is linked to water colour and acidification (organic acids). It can provide a substrate (food source) for heterotrophic organisms, which can impact directly (e.g. shading) and indirectly (e.g. nutrient release) on the characteristic lake communities. Damage and degradation of peatland, e.g. through afforestation or turf-cutting, leading to decomposition of peat is likely to be the predominant source of dissolved and particulate organic carbon in Ireland. Damage to peatlands in the catchment is likely to have increased DOC in Lough Mask and further investigation of all potential sources of DOC and water colour is needed

Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate units	Maintain/restore appropriate turbidity to support the habitat	Turbidity can significantly affect the quantity and quality of light reaching rooted and attached vegetation and can, therefore, impact on lake habitats. The settlement of higher loads of inorganic or organic material on lake vegetation communities may also have impacts on sensitive, delicate species. Turbidity can increase as a result of re-suspension of material within the lake, higher loads entering the lake, or eutrophication. Particulate loads from peatlands are the most likely sources of increased turbidity in lakes with the habitat. Turbidity measurement and interpretation is challenging. As a result, it is likely to be difficult to set habitat-specific targets for turbidity in lakes
Transparency	Metres	Maintain/restore appropriate Secchi transparency. There should be no decline in Secchi depth/transparency	Reported Secchi depths for Lough Mask include 4.3m (Free et al., 2006) and 5.5m (Roden et al., 2020). Transparency relates to light penetration and, hence, to the depth of colonisation of vegetation. Roden et al. (in prep.) advised it is preferable to measure euphotic depth directly by observation, but noted that a decreasing trend in Secchi depth indicates declining water quality. Transparency can be affected by phytoplankton blooms, water colour and turbidity. Secchi depth in marl lakes in good condition is generally >6m. The OECD fixed boundary system set transparency targets for oligotrophic lakes of ≥6m annual mean Secchi disk depth and ≥3m annual minimum Secchi disk depth
Attached algal biomass	Algal cover	Maintain trace/absent attached algal biomass (<5% cover)	Nutrient enrichment can favour epiphytic and epipelic algae that can out-compete the submerged vegetation. Roden et al. (in prep.) noted that occasional blooms of filamentous algae occur in 3130 lakes in the absence of excess nutrients, especially species of the orders Zygnematales or Oedogoniales, but that drifting masses of *Cladophora* species may indicate a decline in water quality. In general, the cover abundance of attached algae in lakes with 3130 should be trace/absent (<5% cover)
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of lake habitat 3130	The shoreline of Lough Mask is highly variable, with limestone habitats including limestone pavement in the east, and siliceous habitats, such as poor fen, flush, blanket bog and wet heath in the west, as well as well-developed woodlands. Heterogeneous lake fringes with a range of natural and semi-natural habitats are preferable. Restoration or maintenance of open, species-rich fen, marsh and grassland can be particularly important. Fringing habitats along lakes intergrade with and support the structure and functions of the lake habitat. Equally, fringing wetland habitats are dependent on the lake, particularly its water levels, and support invertebrate and plant communities and species of high diversity and conservation concern. See the conservation objectives for other habitats in this volume and also Mainstone et al. (2016)

3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.

To restore the favourable conservation condition of Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. in Lough Carra/Mask Complex 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	Lough Carra is one of the most important marl lakes (3140) in Ireland. It is suffering significant ecological stress and there is increasing evidence of biotic impacts from nutrient enrichment (Heuff, 1984; Huxley, 2007; Pentecost, 2009; Roden and Murphy, 2013; Roden et al., 2020). Lake habitat 3140 is also found in eastern and southern parts of Lough Mask, where the loss of its characteristic vegetation needs further investigation. The surface area of the lake is the simplest measure of extent and should be stable or increasing. Further information on all attributes is provided in Roden et al. (2020) and O Connor (2015). See also Pentecost (2009) and Roden et al. (2020) for an overview of marl lakes in Britain and Ireland. Lake habitat 3140 was in bad, deteriorating conservation status across Ireland in the three reporting periods, 2006-2018 (NPWS, 2007, 2013, 2019)
Habitat distribution	Occurrence	No decline, subject to natural processes	Lake habitat 3140 occurs throughout Lough Carra and in eastern and southern parts of Lough Mask (Roden and Murphy, 2013; Roden et al., 2020). It may also occur in smaller lakes and ponds in the SAC. Lough Carra has been well-studied (e.g. Praeger, 1906; Shackleton, 1975, Lockhart, 1982; Heuff, 1984; King and Champ, 2000; Huxley, 2007; Irvine et al., 2008 in Huxley and Irvine, 2008; Huxley and Huxley, 2015; Doddy et al., 2019; Roden et al., 2020; Woodrow, 2020). The vegetation of Lough Carra was mapped in 2011 by Roden and Murphy (2013; see map 4) and its overall conservation condition assessed as poor in 2011 and again in 2018 (Roden et al., 2020). Less is known about habitat 3140 in Lough Mask: it was assessed as in bad condition in 2012 as the typical charophyte and cyanobacterial communities were almost entirely absent (Roden et al., 2020)
Vegetation composition: typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution. Restore condition and extent of typical charophyte species and cyanobacterial crust	Only *Chara virgata* and *C. aspera* were recorded in Mask in 2012 (Roden et al., 2020). 13 charophyte taxa have been recorded in Carra and a total of 16 in the hectad (M17), making it one of the most charophyte-rich areas of Ireland and Great Britain (Stewart, 2018, 2020). However, the Northern and Twin Island's basins were in poor condition with reduced charophyte cover and absent deep-water species (Roden and Murphy, 2013; Roden et al., 2020). Lough Carra is also a very important site for the water beetle *Ochthebius nilssoni*, found on cyanobacterial crust (Nelson et al., 2019; Foster et al., 2020). For lists of 3140 typical species (cyanobacteria, algae, higher plants and water beetles), see the habitat 3140 Article 17 assessments (NPWS, 2013, 2019) and O Connor (2015). Roden et al. (2020) list species present in marl lakes in good condition, as well as other widespread and rare species

Vegetation composition: characteristic zonation	Occurrence	Restore characteristic charophyte and crust zones	The characteristic zonation of lake habitat 3140 in marl lakes was described in Roden and Murphy (2013) and updated by Roden et al. (2020). Marl lakes in good condition have 4 or more characteristic vegetation zones, typically a cyanophyte crust zone with occasional *Chara virgata* var. *annulata*, a *C. curta* zone, a *C. rudis* zone, a *C. virgata* zone and, in some lakes, a *C. denudata* or *Nitella flexilis* zone (Roden et al., 2020). No cyanobacterial crust or developed charophyte zones were found in Mask in 2013 (Roden et al., 2020). While 4 or 5 vegetation zones were recorded in parts of Carra in 2018, there was only 3 in the Twin Island's Basin and the Annie's River area was assessed as bad owing to poor cyanobacterial crust and absence of charophyte vegetation (Roden et al., 2020)
Vegetation distribution: maximum depth	Metres	Restore maximum depth of vegetation (euphotic depth), subject to natural processes	The maximum depth of vegetation at Lough Carra was 6m in the Twin Islands and Northern Basins and 8.5m in the Castlecarra Basin in 2011 (Roden and Murphy, 2013). In 2018, it was assessed as good at Castlecarra (8.6m), Northern (8m) and Cloonkerry (7m) basins, and poor at the Gallagh (4.6m) and Twin Island (5.4m) basins (Roden et al., 2020). Euphotic depth was at best 4m in Lough Mask in 2012 "and even above this depth large areas of bare ground were encountered" (Roden and Murphy, 2012). The target for maximum depth of vegetation colonisation (euphotic depth) in marl lakes is more than 7m (Roden et al., 2020). Euphotic depth is considered to be a key measure of the structure and functions of marl lake vegetation and has been found to exceed 10m in some Irish marl lakes (Roden et al., 2020)
Hydrological regime: water level fluctuations	Metres	Maintain/restore appropriate hydrological regime necessary to support the habitat	Water level is monitored at the Keel weir and Burriscarra (Carra) and Caher Pier and the Cong Canal (Mask). The hydrological regime of the lakes has been modified by arterial drainage, and the flood peaks at Lough Mask were significantly reduced by the construction of the Cong Canal. Water is abstracted from both Carra and Mask. In undisturbed marl lakes, fluctuations follow predictable seasonal trends and relationships exist with the vegetation zones (Roden et al., 2020). In summer, more than 90% of the crust zone should be covered and water levels should never be lower than the top of the *Chara curta* zone; in winter, all zones should be submerged (Roden et al., 2020). Groundwater exerts a strong influence on the hydrology of marl lakes. Wilson and Rocha (2016) report on groundwater discharges to Lough Mask. Increased water level fluctuations can increase wave action, up-root vegetation, increase turbidity, alter the substratum and lead to nutrient release from sediment

Lake substratum quality	Various	Restore appropriate substratum type, extent and chemistry to support the vegetation	See Roden and Murphy (2013) and Roden et al. (2020) for information on substratum types in the lakes in the SAC. In general, marl lakes are dominated by limestone bedrock, calcareous silt and sand, and loose stones (Roden et al., 2020). Deposited peat may indicate excessive sediment inputs and sediment can accumulate phosphorus and release it into the water column (Roden et al., 2020). Phosphorus has increased in the sediments of Lough Carra, especially since the 1950s (Hobbs et al., 2005; Donohue et al., 2010). Sediment total phosphorus (TP) was highest in the North Basin, and a decrease in the Fe:P ratio indicated a reduction in the ability of the more recent lake sediments to bind P, reducing Carra's ability to buffer nutrient pollution (Hobbs et al., 2005). Bare substratum in Lough Mask may also indicate physical or chemical impacts. Further research into acceptable sediment phosphorus concentrations and other aspects of substratum quality in marl lakes would be beneficial
pH and Alkalinity	pH units; mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes	Roden et al. (2020) reported alkalinity of 143mg/l and pH of 8.1 for Lough Carra. Additional data for Carra and Mask are available from EPA routine monitoring and research projects (e.g. Hobbs et al., 2005; Doddy et al., 2019). The lower alkalinity boundary may lie between 80 and 100mg/l; however, alkalinity for lake habitat 3140 is far higher in most Irish marl lakes, exceeding 200mg/l in some cases (Roden et al., 2020). Acidification is not considered a threat to habitat 3140; however, eutrophication can lead to at least temporary increases in pH to toxic levels (>9/9.5 pH units). Maximum pH should be <9.0 pH units, in line with the surface water standards (The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019). Further study of the sediment pH, alkalinity and cation concentration may assist in understanding of nutrient cycling
Nutrients	mg/l P; mg/l N	Restore the concentration of nutrients in the water column to sufficiently low levels to support the habitat and its typical species	From 2007-15, the EPA reported High TP status in Carra (average 0.009-0.009mg/l) and Mask (0.006-0.007mg/l). However, TP >10mg/l has been recorded in Carra and in-flowing streams (King and Champ, 2000; Hobbs et al., 2005; Huxley and Irvine, 2008; Roden and Murphy, 2013; Woodrow, 2020; EPA data 2007-18, BUFFER project data 2001-04). Roden et al. (2020) found the majority of marl lakes in good condition had TP ≤0.01mg/l. While vegetation attributes determine the conservation condition of the habitat and some good condition marl lakes have had higher TP concentrations, ≤0.01mg/l is the target for good condition proposed by Roden et al. (2020). The ≤0.01mg/l TP target is equivalent to oligotrophic (OECD, 1982) and WFD High Status (The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019). WFD High Status targets for total ammonia (annual average ≤0.04mg/l N and annual 95th percentile ≤0.09mg/l N) may also be appropriate. See also Free et al. (2016)

Water colour	mg/l PtCo	Restore appropriate water colour to support the habitat	Roden et al. (2020) reported water colour for Lough Carra: average 12mg/l PtCo 2008-15 (EPA data) and 5-63mg/l PtCo in 2011. Free et al. (2006) reported colour of 14mg/l PtCo in Carra and 22mg/l PtCo in Mask. Damage to catchment peatlands may have increased colour in Lough Mask and further investigation of all potential sources of colour is needed in both catchments. Roden et al. (2020) found that water colour (dissolved light-absorbing compounds) is negatively correlated with euphotic depth, charophyte species richness and cover, and positively correlated with vascular plant cover in marl lakes. Roden et al. (2020) set good condition at <15mg/l PtCo; however, the most important Irish marl lakes have very clear waters with colour of <5mg/l PtCo and this is the recommended target for Lough Carra. Roden et al. (2020) also set a TP×Colour Index with a target of <0.1 for good; Lough Carra was 0.086 in 2018
Dissolved organic carbon (DOC)	mg/l	Maintain/restore appropriate organic carbon levels to support the habitat	Dissolved organic carbon (DOC) in the water column is linked to water colour. It can provide a substrate (food source) for heterotrophic organisms, which can impact directly (e.g. shading) and indirectly (e.g. nutrient release) on the characteristic lake communities. Damage and degradation of peatlands, e.g. through afforestation or turf-cutting, leading to decomposition of peat is likely to be the predominant source of dissolved and particulate organic carbon in Ireland. Damage to peatlands in the catchment is likely to have increased DOC in Lough Mask. Further investigation of all potential sources of DOC and water colour is needed in both catchments
Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate unit	Maintain/restore appropriate turbidity to support the habitat	Turbidity can significantly affect the quantity and quality of light reaching rooted and attached vegetation and can, therefore, impact on lake habitats. The settlement of higher loads of inorganic or organic material on lake vegetation communities may also have impacts on sensitive, delicate species. It can also lead to the release of sediment-bound phosphorus. Much has been published on turbidity in shallow calcareous lakes, interactions with submerged vegetation and alternative stable states (e.g. Moss et al., 1996; Hargeby et al., 2004; Scheffer, 2004; Blindow et al., 2014). Turbidity can increase as a result of re-suspension of material within the lake, higher loads entering the lake, or eutrophication. Turbidity measurement and interpretation is challenging. As a result, it is likely to be difficult to set habitat-specific targets for turbidity in lakes. Damage to peatlands in the catchment is likely to have increased turbidity in Lough Mask
Transparency	Metres	Restore appropriate Secchi transparency. There should be no decline in Secchi depth/transparency	Lough Carra Secchi depth was 3-4m in the Twin Islands Basin, 4m in the Northern Basin and 5m in the Carra Castle Basin (Roden and Murphy, 2013). It was 5.5m south of Twin Islands in 2018 (Roden et al., 2020). Heuff (1984) reported Secchi depth for Carra of 6.5m in 1977; Free et al. (2006) had 4.7m in 2001. Reported Secchi depths for Lough Mask include 4.3m (Free et al., 2006) and 5.5m (Roden et al., 2020). Transparency relates to light penetration and, hence, to the depth of colonisation of vegetation. Roden et al. (2020) said it is preferable to measure euphotic depth directly by observation, but noted that a decreasing trend in Secchi depth indicates declining water quality. Transparency can be affected by phytoplankton blooms, water colour and turbidity. Secchi depth in marl lakes in Good condition is generally >6m. The OECD fixed boundary system set oligotrophic lake targets of ≥6m annual mean Secchi disk depth and ≥3m annual minimum Secchi disk depth

Attached algal biomass	Algal cover	Restore trace/absent attached algal biomass (<5% cover)	Green algae have overgrown the cyanobacterial crust in parts of Lough Carra (Doddy, 2019; Doddy et al., 2019). Roden and Murphy (2013) recorded filamentous green algae at river outflows and underwater springs. Algae were not prevalent in Mask in 2012 (Roden et al., 2020). Roden et al. (2020) stated that springs in marl lakes should not be used in condition assessment and are typically favoured by bryophytes and vascular plants, rather than charophytes. Nutrient enrichment can favour epiphytic and epipelic algae that can out-compete the submerged vegetation. Roden et al. (2020) noted that occasional blooms of filamentous algae occur in marl lakes in the absence of excess nutrients, especially species of the orders Zygnematales or Oedogoniales. Drifting masses of *Cladophora* species may indicate a decline in water quality. In general, the cover abundance of attached algae in marl lakes (3140) should be trace/absent (<5% cover)
Fringing habitat: area and condition	Hectares	Restore the area and condition of fringing habitats necessary to support the natural structure and functioning of habitat 3140	A range of important habitats occurs along the shores of Loughs Carra and Mask, forming natural transitions and mosaics, and are integral to the structure and ecological functioning of habitat 3140. These include fens, limestone pavement, dry calcareous grassland, heath, native woodland and scrub. Several of these are Annex I habitats for which the SAC is selected and for which conservation objectives have been set in this volume. These species-rich fringing habitats are also critical to life-stages of many aquatic invertebrates. Praeger (1906) described the characteristic shoreline vegetation zonation of Lough Carra. Rare plants of the shorelines of Carra and Mask include chives (*Allium schoenoprasum*) (Mask), alder buckthorn (*Frangula alnus*), fly orchid (*Ophrys insectifera*), fen violet (*Viola persicifolia*) and Irish whitebeam (*Sorbus hibernica*). See also Huxley and Huxley (2011, 2015), Devaney et al. (2013) and Mainstone et al. (2016)

4030 European dry heaths

To maintain the favourable conservation condition of European dry heaths in Lough Carra/Mask Complex 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	European dry heath occurs scattered around both Lough Carra and Lough Mask and is well-developed in places within Lough Carra/Mask Complex SAC. The habitat occurs in intimate association with the Annex I habitats Limestone pavements* (habitat code 8240), Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) (6210) and also, in places, juniper (*Juniperus communis*) scrub (NPWS internal files). Therefore, these habitats cannot be easily mapped or considered separately. Conservation objectives for all the Annex I habitats should be used in conjunction with each other as appropriate. As part of the National Survey of Limestone Pavement and Associated Habitats, Wilson and Fernandez (2013) recorded the habitat in the sub-site Lough Mask (site code NSLP05). This survey should be consulted for further details
Habitat distribution	Occurrence	No decline, subject to natural processes	See the notes for habitat area above
Vegetation composition: positive indicator species	Number at a representative number of monitoring stops	At least seven positive indicator species present	Attribute and target based on Wilson and Fernandez (2013), where the list of positive indicator species for this habitat is also presented. Typical species recorded in the habitat in the SAC include bell heather (*Erica cinerea*), ling (*Calluna vulgaris*), juniper (*Juniperus communis*), slender St. John's-wort (*Hypericum pulchrum*), common bird's-foot-trefoil (*Lotus corniculatus*), tormentil (*Potentilla erecta*), devil's-bit scabious (*Succisa pratensis*), glaucous sedge (*Carex flacca*), purple moor-grass (*Molinia caerulea*), blue moor-grass (*Sesleria caerulea*) and the mosses *Pseudoscleropodium purum* and *Breutelia chrysocoma* (Wilson and Fernandez, 2013; NPWS internal files). Other species recorded in the habitat include gorse (*Ulex europaeus*), St. Dabeoc's heath (*Daboecia cantabrica*) and lesser twayblade (*Neottia cordata*) (NPWS internal files)
Vegetation composition: negative indicator species	Percentage cover at a representative number of monitoring stops	Negative indicator species collectively not more than 1% cover	Attribute and target based on Wilson and Fernandez (2013), where the list of negative indicator species for this habitat, as identified by Wilson and Fernandez (2013), is presented
Vegetation composition: non-native species	Percentage cover at a representative number of monitoring stops	Non-native species not more than 1% cover	Attribute and target based on Wilson and Fernandez (2013)
Vegetation composition: native trees and shrubs	Percentage cover at a representative number of monitoring stops	Cover of native trees and shrubs (excluding juniper (*Juniperus communis*)) not more than 25% cover	Attribute and target based on Wilson and Fernandez (2013)
Physical structure: disturbance	Percentage cover at a representative number of monitoring stops	Less than 10% disturbed bare ground (excluding rocks/stones)	Attribute and target based on Wilson and Fernandez (2013)
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/or Red Lists (Byrne et al., 2009; Regan et al., 2010; Lockhart et al., 2012; Wyse Jackson et al., 2016, etc.) and other rare or localised species, as well as archaeological and geological features, which often support distinctive species

6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)

To restore the favourable conservation condition of Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) in Lough Carra/Mask Complex 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	The habitat in this SAC occurs in mosaic with Limestone pavements* (habitat code 8210), European dry heaths (4030), and scrub, along the shores of Lough Carra and Lough Mask. These habitats cannot be easily mapped or considered separately. Conservation objectives should be used in conjunction with each other as appropriate. Multiple surveys have visited parts of this SAC, but comprehensive mapping is not available. Areas were surveyed by the Grassland Monitoring Project 2006 (Dwyer et al., 2007), Irish Semi-natural Grassland Survey (ISGS; O'Neill et al., 2013), and Grassland Monitoring Survey (GMS; Martin et al., 2018). The habitat was recorded at sites 1839, 1851, 1852, 1854 and 1869 in the ISGS, and by the GMS at 1839 also. The habitat was also recorded by Wilson and Fernandez (2013; National Survey of Limestone Pavement and Associated Habitats; site 'Lough Mask', code NSLP05). Total area recorded in surveys is 8.16ha. Note that further unsurveyed areas are likely to be present
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 5 for surveyed locations	Distribution based on mapping from Dwyer et al. (2007), O'Neill et al. (2013), Wilson and Fernandez (2013) and Martin et al. (2018). It is important to note that further unsurveyed areas may be present within the SAC
Vegetation composition: positive indicator species	Number at a representative number of 2m x 2m monitoring stops; within 20m surrounding area of monitoring stops	At least 7 positive indicator species present in monitoring stop or, if 5–6 present in stop, additional species within 20m of stop; this includes at least two 'high quality' positive indicator species present in stop or within 20m of stop	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018), where the lists of positive indicator species, including high quality indicators, are also presented. High quality indicators recorded in the habitat in the SAC include quaking-grass (*Briza media*), carline thistle (*Carline vulgaris*) and the Near Threatened spring gentian (*Gentiana verna*) (Wyse Jackson et al., 2016); positive indicators include blue moor-grass (*Sesleria albicans*) and wild carrot (*Daucus carota*) (O'Neill et al., 2013). Orchids recorded include fragrant orchid (*Gymnadenia conopsea*), bee orchid (*Ophrys apifera*), early-purple orchid (*Orchis macula*) and the Near Threatened orchids frog orchid (*Coeloglossum viride*), Irish lady's-tresses (*Spiranthes romanzoffiana*; also listed on the Flora (Protection) Order, 2015), and dense-flowered orchid (*Neotinea maculata*) (O'Neill et al., 2013; NPWS internal files)
Vegetation composition: negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Negative indicator species collectively not more than 20% cover, with cover of an individual species not more than 10%	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018), where the list of negative indicator species is presented
Vegetation composition: non-native species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of non-native species not more than 1%	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018)

Vegetation composition: woody species and bracken	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of woody species (except certain listed species) and bracken (*Pteridium aquilinum*) not more than 5%	Woody species that can occur above 5% cover are juniper (*Juniperus communis*), burnet rose (*Rosa spinosissima*), mountain avens (*Dryas octopetala*) and hoary rock-rose (*Helianthemum oelandicum*). However, cover of these species above 25% may indicate transition to another Annex I habitat such as Alpine and Boreal heaths (4060) or *Juniperus communis* formations (5130). Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018). Encroachment by blackthorn (*Prunus spinosa*) and bracken in parts of the habitat in ISGS site 1839, called Annies, was reported in 2011 (O'Neill et al., 2013); no changes were reported when the site was surveyed by the GMS in 2017, with extensive cattle grazing occurring (Martin et al., 2018). Scrub encroachment, particularly by ash (*Fraxinus excelsior*), was noted as a threat to the habitat in the ISGS site Partry House Estate (code 1869) when surveyed by the ISGS
Vegetation structure: broadleaf herb:grass ratio	Percentage at a representative number of 2m x 2m monitoring stops	Broadleaf herb component of vegetation between 40% and 90%	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018). Broadleaf herb component of vegetation between 30% and 40% may be allowed to pass on expert judgement (Martin et al., 2018)
Vegetation structure: sward height	Percentage at a representative number of 2m x 2m monitoring stops	At least 30% of sward between 5cm and 40cm tall	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018)
Vegetation structure: litter	Percentage cover at a representative number of 2m x 2m monitoring stops	Litter cover not more than 25%	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018)
Physical structure: bare soil	Percentage cover at a representative number of 2m x 2m monitoring stops	Not more than 10% bare soil	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018)
Physical structure: grazing or disturbance	Area in local vicinity of a representative number of monitoring stops	Area of the habitat showing signs of serious grazing or disturbance less than 20m²	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018)

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

To maintain the favourable conservation condition of Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae* in Lough Carra/Mask Complex 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	Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae* has not been mapped in detail for Lough Carra/Mask Complex SAC and thus the exact total area of the qualifying priority habitat in the SAC is unknown. It has been documented that the habitat occurs in association with the Annex I habitat Alkaline fens (habitat code 7230) and other swamp/marsh vegetation, particularly around the sheltered parts of Lough Carra, and to a lesser extent on the eastern and southern shores of Lough Mask (NPWS internal files). The conservation objectives for the Annex I habitats and Annex II species in this volume should be used in conjunction with each other as appropriate
Habitat distribution	Occurrence	No decline, subject to natural processes	See the notes for habitat area above
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 for fen habitats. Increased nutrients can lead to changes in plant and invertebrate species through competition and subsequent structural changes to micro-habitat. 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	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 a 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 effect 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 fen 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
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 *Cladium mariscus*	Percentage cover at a representative number monitoring stops	Cover of *Cladium mariscus* 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 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 *Anthoxanthum odoratum, Epilobium hirsutum, Holcus lanatus, Juncus effusus, Phragmites australis, Ranunculus repens* and *Typha latifolia*. 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 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/or Red Lists (Byrne et al., 2009; Regan et al., 2010; Lockhart et al., 2012; Wyse Jackson et al., 2016, etc.)
Transitional areas between fen and adjacent habitats	Hectares; distribution	Maintain/restore adequate transitional areas to support/protect the *Cladium* fen habitat and the services it provides	In many cases, fens transition to other wetland habitats. It is important that the transitional areas between *Cladium* fen and other habitats are maintained in as natural condition as possible in order to protect the functioning of the fen

7230 Alkaline fens

To restore the favourable conservation condition of Alkaline fens in Lough Carra/Mask Complex 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	Alkaline fen has not been mapped in detail for Lough Carra/Mask Complex SAC and thus the exact total area of the qualifying habitat in the SAC is unknown. It has been documented that extensive areas of alkaline fen occur around Lough Carra (e.g. in the environs of Cloondaver, Ballintuber and Keel Bridge), and to a much lesser extent, around Lough Mask (NPWS internal files). In places, the habitat occurs in association with *Cladium* fen (Annex I priority habitat 7210) and juniper (*Juniperus communis*) formations (see site MO02 in O'Neill and Martin, 2018), and grades into reed swamp and wet grassland/marsh habitat (NPWS internal files). The conservation objectives for the Annex I habitats and Annex II species in this volume should be used in conjunction with each other as appropriate
Habitat distribution	Occurrence	No decline, subject to natural processes	See the notes for habitat area above
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-habitat. 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	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 alkaline fen 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 damage in a small proportion of the habitat has occurred due to 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 surveyed in 2019-2020 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.). The habitat in the SAC is dominated by black bog-rush (*Schoenus nigricans*), with other sedges (*Carex* spp.), and is species-rich. Other typical species recorded include purple moor-grass (*Molinia caerulea*) and common butterwort (*Pinguicula vulgaris*). A rich orchid flora has been recorded in the habitat, including marsh helleborine (*Epipactis palustris*) and early marsh-orchid (*Dactylorhiza incarnata*) (Praeger, 1906; Shackleton, 1975; Bonham, 1978; Goodwillie, 1979; Huxley and Huxley, 2007; NPWS internal files)
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 *Anthoxanthum odoratum, Epilobium hirsutum, Holcus lanatus, Juncus effusus, Phragmites australis* and *Ranunculus repens*. 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/or Red Lists (Byrne et al., 2009; Regan et al., 2010; Lockhart et al., 2012; Wyse Jackson et al., 2016, etc.). The Near Threatened (Wyse Jackson et al., 2016) fly orchid (*Ophrys insectifera*) has been recorded in the habitat in the SAC (Huxley and Huxley, 2007; NPWS internal files)
Transitional areas between fen and adjacent habitats	Hectares; distribution	Maintain 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

8240 Limestone pavements*

To restore the favourable conservation condition of Limestone pavements* in Lough Carra/Mask Complex 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	Limestone pavements* in Lough Carra/Mask Complex SAC represents the northern limit of the limestones of Clare and Galway and occurs in intimate association with other habitats in the SAC: dry heaths (Annex I habitat 4030), orchid-rich grassland (Annex I habitat 6210), and wetland habitats, as well as juniper (*Juniperus communis*) formations (see site MO02 in O'Neill and Martin, 2018). Therefore, these habitats cannot easily be mapped or considered separately. Conservation objectives for the Annex I habitats should be used in conjunction with each other as appropriate. Wilson and Fernandez (2013) mapped the indicative area of limestone pavement, including mosaics with associated habitats, as 425ha (see map 6). As part of the National Survey of Limestone Pavement and Associated Habitats (Wilson and Fernandez, 2013), the sub-site Lough Mask (site code NSLP05) was surveyed in detail. This survey should be consulted for further details
Distribution	Occurrence	No decline. Map 6 shows indicative distribution, including mosaics with other habitats	See the notes for habitat area above. Distribution based on data from Wilson and Fernandez (2013). This habitat can be split into exposed pavement and wooded pavement. In Lough Carra/Mask Complex SAC, the limestone pavement is variable in character, from open bare pavement to areas covered with dense scrub to wooded pavement (NPWS internal files)
Vegetation composition: positive indicator species	Number at a representative number of monitoring stops	At least seven positive indicator species present	Positive indicator species for exposed and wooded pavement are listed in Wilson and Fernandez (2013). Positive indicator species recorded in exposed pavement in the SAC include bloody crane's-bill (*Geranium sanguineum*), herb-robert (*G. robertianum*), wild thyme (*Thymus polytrichus*), sea plantain (*Plantago maritima*), maidenhair spleenwort (*Asplenium trichomanes*), wall-rue (*A. ruta-muraria*), rustyback fern (*A. ceterach*), hart's-tongue fern (*A. scolopendrium*), soft shield-fern (*Polystichum setiferum*) and the mosses *Neckera crispa* and *Tortella tortuosa* and those recorded in wooded pavement include hazel (*Corylus avellana*), hawthorn (*Crataegus monogyna*), spindle (*Euonymus europaeus*), ash (*Fraxinus excelsior*), false brome (*Brachypodium sylvaticum*) and barren strawberry (*Potentilla sterilis*) (Wilson and Fernandez, 2013; NPWS internal files)
Vegetation composition: bryophyte layer	Percentage at a representative number of monitoring stops	Bryophyte cover at least 50% on wooded pavement	Attribute and target based on Wilson and Fernandez (2013)
Vegetation composition: negative indicator species	Percentage at a representative number of monitoring stops	Collective cover of negative indicator species on exposed pavement not more than 1%	Negative indicator species are listed in Wilson and Fernandez (2013). Negative indicator species for wooded pavement overlap with non-native species (below)
Vegetation composition: non-native species	Percentage at a representative number of monitoring stops	Cover of non-native species not more than 1% on exposed pavement; on wooded pavement not more than 10% with no regeneration	Attribute and target based on Wilson and Fernandez (2013). Cotoneaster (*Cotoneaster* spp.) was recorded in the habitat by Wilson and Fernandez (2013) and O'Neill and Martin (2018). Thunberg's barberry (*Berberis thunbergii*) was also recorded in the habitat in the SAC by O'Neill and Martin (2018)
Vegetation composition: scrub	Percentage at a representative number of monitoring stops	Scrub cover no more than 25% of exposed pavement	Attribute and target based on Wilson and Fernandez (2013)

Vegetation composition: bracken cover	Percentage at a representative number of monitoring stops	Bracken (*Pteridium aquilinum*) cover no more than 10% on exposed pavement	Attribute and target based on Wilson and Fernandez (2013)
Vegetation structure: woodland canopy	Percentage at a representative number of monitoring stops	Canopy cover on wooded pavement at least 30%	Attribute and target based on Wilson and Fernandez (2013)
Vegetation structure: dead wood	Occurrence in a representative number of monitoring stops	Sufficient quantity of dead wood on wooded pavement to provide habitat for saproxylic organisms	Dead wood is a valuable resource and an integral part of a healthy, functioning woodland ecosystem
Physical structure: disturbance	Occurrence in a representative number of monitoring stops	No evidence of grazing pressure on wooded pavement	Attribute and target based on Wilson and Fernandez (2013)
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 (FPO) and/or Red Lists (Byrne et al., 2009; Regan et al., 2010; Lockhart et al., 2012; Wyse Jackson et al., 2016, etc.) and other rare or localised species, as well as archaeological and geological features, which often support distinctive species. The Vulnerable and FPO listed species chives (*Allium schoenoprasum*) as well as the Near Threatened species spring gentian (*Gentiana verna*) and dense-flowered orchid (*Neotinea maculata*) (Wyse Jackson et al., 2016) have been recorded in the habitat in the SAC (Bonham, 1978; NPWS internal files). Around the lakeshores in particular, the limestone pavement displays some interesting karstic features; see Simms (2005) in Coxon (2005)

91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)*

To restore the favourable conservation condition of Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)* in Lough Carra/Mask Complex 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	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)* was surveyed by Perrin et al. (2008) as part of the National Survey of Native Woodlands (NSNW) within the sub-site Derrymore (NSNW site code 1796). An area of 0.16ha of 91E0* is estimated to occur in the sub-site within the SAC boundary. See map 7 for woodland areas surveyed by the NSNW in the SAC. 91E0* also occurs in the Clonbur area in the south of the SAC, including Ballykine and Rosshill Woods, where the habitat occurs in association with other habitats, particularly Limestone pavements (Annex I prioirty habitat 8240) (Kelly and Iremonger, 1997; Dunford, 2003; NPWS internal files). Map 7 also shows the location of Rosshill Woods and Ballykine Woods. It is important to note that further unsurveyed areas of the habitat may be present in the SAC, particularly around lakeshores
Habitat distribution	Occurrence	No decline. The location of 91E0* at Derrymore (NSNW site code 1796) and at Rosshill and Ballykine Woods is shown on map 7	Distribution based on Perrin et al. (2008) and NPWS internal files. See the notes for Habitat area above. It is important to note that further unsurveyed areas may be present in the SAC, particularly around lakeshores
Woodland size	Hectares	Area stable or increasing. Where topographically possible, "large" woods at least 25ha in size and "small" woods at least 3ha in size	The target areas for individual woodlands aim to reduce habitat fragmentation and benefit those species requiring 'deep' woodland conditions (Peterken, 2002). In some cases, topographical constraints may restrict expansion
Woodland structure: cover and height	Percentage; metres; centimetres	Total canopy cover at least 30%; median canopy height at least 7m; native shrub layer cover 10-75%; native herb/dwarf shrub layer cover at least 20% and height at least 20cm; bryophyte cover at least 4%	The target aims for a diverse structure with a canopy containing mature trees, shrub layer with semi-mature trees and shrubs, and well-developed field layer (herbs and dwarf shrubs) and ground layer (bryophytes). Assessment criteria are described in Daly et al. (in prep.) and O'Neill and Barron (2013)
Woodland structure: community diversity and extent	Hectares	Maintain diversity and extent of community types	Described in Perrin et al. (2008), Kelly and Iremonger (1997) and NPWS internal files. See also the Irish Vegetation Classification (Perrin, 2016; www.biodiversityireland.ie/projects/ivc-classification-explorer)
Woodland structure: natural regeneration	Seedling:sapling:pole ratio	Seedlings, saplings and pole age-classes of target species for 91E0* woodlands and other native tree species occur in adequate proportions to ensure survival of woodland canopy	The target species for 91E0* are alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*) and willows (*Salix* spp.). Assessment criteria are described in Daly et al. (in prep.) and O'Neill and Barron (2013)
Hydrological regime: flooding depth/height of water table	Metres	Appropriate hydrological regime necessary for maintenance of alluvial vegetation	Periodic flooding is essential to maintain alluvial woodlands along river and lake floodplains, but not for woodland around springs/seepage areas

Woodland structure: dead wood	Number per hectare	At least 19 stems/ha of dead wood of at least 20cm diameter	Dead wood is a valuable resource and an integral part of a healthy, functioning woodland ecosystem. Dead wood comprises old senescent trees, standing dead trees, fallen dead wood (including large branches) and rotten stumps of any tree species. Assessment criteria are described in Daly et al. (in prep.) and O'Neill and Barron (2013)
Woodland structure: veteran trees	Number per hectare	No decline	Mature and veteran trees are important habitats for bryophytes, lichens, saproxylic organisms and some bird species. Their retention is important to ensure continuity of habitats/niches and propagule sources
Woodland structure: indicators of local distinctiveness	Occurrence; population size	No decline in distribution and, in the case of red listed and other rare or localised species, population size	Includes ancient or long-established woodlands (see Perrin and Daly, 2010), archaeological and geological features as well as red listed and other rare or localised species
Woodland structure: indicators of overgrazing	Occurrence	All five indicators of overgrazing absent	There are five indicators of overgrazing within 91E0*: topiary effect on shrubs and young trees, browse line on mature trees, abundant dung, severe recent bark stripping, and trampling (Daly et al., in prep.)
Vegetation composition: native tree cover	Percentage	No decline. Native tree cover at least 90% of canopy; target species cover at least 50% of canopy	The target species for 91E0* are alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*) and willows (*Salix* spp.) (Daly et al., in prep.; O'Neill and Barron, 2013). Species reported in Perrin et al. (2008) and NPWS internal files
Vegetation composition: typical species	Occurrence	At least 1 target species for 91E0* woodlands present; at least 6 positive indicator species for 91E0* woodlands present	A variety of typical native species should be present, depending on woodland type. The target species for 91E0* are alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*) and willows (*Salix* spp.). Positive indicator species for 91E0* are listed in Daly et al. (in prep.) and O'Neill and Barron (2013). Species reported in Perrin et al. (2008) and NPWS internal files
Vegetation composition: negative indicator species	Occurrence	Negative indicator species cover not greater than 10%; regeneration of negative indicator species absent	Negative indicator species (i.e. any non-native species, including herbaceous species) should be absent or under control. In general, the following are the most common non-native invasive species in 91E0* woodlands: sycamore (*Acer pseudoplatanus*), beech (*Fagus sylvatica*) and horse-chestnut (*Aesculus hippocastanum*) (Daly et al., in prep.). Areas of wet woodland in the Clonbur area have been planted with beech and conifers such as spruce (*Picea* spp.) and larch (*Larix* spp.) (Dunford, 2003; NPWS internal files). Restoration works undertaken by Coillte as part of the EU LIFE project 'Restoring Priority Woodland Habitats in Ireland' in the Clonbur area included the removal of exotic species
Vegetation composition: problematic native species	Percentage	Cover of common nettle (*Urtica dioica*) less than 75%	Common nettle (*Urtica dioica*) is a positive indicator species for 91E0* but, in some cases, it may become excessively dominant. Increased light and nutrient enrichment are factors which favour proliferation of common nettle (Daly et al., in prep.)

1303 Lesser Horseshoe Bat *Rhinolophus hipposideros*

To restore the favourable conservation condition of Lesser Horseshoe Bat (*Rhinolophus hipposideros*) in Lough Carra/Mask Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population per roost	Number	Minimum number of 100 bats for the summer roost with roost id. 667 (in NPWS database); minimum number of 467 bats for the summer roost with roost id. 669; minimum number of 140 bats for the summer roost with roost id. 686. See map 8	A figure of 100 bats for summer roosts and 50 bats for winter roosts was set as a minimum qualifying standard (MQS) when SACs were being selected for lesser horseshoe bat (*Rhinolophus hipposideros*). NPWS conduct annual counts at each qualifying roost. Qualified means from the 2015-2019 data have been calculated whereby the year with the highest maximum count and the year with the lowest maximum count were removed and the mean of the remaining years was calculated. This mean is set as the target figure for each of two of the summer roosts, roost id. 669 and roost id. 686 in NPWS database, in Lough Carra/Mask Complex SAC. However, in the case of the third summer roost (roost site id. 667), where a mean of 51 bats was recorded (2015-2019), the target is instead set at the MQS of 100 bats. See the conservation objectives supporting document for lesser horseshoe bat (NPWS, 2018) for further information on this and all attributes and targets
Summer roosts	Condition	No decline	Lough Carra/Mask Complex SAC has been selected for lesser horseshoe bats because of the presence of three internationally important summer roosts (roost id. 667, roost id. 669 and roost id. 686 in NPWS database). Damage or disturbance to the roosts or to the habitat immediately surrounding the roosts will lead to a decline in their condition (Kelleher and Marnell, 2006)
Auxiliary roosts	Number and condition	No decline	Lesser horseshoe bat populations will use a variety of roosts during the year besides the main summer maternity and winter hibernation roosts. Such additional roosts within the SAC may be important as night roosts, satellite roosts, etc. Night roosts are also considered an integral part of core foraging areas and require protection (Knight and Jones, 2009). In addition, in response to weather conditions for example, bats may use different seasonal roosts from year to year; this is particularly noticeable in winter. Several other roosts that support lesser horseshoe bats, but at numbers below the MQS figures, are known from Lough Carra/Mask Complex SAC. A database of all known lesser horseshoe bat roosts is available on the National Biodiversity Data Centre website. NB further unrecorded roosts may also be present within this SAC
Extent of potential foraging habitat	Hectares	No significant decline within 2.5km of qualifying roosts	Lesser horseshoe bats normally forage in woodlands/scrub within 2.5km of their roosts (Schofield, 2008). See map 8 which shows a 2.5km zone around the above roosts and identifies potential foraging grounds
Linear features	Kilometres	No significant loss within 2.5km of qualifying roosts. See map 8	This species follows commuting routes from its roost to its foraging grounds. Lesser horseshoe bats will not cross open ground. Consequently, linear features such as hedgerows, treelines and stone walls provide vital connectivity for this species within 2.5km around each roost (Schofield, 2008)

Light pollution	Lux	No significant increase in artificial light intensity adjacent to named roosts or along commuting routes within 2.5km of those roosts. See map 8	Lesser horseshoe bats are very sensitive to light pollution and will avoid brightly lit areas. Inappropriate lighting around roosts may cause abandonment; lighting along commuting routes may cause preferred foraging areas to be abandoned, thus increasing energetic costs for bats (Schofield, 2008)

1355 Otter *Lutra lutra*

To maintain the favourable conservation condition of Otter (*Lutra lutra*) in Lough Carra/Mask Complex SAC, which is defined by the following list of attributes and targets:

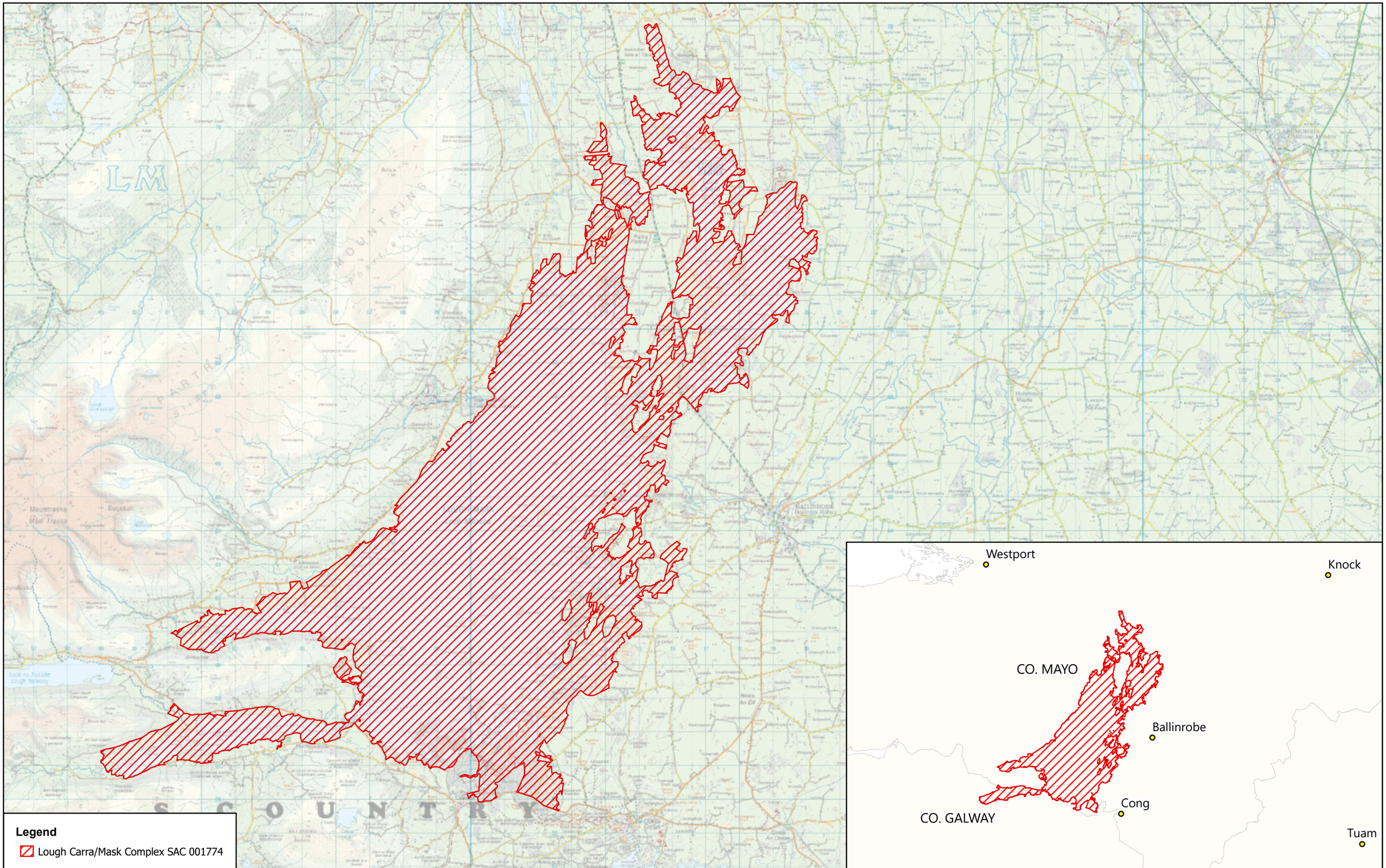
Attribute	Measure	Target	Notes
Distribution	Percentage positive survey sites	No significant decline	Measure based on standard otter survey technique. Favourable Conservation Status (FCS) target, based on 1980/81 survey findings, is 88% in SACs. Current range is estimated at 93.6% (Reid et al., 2013)
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 442ha along river banks/ lake shoreline/around ponds	No field survey. Areas mapped to include 10m terrestrial buffer, identified as critical for otters (NPWS, 2007), along rivers and around water bodies
Extent of freshwater (river) habitat	Kilometres	No significant decline. Length mapped and calculated as 37km	No field survey. River length calculated on the basis that otters will utilise freshwater habitats from estuary to headwaters (Chapman and Chapman, 1982)
Extent of freshwater (lake) habitat	Hectares	No significant decline. Area mapped and calculated as 2,325ha	No field survey. Area mapped based on evidence that otters tend to forage within 80m of the shoreline (NPWS, 2007)
Couching sites and holts	Number	No significant decline	Otters need lying up areas throughout their territory where they are secure from disturbance (Kruuk and Moorhouse, 1991; Kruuk, 2006)
Fish biomass available	Kilograms	No significant decline	Broad diet that varies locally and seasonally, but dominated by fish, in particular salmonids, eels and sticklebacks in freshwater (Bailey and Rochford, 2006; Reid et al., 2013)
Barriers to connectivity	Number	No significant increase. For guidance, see map 9	Otters will regularly commute across stretches of open water up to 500m e.g. between the mainland and an island; between two islands; across an estuary (De Jongh and O'Neill, 2010). It is important that such commuting routes are not obstructed

6216 Slender Green Feather-moss *Hamatocaulis vernicosus*

To maintain the favourable conservation condition of Slender Green Feather-moss (*Hamatocaulis vernicosus*) at Lough Carra/Mask Complex SAC, which is defined by the following list of attributes and targets

Attribute	Measure	Target	Notes
Distribution	Number and geographical spread of populations	No decline, subject to natural processes. See map 10 for the recorded location at Owenbrin (site code Hv05) based on Campbell et al. (2019)	The known population of slender green feather-moss (*Hamatocaulis vernicosus* [formerly *Drepanocladus vernicosus*, species code 1393; see Hedenäs (1989)]) in Lough Carra/Mask Complex SAC occurs on the floodplain shores of Lough Mask at Owenbrin (site code Hv05 in Campbell et al., 2019), just north of where the Owenbrin River enters Lough Mask. Data from NPWS surveys (NPWS internal files), Campbell (2013) and Campbell et al. (2015, 2019)
Population size	Number of individuals	No decline, subject to natural processes	The population at Owenbrin (Hv05) was estimated by Campbell et al. (2019) to be c.76,384,000 shoots. The estimate of shoots is based on the mean of number of shoots in 10cm x 10cm areas in four monitoring stops (plots) at Owenbrin (Hv05), extrapolated to 12,400 shoots per m² in 6,160m² (Campbell et al., 2019). The target set by Campbell et al. (2015) was 15,000 shoots/m². See Campbell et al. (2015, 2019) for further details on this and all attributes
Population cover	Percentage cover in a representative number of 2m x 2m monitoring stops	Mean percentage cover of slender green feather-moss (*Hamatocaulis vernicosus*) should be at least 40%	Target based on Campbell et al. (2015). The mean percentage cover of slender green feather-moss (*Hamatocaulis vernicosus*) recorded in four 2m x 2m monitoring stops at Owenbrin (Hv05) by Campbell et al. (2019) was 58%. See Campbell et al. (2015; 2019) for further details
Area of suitable habitat	Hectares	No decline, subject to natural processes	The extent of occurrence at Owenbrin (Hv05) in Lough Carra/Mask Complex SAC was estimated by Campbell et al. (2019) to be 10,620m² (1.06ha). See map 10. However, within this area, only c.58% is considered suitable habitat for the species, i.e. c.6,160m² (0.62ha). See Campbell et al. (2015, 2019) for further details
Hydrological conditions: water table level	Metres	Maintain the appropriate hydrological conditions necessary to support the habitat for the species	Slender green feather-moss (*Hamatocaulis vernicosus*) is mostly confined to mesotrophic fens, a transitional habitat between acid bog and base-rich fen. This appears to occur in at least two forms in Ireland: upland transitional flushes, where the plants can occur in lawns that rise and fall with fluctuating water table levels; and wet lowland sedge meadows, where plants can be inundated in winter, but may be subject to some desiccation in the summer, such as at Owenbrin (Hv05), which is also subject to lake flooding. Based on Campbell (2013) and Campbell et al. (2015, 2019)
Vegetation composition: tree cover	Percentage cover in a representative number of 2m x 2m monitoring stops	Mean percentage tree cover should be less than 15%	Attribute and target based on Campbell et al. (2015, 2019). Slender green feather-moss (*Hamatocaulis vernicosus*) grows in moss-dominated, open communities, generally with a low cover of trees and shrubs. Campbell et al. (2019) recorded 0% tree cover in four 2m x 2m monitoring stops at Owenbrin (Hv05). See Campbell et al. (2015, 2019) for further details
Vegetation composition: shrub cover	Percentage cover in a representative number of 2m x 2m monitoring stops	Mean percentage shrub cover should be less than 20%	Attribute and target based on Campbell et al. (2015, 2019). Slender green feather-moss (*Hamatocaulis vernicosus*) grows in moss-dominated, open communities, generally with a low cover of trees and shrubs. Campbell et al. (2019) recorded 0% shrub cover in four 2m x 2m monitoring stops at Owenbrin (Hv05). See Campbell et al. (2015, 2019) for further details

Vegetation composition: grass cover	Percentage cover in a representative number of 2m x 2m monitoring stops	Mean percentage grass species cover should be less than 25%	Attribute and target based on Campbell et al. (2015, 2019). Slender green feather-moss (*Hamatocaulis vernicosus*) grows in moss-dominated, open communities, generally with a low cover of grasses, maintained by a low grazing intensity by cattle and also by regular mowing at Owenbrin (Campbell, 2013; Campbell et al., 2015, 2019). Campbell (2013) had recorded grass cover of c.4-25% in four 2m x 2m plots at Owenbrin in 2009. Campbell et al. (2019) recorded a mean grass cover of c.55% in four 2m x 2m monitoring stops (plots) at the site (Hv05) in 2016. The reason for the increase in grass cover is not clear. See Campbell et al. (2015, 2019) for further details
Vegetation composition: bryophyte cover	Percentage cover in a representative number of 2m x 2m monitoring stops	Mean percentage bryophyte cover should be more than 50%	Attribute and target based on Campbell et al. (2015, 2019). Campbell et al. (2019) recorded a mean bryophyte cover of c.65% in four 2m x 2m monitoring stops at Owenbrin (Hv05). See Campbell et al. (2015, 2019) for further details
Vegetation composition: negative indicator species	Percentage cover in a representative number of 2m x 2m monitoring stops	Mean percentage cover of *Calliergonella cuspidata* should be less than 15%	Attribute and target based on Campbell et al. (2015, 2019). *Calliergonella cuspidata*, a moss species often associated with high nutrient conditions, is usually present, but with low cover and is rarely dominant. Mean cover of *Calliergonella cuspidata* was c.1% in four 2m x 2m monitoring stops recorded by Campbell et al. (2019) at Owenbrin (Hv05). See Campbell et al. (2015, 2019) for further details
Vegetation structure: vegetation height	Centimetres in a representative number of 2m x 2m monitoring stops	Mean vegetation height should not exceed 40cm	Attribute and target based on Campbell et al. (2015, 2019). Campbell et al. (2019) recorded a mean vegetation height of c.14cm in four 2m x 2m monitoring stops at Owenbrin (Hv05). See Campbell et al. (2015, 2019) for further details



Legend

Lough Carra/Mask Complex SAC 001774

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

MAP 1:
LOUGH CARRA / MASK COMPLEX SAC
CONSERVATION OBJECTIVES
SAC DESIGNATION

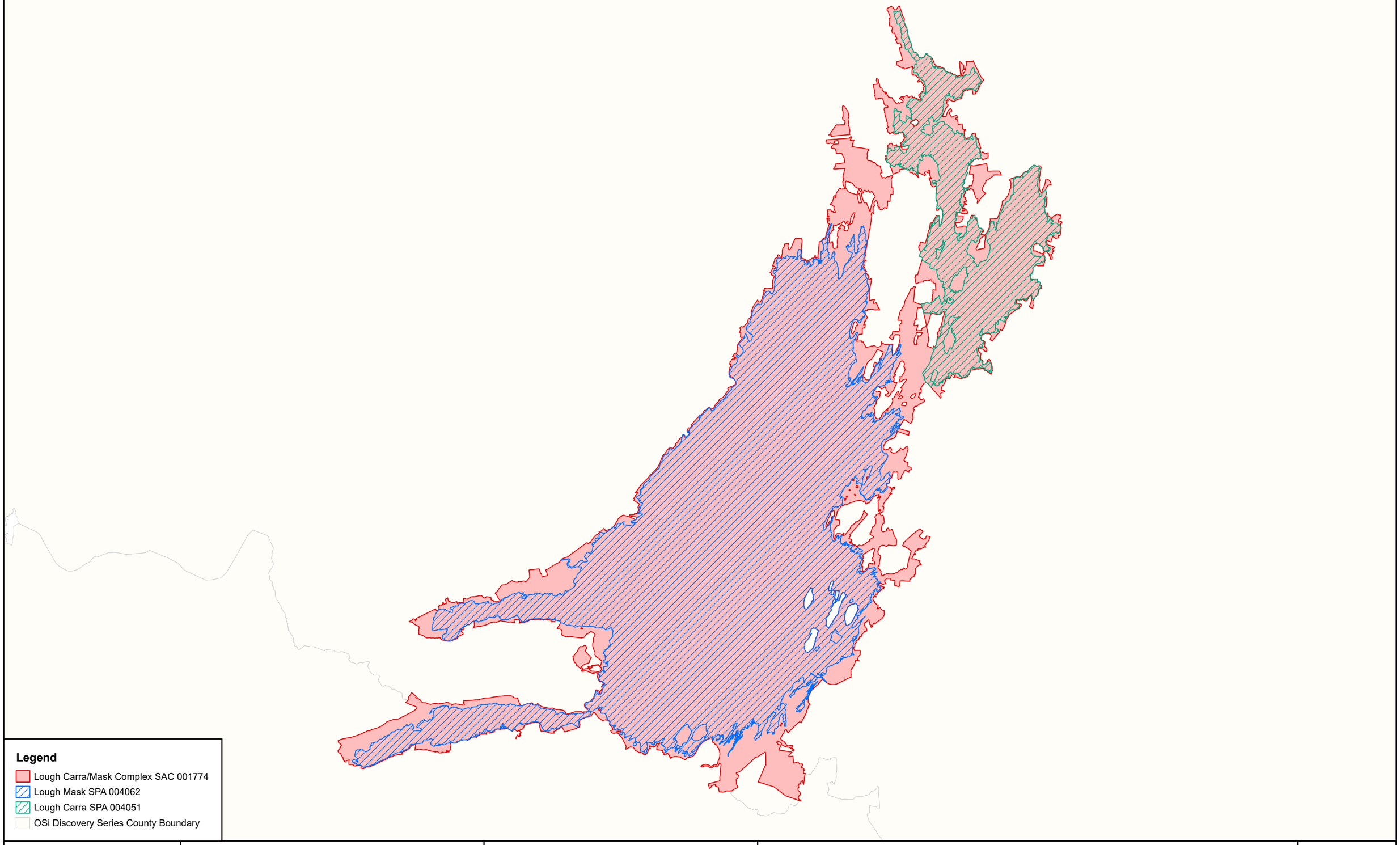
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001774; version 3.02. CO. MAYO / CO. GALWAY

0 1.5 3 4.5 6 Kilometers

N

Map Version 1
Date: October 2021



Legend

- Lough Carra/Mask Complex SAC 001774
- Lough Mask SPA 004062
- Lough Carra SPA 004051
- OSi Discovery Series County Boundary

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

MAP 2:
LOUGH CARRA / MASK COMPLEX SAC
CONSERVATION OBJECTIVES ADJACENT ADJOINING AND OVERLAPPING DESIGNATIONS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001774; version 3.02. SPA 004062; version 3.0.
SPA 004062; version 3.0. CO. MAYO / CO. GALWAY

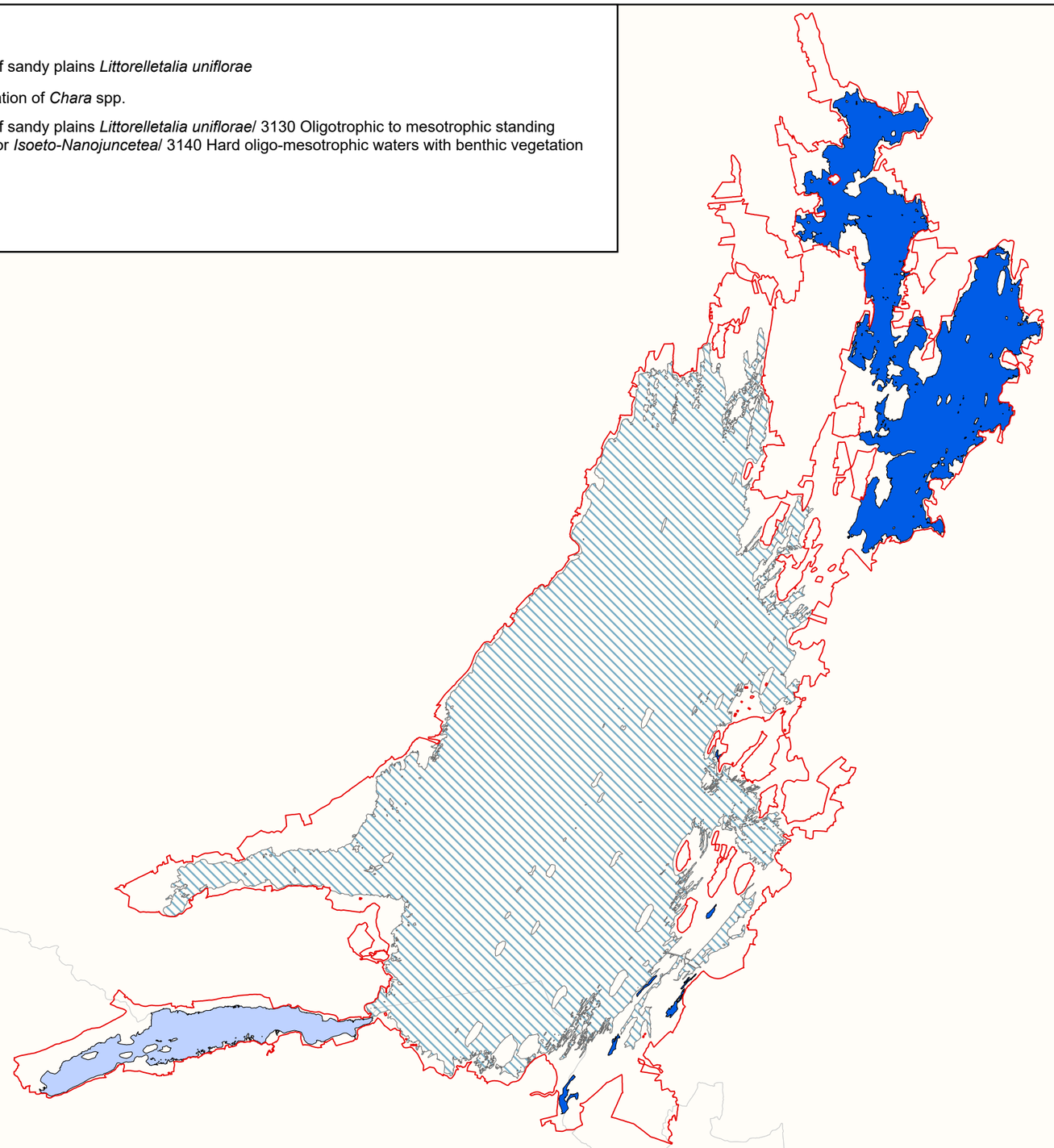
0 1 2 3 4 Kilometers

N

Map Version 1
Date: October 2021

Legend

- 3110 Oligotrophic waters containing very few minerals of sandy plains *Littorelletalia uniflorae*
- 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
- 3110 Oligotrophic waters containing very few minerals of sandy plains *Littorelletalia uniflorae*/ 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*/ 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
- Lough Carra/Mask Complex SAC 001774
- OSi Discovery Series County Boundary



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

MAP 3:
LOUGH CARRA / MASK COMPLEX SAC
CONSERVATION OBJECTIVES
INDICATIVE LAKE HABITATS

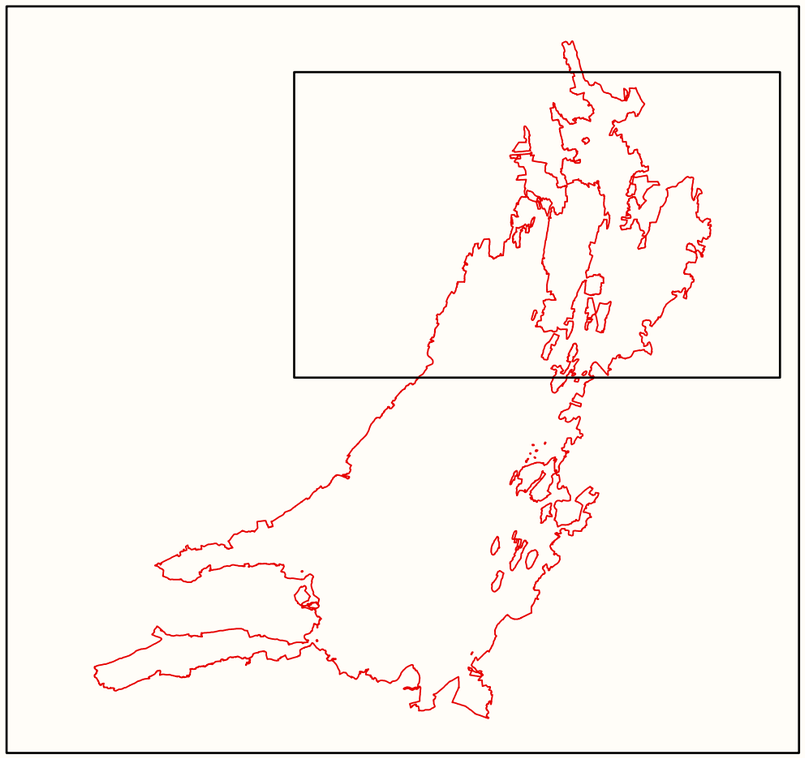
Map to be read in conjunction with the NPWS Conservation Objectives Document.

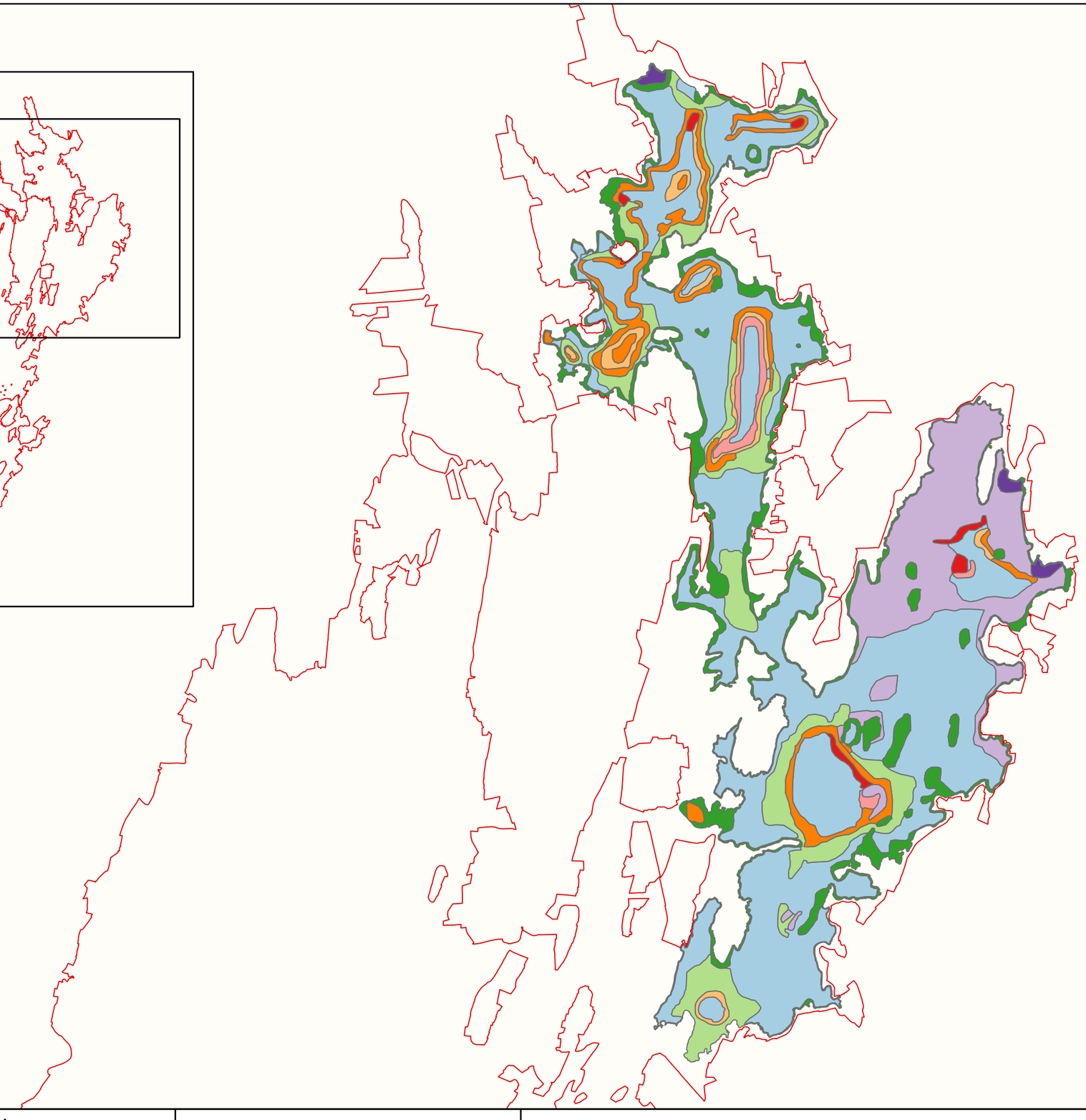
SITE CODE:
SAC 001774; version 3.02.
CO. MAYO / CO. GALWAY

0 1 2 3 4 Kilometers

N

Map Version 1
Date: October 2021





Legend

Lough Carra/Mask Complex SAC 001774

Vegetation Unit Name

- Krustenstein Unit
- *Chara curta* Unit
- *Chara tomentosa* Unit
- *Chara rudis* Unit
- *Chara globularis* Unit
- Aquatic angiosperm Units
- *Chara denudata* Unit
- River-mouth community
- Sandy Marl (bare substratum)
- OSi Discovery Series County Boundary

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

MAP 4:
LOUGH CARRA / MASK COMPLEX SAC
CONSERVATION OBJECTIVES
LOUGH CARRA VEGETATION UNITS
(Roden and Murphy, 2013)

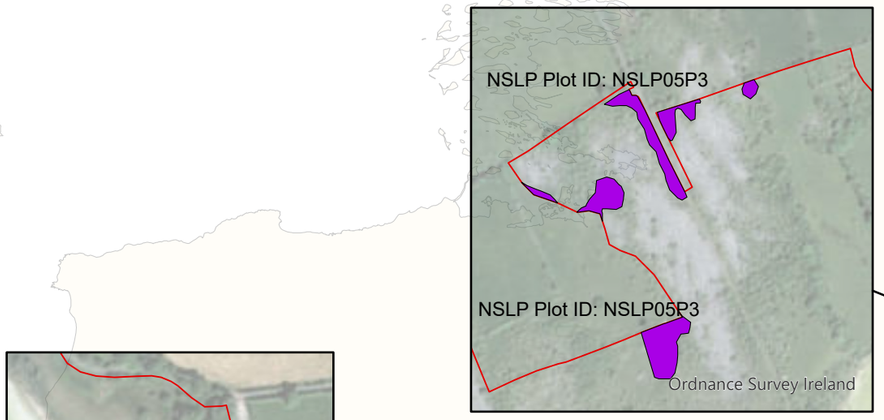
Map to be read in conjunction with the NPWS Conservation Objectives Document.

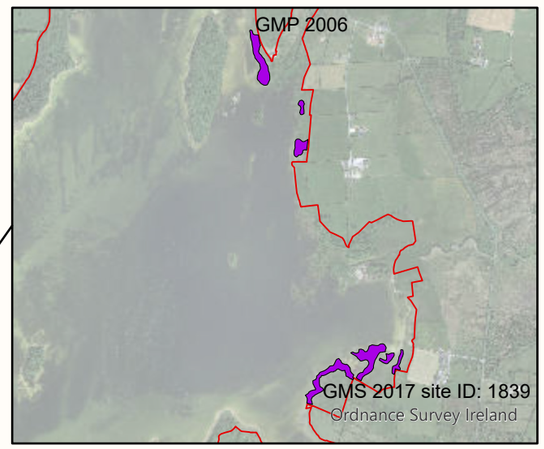
SITE CODE:
SAC 001774; version 3.02.
CO. MAYO / CO. GALWAY

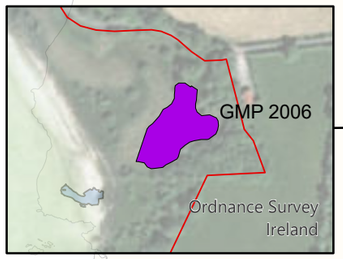
0 0.5 1 1.5 2 Kilometers

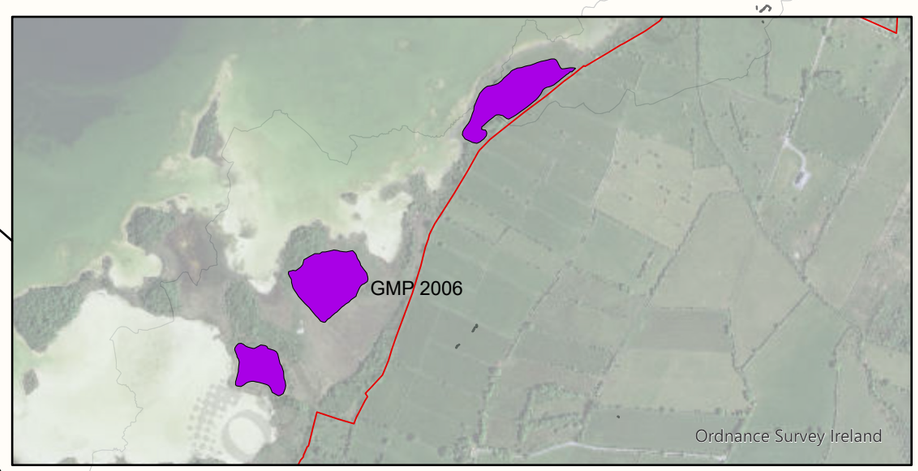
N

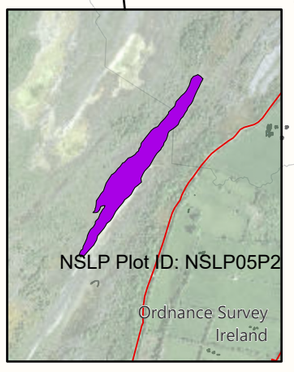
Map Version 1
Date: October 2021

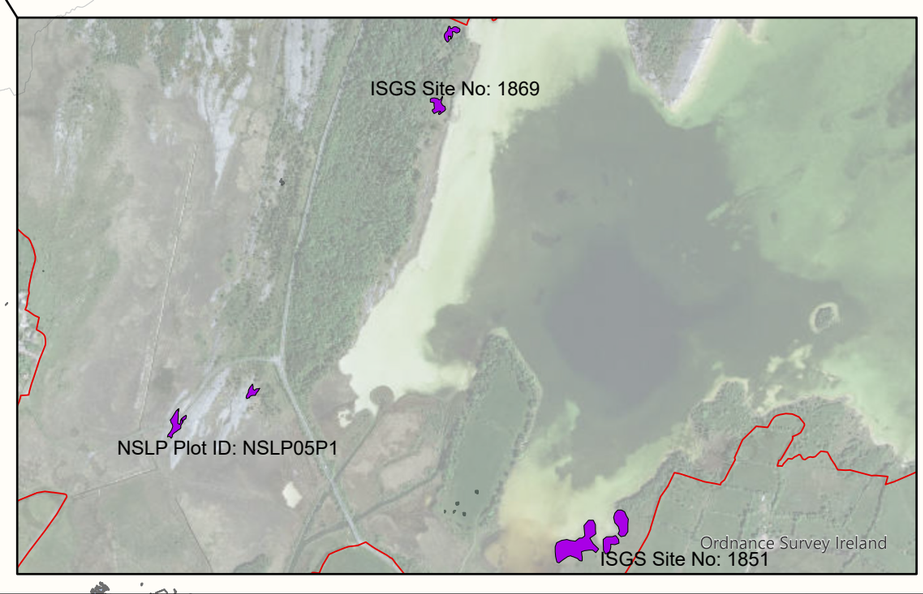












Legend

- 6210 * Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)
- Lough Carra/Mask Complex SAC 001774
- OSi Discovery Series County Boundary

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

MAP 5:
LOUGH CARRA / MASK COMPLEX SAC
CONSERVATION OBJECTIVES
GRASSLAND HABITATS

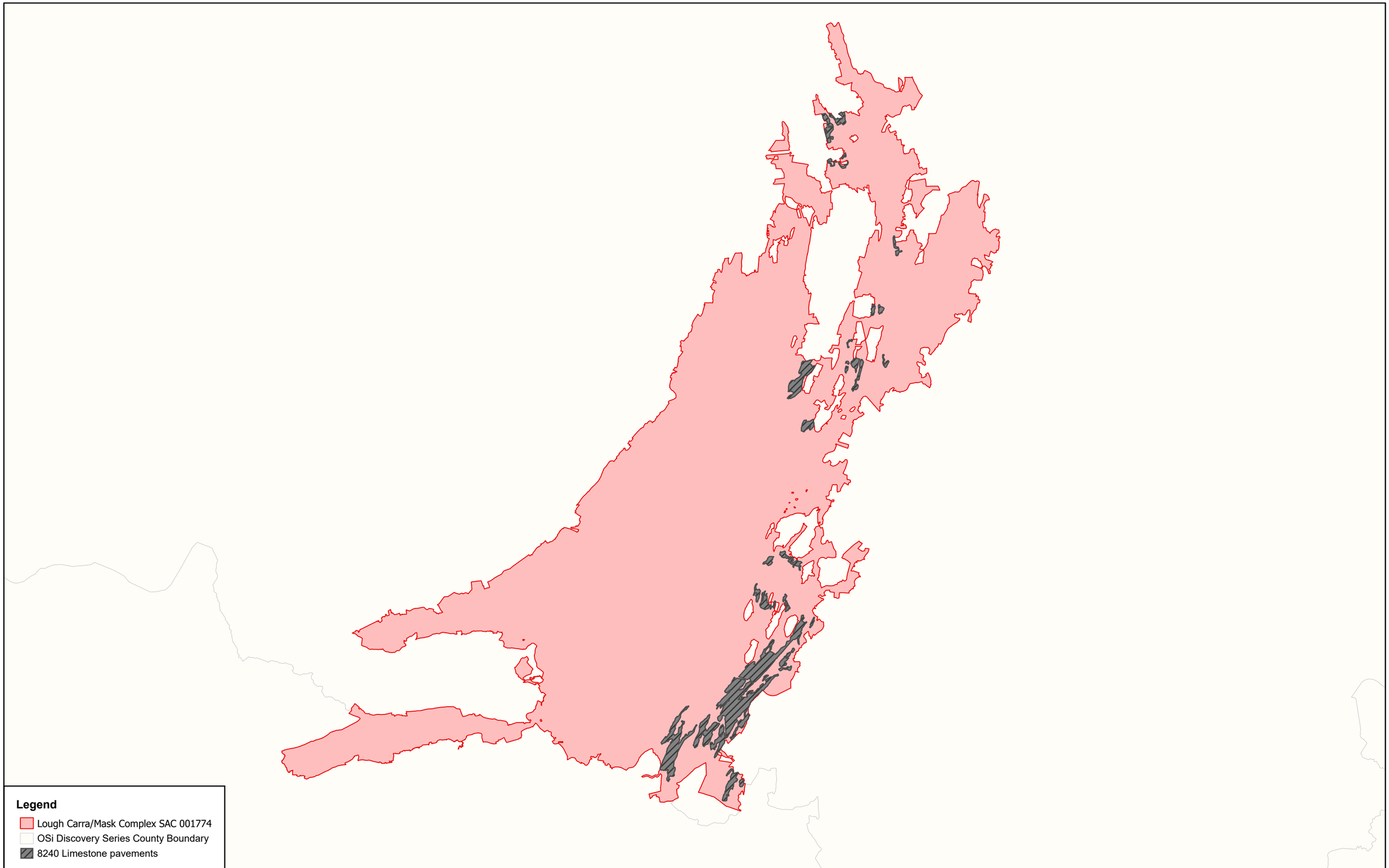
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001774; version 3.02.
CO. MAYO / CO. GALWAY

0 3 6 9 12 Kilometers

N

Map Version 1
Date: October 2021



Legend

- Lough Carra/Mask Complex SAC 001774
- OSi Discovery Series County Boundary
- 8240 Limestone pavements

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

MAP 6:
LOUGH CARRA / MASK COMPLEX SAC
CONSERVATION OBJECTIVES
LIMESTONE PAVEMENT

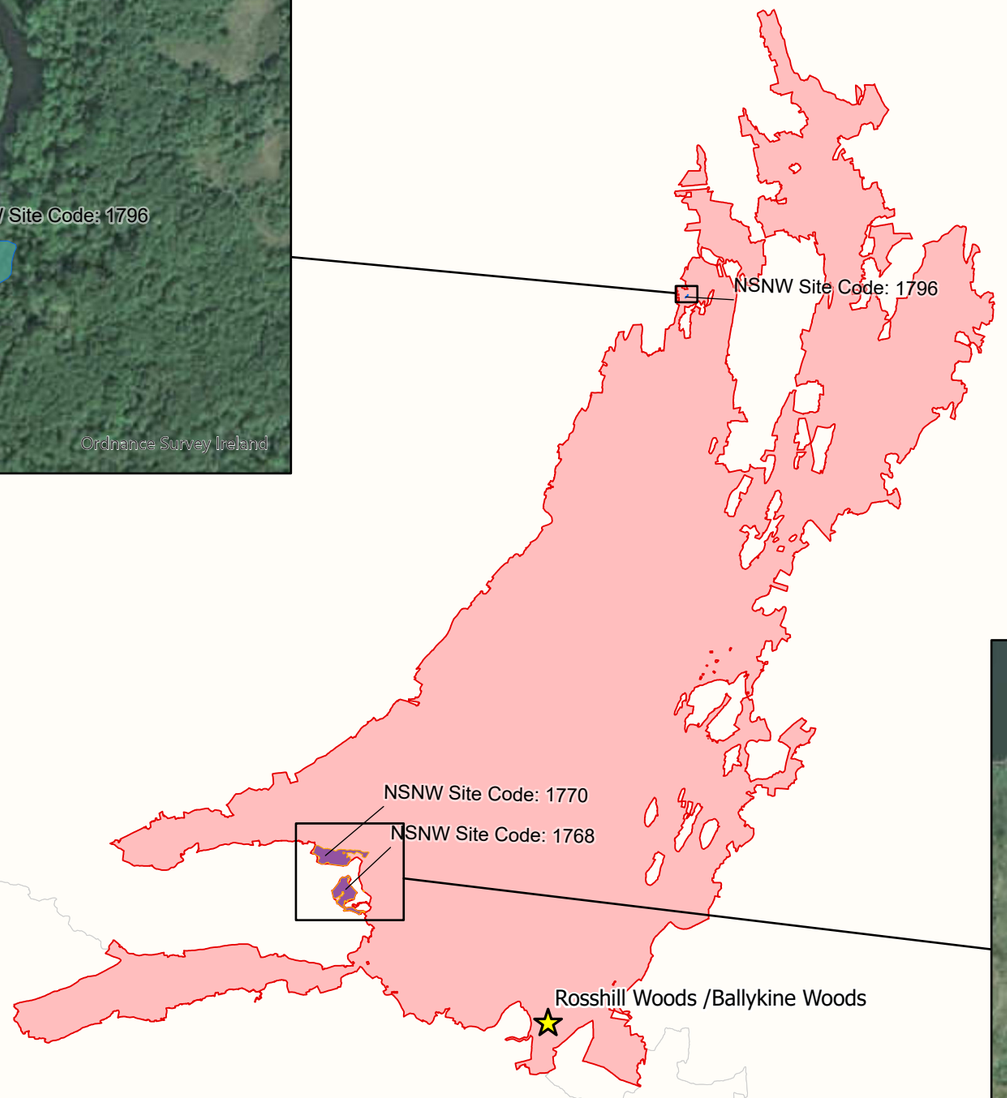
Map to be read in conjunction with the NPWS Conservation Objectives Document.

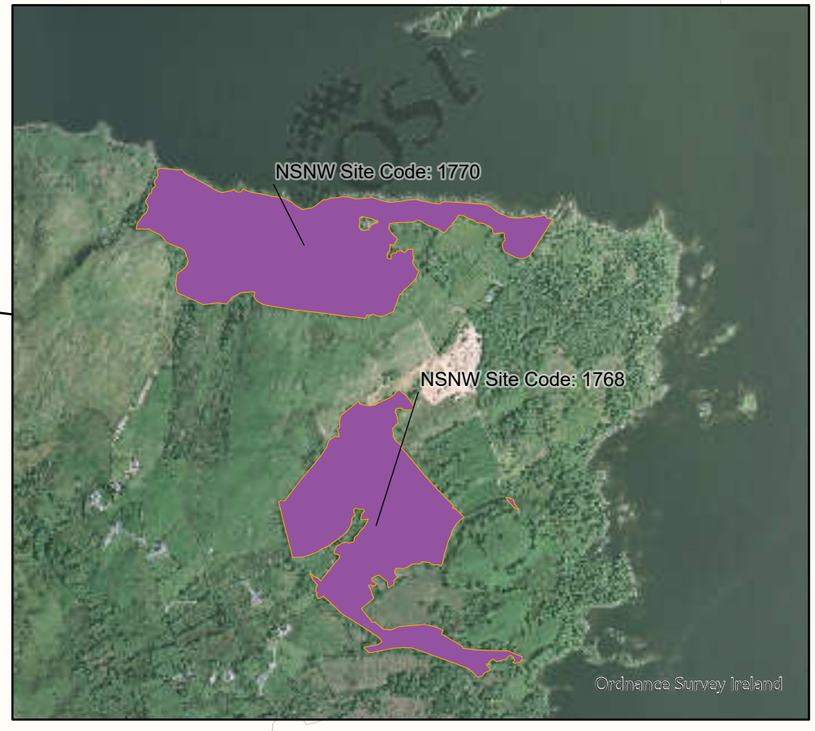
SITE CODE:
SAC 001774; version 3.02.
CO. MAYO / CO. GALWAY

0 1 2 3 4 Kilometers

N

Map Version 1
Date: October 2021





Legend

Annex I Qualifying Interests

91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

Annex I Non-qualifying Interests

91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

Lough Carra/Mask Complex SAC 001774

OSi Discovery Series County Boundary

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

MAP 7:
LOUGH CARRA / MASK COMPLEX SAC
CONSERVATION OBJECTIVES
WOODLAND HABITATS

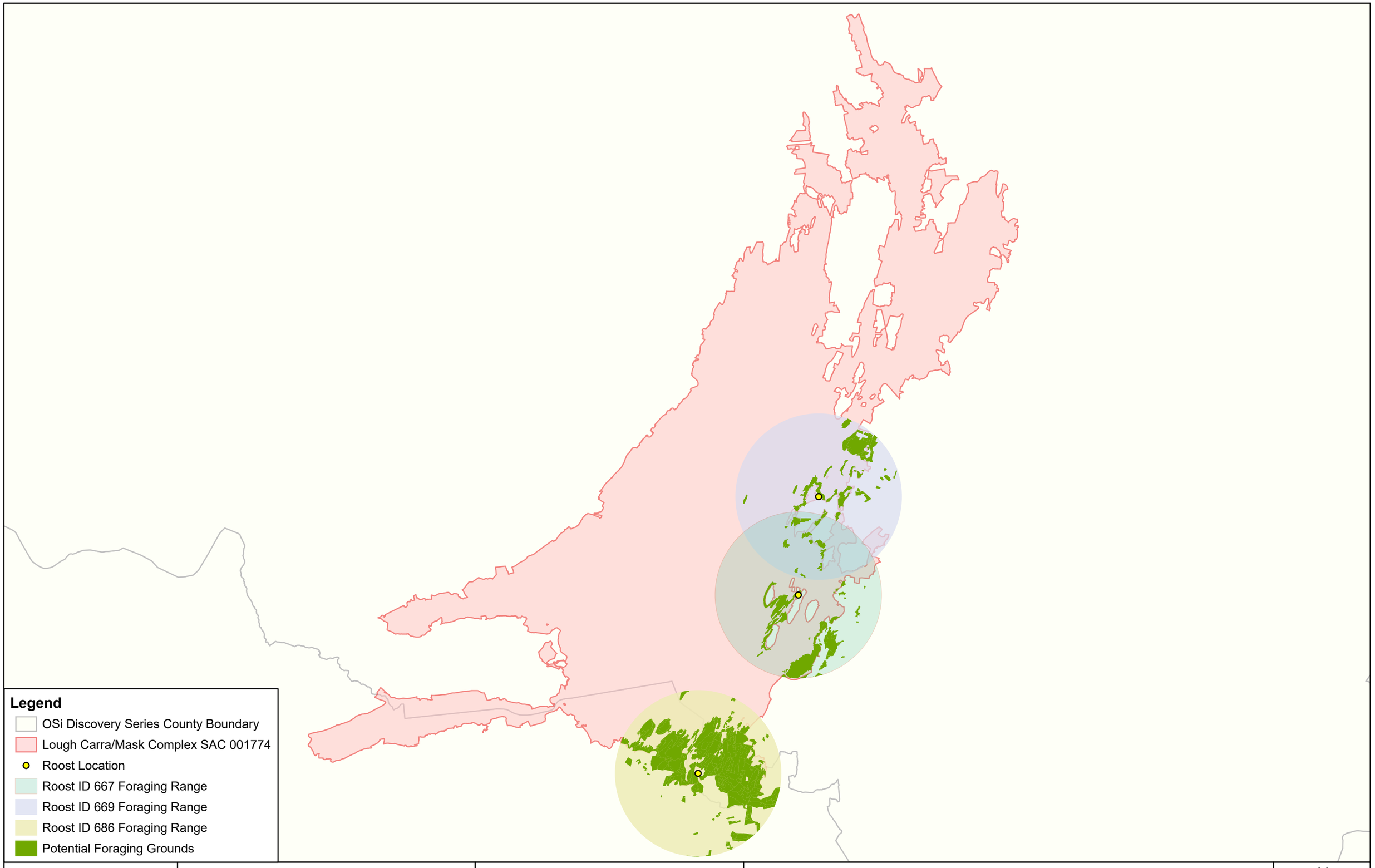
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001774; version 3.02.
CO. MAYO / CO. GALWAY

0 1.5 3 4.5 6 Kilometers

N

Map Version 1
Date: October 2021



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

MAP 8:
LOUGH CARRA/MASK COMPLEX SAC
CONSERVATION OBJECTIVES
LESSER HORSESHOE BAT

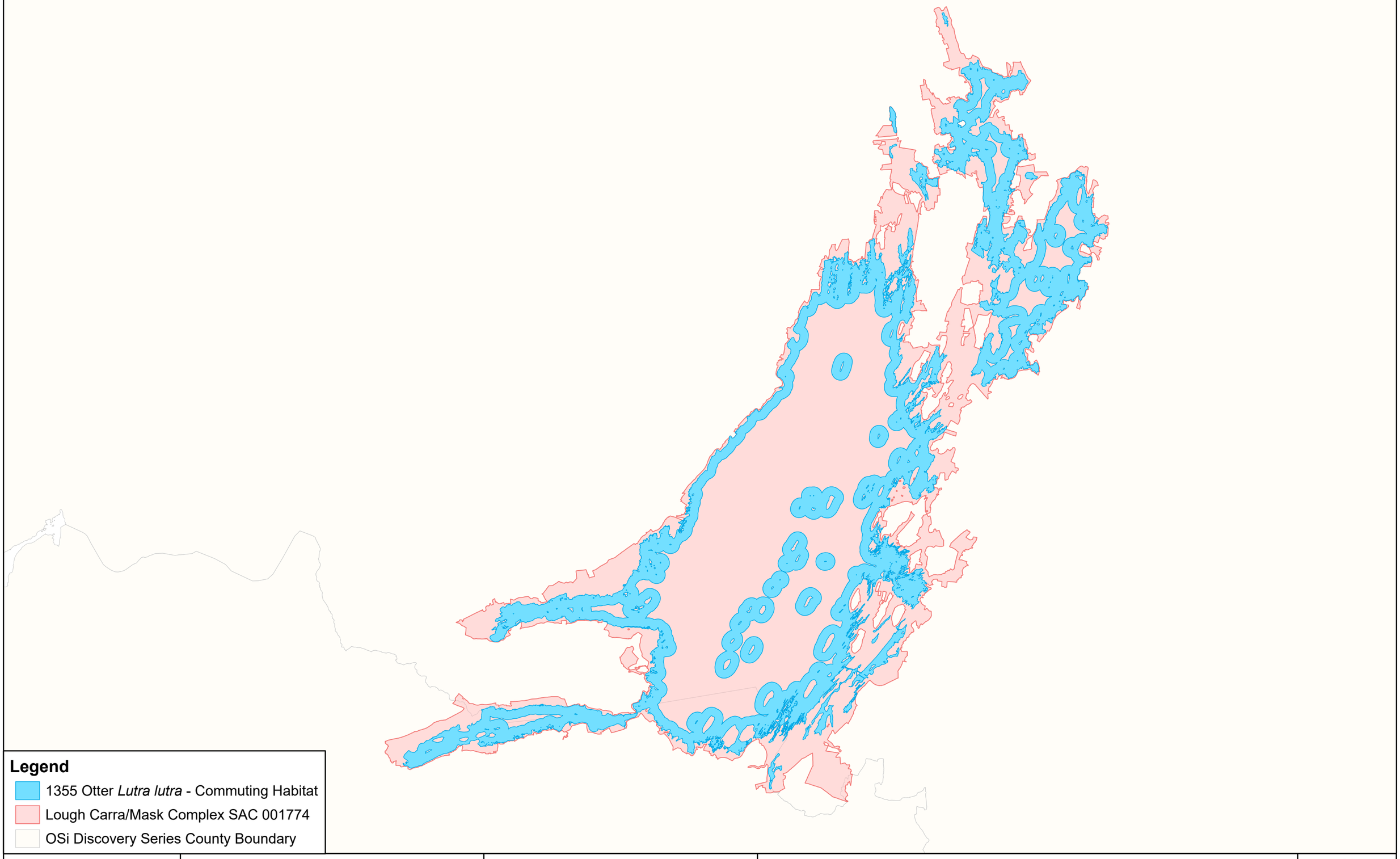
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001774; version 3.02. CO. MAYO / CO. GALWAY

0 1 2 3 4 Kilometers

N

Map Version 1
Date: October 2021



Legend

- 1355 Otter *Lutra lutra* - Commuting Habitat
- Lough Carra/Mask Complex SAC 001774
- OSi Discovery Series County Boundary

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

MAP 9:
LOUGH CARRA/MASK COMPLEX SAC
CONSERVATION OBJECTIVES
OTTER COMMUTING HABITAT

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001774; version 3.02. CO. MAYO / CO. GALWAY

0 1.5 3 4.5 6 Kilometers

N

Map Version 1
Date: October 2021

Legend

- Lough Carra/Mask Complex SAC 001774
- OSi Discovery Series County Boundary
- 6216 Slender Green Feather-moss *Hamatocaulis vernicosus*

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

MAP 10:
LOUGH CARRA/MASK COMPLEX SAC
CONSERVATION OBJECTIVES
SLENDER GREEN FEATHER MOSS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001774; version 3.02. CO. MAYO / CO. GALWAY

0 1.5 3 4.5 6 Kilometers

N

Map Version 1
Date: October 2021