

National Parks and Wildlife Service

Conservation Objectives Series

Lough Gill SAC 001976



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

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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

001976 Lough Gill SAC

- 1092 White-clawed Crayfish *Austropotamobius pallipes*
- 1095 Sea Lamprey *Petromyzon marinus*
- 1096 Brook Lamprey *Lampetra planeri*
- 1099 River Lamprey *Lampetra fluviatilis*
- 1106 Salmon *Salmo salar*
- 1355 Otter *Lutra lutra*
- 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
- 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)
- 91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles
- 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)*

Please note that this SAC is adjacent to Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627) and Glenade Lough SAC (001919). See map 2. The conservation objectives for this site should be used in conjunction with those for the adjacent 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 :	1972
Title :	A Preliminary Report on Areas of Scientific Interest in County Sligo
Author :	Goodwillie, R.N.
Series :	Unpublished Report
Year :	2006
Title :	Otter survey of Ireland 2004/2005
Author :	Bailey, M.; Rochford, J.
Series :	Irish Wildlife Manuals, No. 23
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 :	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 :	Monitoring of white-clawed crayfish <i>Austropotamobius pallipes</i> in Irish lakes in 2007
Author :	O'Connor, W.; Hayes, G.; O'Keeffe, C.; Lynn, D.
Series :	Irish Wildlife Manuals, No. 37
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 :	A technical manual for monitoring white-clawed crayfish (<i>Austropotamobius pallipes</i>) in Irish lakes
Author :	Reynolds, J.; O'Connor, W.; O'Keeffe, C.; Lynn, D.
Series :	Irish Wildlife Manuals, No.45
Year :	2012
Title :	The beetles of decaying wood in Ireland. A provisional annotated checklist of saproxylic Coleoptera
Author :	Alexander, K.N.A.; Anderson, R.
Series :	Irish Wildlife Manuals, No. 65
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 :	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 :	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 :	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 :	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 :	2019
Title :	The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments
Author :	NPWS
Series :	Conservation assessments
Year :	2021
Title :	Conservation Objectives: Lough Carra/Mask Complex SAC 001774. Version 1
Author :	NPWS
Series :	Conservation Objectives
Year :	2021
Title :	White-clawed Crayfish <i>Austropotamobius pallipes</i> survey in designated SACs in 2017
Author :	Gammell, M.; McFarlane, A.; Brady, D.; O'Brien, J.; Mirimin, L.; Graham, C.; Lally, H.; Minto, C.; O'Connor, I.
Series :	Irish Wildlife Manuals, No. 131
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 (<i>Najas flexilis</i>)
Author :	Roden, C.; Murphy, P.; Ryan, J.B.
Series :	Irish Wildlife Manuals

Other References

Year :	1950
Title :	<i>Arbutus unedo</i> L.
Author :	Sealy, J.R.; Webb, D.A.
Series :	Journal of Ecology, 38: 223-36
Year :	1975
Title :	A preliminary survey of Irish lakes
Author :	Flanagan, P.J.; Toner P.F.
Series :	An Foras Forbartha
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 :	Moor Balls from the Shore of Lough Gill, Co Sligo
Author :	Campbell, J.; Scannell, M.J.P.
Series :	Irish Naturalists' Journal, 23(2): 75-76
Year :	1991
Title :	The spatial organization of otters (<i>Lutra lutra</i>) in Shetland
Author :	Kruuk, H.; Moorhouse, A.
Series :	Journal of Zoology, 224: 41-57
Year :	1993
Title :	Ecological Study of Lough Gill - to Predict the Effects of the Sligo and Environs Water Supply Scheme on the Flora and Fauna with Suggestions for Future Management
Author :	Cotton, D.C.F.
Series :	Report prepared in conjunction with Jennings O'Donovan and Partners for Sligo County Council
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 :	2002
Title :	Reversing the habitat fragmentation of British woodlands
Author :	Peterken, G.
Series :	WWF-UK, London
Year :	2002
Title :	A survey of the white-clawed crayfish, <i>Austropotamobius pallipes</i> (Lereboullet), and of water quality in two catchments of eastern Ireland
Author :	Demers, A.; Reynolds, J.D.
Series :	Bulletin Francais de la Peche et de la Pisciculture, 367: 729-740

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 :	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 :	National Programme: Habitats Directive and Red Data Book Species Executive Report 2009
Author :	Inland Fisheries Ireland (IFI)
Series :	IFI/2010/1-0480. Inland Fisheries Ireland
Year :	2011
Title :	Comparison of field- and GIS-based assessments of barriers to Atlantic salmon migration: a case study in the Nore Catchment, Republic of Ireland
Author :	Gargan, P.G.; Roche, W.K.; Keane, S.; King, J.J.; Cullagh, A.; Mills, P.; O'Keeffe, J.
Series :	Journal of Applied Ichthyology, 27 (Suppl. 3): 66-72
Year :	2013
Title :	Aspects of brook lamprey (<i>Lampetra planeri</i> Bloch) spawning in Irish waters
Author :	Rooney, S.M.; O'Gorman, N.M.; Green, F.; King, J.J.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 113B(1): 13-25
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 :	Behaviour of sea lamprey (<i>Petromyzon marinus</i> L.) at man-made obstacles during upriver spawning migration: use of telemetry to assess efficacy of weir modifications for improved passage
Author :	Rooney, S.M.; Wightman, G.D.; O Conchuir, R.; King, J.J.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 115B: 1-12
Year :	2015
Title :	Common standards monitoring guidance for freshwater fauna. Version October 2015
Author :	JNCC
Series :	Joint Nature Conservation Committee, Peterborough

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 :	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 :	2017
Title :	National Programme: Habitats Directive and Red Data Book Species Summary Report 2016
Author :	Gallagher, T.; O'Gorman, N.M.; Rooney, S.M.; Coghlan, B.; King, J.J.
Series :	IFI/2017/1-4383. Inland Fisheries Ireland
Year :	2018
Title :	Initial observations on feeding juvenile sea lamprey (<i>Petromyzon marinus</i>) L. in Irish Lakes
Author :	King, J.J.; O'Gorman, N.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 118B(2): 113-120
Year :	2019
Title :	Resurvey of long-term ecological monitoring transects at the People's Millennium Forests
Author :	Daly, O.H.; O'Neill, F.H.; Perrin, P.M.
Series :	Unpublished report to Woodlands of Ireland, Coillte and The Forest Service
Year :	2021
Title :	The Status of Irish Salmon Stocks in 2020 with Catch Advice for 2021
Author :	Gargan, P.; Fitzgerald, C.; Kennedy, R.; Maxwell, H.; McLean, S.; Millane, M.
Series :	Report of the Technical Expert Group on Salmon (TEGOS) to the North-South Standing Scientific Committee for Inland Fisheries

Spatial data sources

Year :	2021
Title :	OSi Prime 2 water polygon file
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 :	3150 (map 3)
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 4)
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 :	91A0, 91E0 (map 5)
Year :	2018
Title :	Woodland Monitoring Survey 2017-2018
GIS Operations :	QIs selected; clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	91E0 (map 5)
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 :	1092 (map 6)
Year :	2010
Title :	OSi 1:5000 IG vector dataset
GIS Operations :	Creation of 80m buffer on aquatic side of lake data; creation of 10m buffer on terrestrial side of lake data. Datasets combined with derived OSi Prime 2 water dataset. Overlapping regions investigated and resolved; resulting dataset clipped to SAC boundary. Expert opinion used as necessary to resolve any issues arising. Creation of 250m buffer on aquatic side of the lake boundary to highlight potential commuting points
Used For :	1355 (map 7)
Year :	2021
Title :	OSi Prime 2 water polygon file
GIS Operations :	Creation of 10m buffer on terrestrial side of river banks data. Dataset combined with derived OSi 1:5000 vector lake buffer data. 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 7)

Conservation Objectives for : Lough Gill SAC [001976]

3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation

To restore the favourable conservation condition of Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation in Lough Gill 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	It is uncertain whether the lake habitat in Lough Gill is 3150, or more closely aligned with the <i>Najas</i> -type lake habitat 3130 as is the upstream Glenade Lough. The mixed geology of the catchment suggests that habitat 3130 may be more appropriate. This distinction has important implications for the targets used as Water Framework Directive good ecological status/mesotrophic is considered sufficient for habitat 3150, while habitat 3130 broadly requires high status/oligotrophic status and has habitat-specific attributes and targets (see Roden et al., in prep.; see also 3130 in NPWS, 2021). Lough Gill has steeply sloping littoral zones and large areas of deep water. Despite this, a wide variety of pondweed species has been recorded. Further study of its aquatic vegetation is needed. 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, it is unclear whether the vegetation of Lough Gill is that of habitat 3150 or 3130
Vegetation composition: typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution	A number of accounts indicate that the flora of Lough Gill is limited, most likely owing to its steeply sloping shorelines (Cotton, 1993). Nevertheless, a range of submerged aquatics have been recorded in Lough Gill, including charophytes: <i>Chara aspera</i> , <i>C. contraria</i> , <i>C. curta</i> , <i>C. hispida</i> , <i>C. virgata</i> and <i>Tolypella glomerata</i> ; <i>Callitriche hermaphroditica</i> , <i>Hippuris vulgaris</i> , <i>Littorella uniflora</i> , <i>Myriophyllum alterniflorum</i> , <i>M. spicatum</i> , <i>Potamogeton alpinus</i> , <i>P. berchtoldii</i> , <i>P. coloratus</i> , <i>P. filiformis</i> , <i>P. gramineus</i> , <i>P. lucens</i> , <i>P. natans</i> , <i>P. perfoliatus</i> , <i>P. x angustifolius</i> and <i>P. x nitens</i> . <i>Lemna minor</i> and <i>L. trisulca</i> also occur. See Roden et al. (in prep.) for habitat 3130 typical species. For lists of typical plant species of both habitats 3150 and 3130, see the Article 17 habitat assessments (NPWS, 2013, 2019) and the lake habitats supporting document (O Connor, 2015)
Vegetation composition: characteristic zonation	Occurrence	All characteristic zones should be present, correctly distributed and in good condition	The vegetation zones/communities of Lough Gill have not been fully described. Further survey using snorkel/scuba is required. The characteristic zonation of habitat 3150 has not yet been described. Roden et al. (in prep.) describe the characteristic zonation and other spatial patterns of lake habitat 3130
Vegetation distribution: maximum depth	Metres	Maintain maximum depth of vegetation, subject to natural processes	Information on the maximum depth of vegetation growth in Lough Gill may be available from the Environmental Protection Agency (EPA). Roden et al. (in prep.) describe the maximum vegetation depth of habitat 3130 in Ireland. Further work is necessary to develop indicative targets for lake habitat 3150. The maximum depth of vegetation may be specific to the lake shoreline in question. It should be large in lakes within undisturbed peatland and uplands; however, pressures on peatland such as overgrazing, as well as eutrophication, may have reduced vegetation depth

Hydrological regime: water level fluctuations	Metres	Maintain appropriate hydrological regime necessary to support the habitat	The mixed geology of the lake's basin and catchment influences Lough Gill's hydrological regime, and it is likely that seepages and springs discharge to the lake. The inflowing Bonet River was arterially drained 1982-1992. 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	Roden et al. (in prep.) provide information on the substratum types of lake habitat 3130 in Ireland. Research is required to further characterise the substratum types (particle size and origin) of habitat 3150 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 soft muddy substrata dominate habitat 3150. Substratum varies with catchment geology, and with depth and along shorelines in an individual lake
Transparency	Metres	Maintain/restore appropriate Secchi transparency. There should be no decline in Secchi depth/transparency	McGarrigle et al. (2010) report average Secchi transparency of 2m in Lough Gill in 2008. The OECD fixed boundary system set transparency targets for mesotrophic lakes of 6-3m annual mean Secchi disk depth, and 3-1.5m annual minimum Secchi disk depth and for oligotrophic lakes of ≥ 6 m annual mean Secchi disk depth, and ≥ 3 m annual minimum Secchi disk depth. 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 habitats (O Connor, 2015); however, Roden et al. (in prep.) discuss Secchi depths in habitat 3130 in Ireland. Habitat 3130 is associated with clear water, as evidenced by the growth of the character species <i>Najas flexilis</i> (slender naiad) at depths of up to 10m
Nutrients	$\mu\text{g/l P}$; mg/l N	Maintain/restore the concentration of nutrients in the water column to sufficiently low levels to support the habitat and its typical species	Depending on which habitat occurs naturally in Lough Gill, the target is Water Framework Directive (WFD) good status and mesotrophic or better for 3150, or high status and oligotrophic for 3130. The 'good-moderate' boundary is too enriched to support habitat 3130. Lough Gill had good nutrient status from 2007-2015 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017). Good status/mesotrophic has annual average TP concentration $\leq 20\mu\text{g/l TP}$, average annual total ammonia concentration $\leq 0.065\text{mg/l N}$ and annual 95th percentile for total ammonia $\leq 0.140\text{mg/l N}$. High status/oligotrophic has annual average TP concentration $\leq 10\mu\text{g/l TP}$, average annual total ammonia concentration $\leq 0.040\text{mg/l N}$ and annual 95th percentile for total ammonia $\leq 0.090\text{mg/l N}$. See also O Connor (2015), OECD (1982) and The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019

Phytoplankton biomass	µg/l chlorophyll <i>a</i>	Maintain appropriate water quality to support the habitat, including high chlorophyll <i>a</i> status	Lough Gill had high chlorophyll status from 2007-2015 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017); therefore, the target for Lough Gill is set as high status and oligotrophic. The average growing season (March-October) chlorophyll <i>a</i> concentration must be <5.8µg/l. The annual average chlorophyll <i>a</i> concentration should be <2.5µg/l and the annual peak chlorophyll <i>a</i> concentration should be ≤8.0µg/l. Where a lake has a chlorophyll <i>a</i> concentration that is lower than this target, there should be no decline within class, i.e. no upward trend in phytoplankton biomass. See also OECD (1982) and The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019
Phytoplankton composition	EPA phytoplankton composition metric	Maintain/restore 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. Phytoplankton composition status at Lough Gill was high in 2007-2009, but declined to good in 2010-12 and 2013-15 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017)
Attached algal biomass	Algal cover	Maintain/restore trace/absent attached algal biomass (<5% cover)	Cotton (1993) noted that <i>Cladophora</i> balls, first observed in Lough Gill by Campbell and Scannell (1989), are a regular occurrence. Nutrient enrichment can favour epiphytic and epipelic algae that can out-compete the submerged vegetation. The cover abundance of attached algae in habitats 3130 and 3150 should, ideally therefore, be trace/absent (<5% cover)
Macrophyte status	EPA macrophyte metric (The Free Index)	Restore high/good macrophyte status	If habitat 3150 is present, the target for Lough Gill is WFD good status, or better. It failed to reach this, having moderate macrophyte status 2007-2009 and 2010-12, and poor in 2013-15 (McGarrigle et al., 2010; Bradley et al., 2015; Fanning et al., 2017). Specific vegetation targets are set for habitat 3130 (Roden et al., in prep.). 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 Water Framework Directive purposes using the 'Free Index'. See also The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019
Acidification status	pH units, mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes	Habitat 3130 is associated with intermediate alkalinity, largely between 20-80mg/l (Roden et al., in prep.), and in line with targets for <i>Najas flexilis</i> , median pH values should be >7 pH units. The specific requirements of habitats 3150, in terms of water and sediment pH, alkalinity and cation concentration, have not been determined, but it is also expected to have median pH values above 7 pH units. Acidification can impact on species abundance and composition in lake habitats. Maximum pH should be <9.0 pH units, in line with the surface water standards. See also The European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. Lough Gill passed this target from 2007-15 (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	Flanagan and Toner (1975) noted that the water of Lough Gill was markedly coloured. Free et al. (2006) reported colour of 44mg/l PtCo in Lough Gill. Roden et al. (in prep.) showed that habitat 3130 is found in clear water, and water colour is negatively correlated with maximum vegetation (euphotic) depth. They set good condition at <40mg/l PtCo; however, further work is necessary to determine sustainable water colour levels for the habitat, which may be <30 or even <20mg/l PtCo. 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). 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
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.
Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate units	Maintain/restore appropriate turbidity to support the habitat	Lough Gill should, naturally, have clear water with low levels of turbidity. Cotton (1993) noted high turbidity in Lough Gill as a result of the Bonet drainage scheme. Jim Ryan (pers. comm.) has also noted high turbidity in the lake. 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
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of the habitat	Most lake shorelines have fringing habitats that intergrade with and support the structure and functions of the lake habitat. Lough Gill has a variety of important fringing habitats including alluvial woodland, other woodland, marsh, heath, wet grassland and orchid-rich calcareous grassland (see conservation objectives for 91E0, 91A0 and 6210). A number of rare and threatened plant species (see Wyse Jackson et al., 2016) are found in the fringing habitats including <i>Arbutus unedo</i> , <i>Taxus baccata</i> , <i>Prunus padus</i> , <i>Sorbus rupicola</i> , <i>Hieracium basalticola</i> , <i>Leucojum aestivum</i> , <i>Scutellaria minor</i> , <i>Sagittaria sagittifolia</i> , <i>Tamus communis</i> , <i>Neottia nidus-avis</i> and <i>Hypopitys monotropa</i> . 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. See also Mainstone et al. (2016)

Conservation Objectives for : Lough Gill SAC [001976]

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 Gill 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 Irish Semi-natural Grasslands Survey (ISGS; O'Neill et al., 2013) surveyed a number of areas of semi-natural grasslands within Lough Gill SAC, and found species-rich calcareous grassland habitat in one of those areas. The area of the habitat recorded within the SAC is located approximately midway along the northern shore of Lough Gill, in an area called Clogher Beg (survey site code 1556). This site (1556) was again visited as part of the Grasslands Monitoring Survey (GMS; Martin et al., 2018). The GMS (Martin et al., 2018) mapped 6.9ha of the habitat in Lough Gill SAC. See map 4. It is important to note that further unsurveyed areas of the habitat may be present within the SAC
Habitat distribution	Occurrence	No decline, subject to natural processes	Distribution based on GMS (Martin et al., 2018). See map 4. Note that further unsurveyed areas of the habitat 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. These documents should be consulted for further details
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. The GMS (Martin et al., 2018) noted relatively high cover of the negative indicator species white clover (<i>Trifolium repens</i>) throughout the Clogher Beg site (site code 1556)
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 (<i>Pteridium aquilinum</i>) not more than 5%	Woody species that can occur above 5% cover are juniper (<i>Juniperus communis</i>), burnet rose (<i>Rosa spinosissima</i>), mountain avens (<i>Dryas octopetala</i>) and hoary rock-rose (<i>Helianthemum oelandicum</i>). However, cover of these species above 25% may indicate transition to another Annex I habitat such as Alpine and Boreal heaths (4060) or <i>Juniperus communis</i> formations (5130). Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018)
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). The GMS (Martin et al., 2018) recorded both tall rank vegetation and very short vegetation (3cm) at separate monitoring stops at the Clogher Beg site (site code 1556) in 2017
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 20m ²	Attribute and target based on O'Neill et al. (2013) and Martin et al. (2018)

Conservation Objectives for : Lough Gill SAC [001976]

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

To restore the favourable conservation condition of Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles in Lough Gill 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. See map 5	Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles is present at Lough Gill SAC. As part of the National Survey of Native Woodlands (NSNW), the sub-sites Stonepark (NSNW site code 333), Cullentra (1400) and Sliswood (1411) were surveyed by Perrin et al. (2008). The conservation assessment score of Cullentra was ranked as joint first in Co. Sligo. National monitoring surveys have included Sliswood (1411) (Daly et al., in prep.) and Stonepark (333) (O'Neill and Barron, 2013). Oak woodland was formerly much more extensive at Sliswood, but much of the site was planted with conifers c. the 1950s (Goodwillie, 1972). Map 5 shows the minimum area of old sessile oak woods in the SAC which is estimated to be 41.42ha: 16.85ha at Stonepark, 6.07ha at Sliswood, and 18.50ha at Cullentra where the habitat occurs in association with other native woodland types (Perrin et al., 2008). It is important to note that further unsurveyed areas are present within the SAC
Habitat distribution	Occurrence	No decline, subject to natural processes. The surveyed woodland locations are shown on map 5	Distribution based on Perrin et al. (2008). It is important to note that further unsurveyed areas are present within the SAC
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 11m; native shrub layer cover 10-75%; native herb/dwarf shrub layer cover at least 20% and height at least 20 cm; bryophyte cover at least 4%	The target aims for a diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi-mature trees and shrubs; and well-developed herb layer and ground layer. 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). 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 91A0 woodlands and other native tree species occur in adequate proportions to ensure survival of woodland canopy	The target species for 91A0 are sessile oak (<i>Quercus petraea</i>) and the hybrid oak <i>Quercus x rosacea</i> . Assessment criteria are described in Daly et al. (in prep.) and O'Neill and Barron (2013)
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 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	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. The eastern half of Cullentra (site code 1400) and the majority of Sliswood (1411) have been classified as Possible Ancient Woodland. Stonepark (333) contains an area of Long-established Woodland (I) (Perrin and Daly, 2010). Rare and red listed plant species have been recorded within the SAC, including the Near Threatened yellow bird's-nest (<i>Hypopitys monotropa</i>) and the Vulnerable rock whitebeam (<i>Sorbus rupicola</i>) (NPWS internal files; Wyse Jackson et al., 2016). Strawberry tree (<i>Arbutus unedo</i>) is present, Lough Gill being its most northerly site globally (Sealy and Webb, 1950). Rare old growth species of saproxylic beetle have been recorded at Sliswood, one of only two sites in Ireland for the fire-winged beetle <i>Pyropterus nigroruber</i> (Alexander and Anderson, 2012)
Woodland structure: indicators of overgrazing	Occurrence	All four indicators of overgrazing absent	There are four indicators of overgrazing within 91A0: topiary effect on shrubs and young trees, browse line on mature trees, abundant dung, and severe recent bark stripping (Daly et al., in prep.; O'Neill and Barron, 2013). A large herd of fallow deer is present within the SAC (NPWS internal files). Excessive levels of grazing by deer have been recorded at Sliswood (Daly et al., in prep.) and Cullentra (Perrin et al., 2008). As part of the People's Millennium Forests Project, conifer clear felling was undertaken adjacent to Cullentra with the aim of allowing natural regeneration of native woodland. The area remains largely open, mainly due to heavy grazing by deer (Daly et al., 2019)
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 91A0 are sessile oak (<i>Quercus petraea</i>) and the hybrid oak <i>Quercus x rosacea</i> (Daly et al., in prep.; O'Neill and Barron, 2013)
Vegetation composition: typical species	Occurrence	At least 1 target species for 91A0 woodlands present; at least 6 positive indicator species for 91A0 woodlands present	A variety of typical native species should be present, depending on woodland type. The target species for 91A0 are sessile oak (<i>Quercus petraea</i>) and the hybrid oak <i>Quercus x rosacea</i> . Positive indicator species for 91A0 are listed in Daly et al. (in prep.) and O'Neill and Barron (2013)
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 such as montbretia (<i>Crocsmia x crocosmiiflora</i>) should be absent or under control. Rhododendron (<i>Rhododendron ponticum</i>) is problematic at Sliswood (Perrin et al., 2008; Daly et al., in prep.)

Conservation Objectives for : Lough Gill SAC [001976]

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 Gill 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. See map 5	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (Alno-Padion, Alnion incanae, Salicion albae)* is present within Lough Gill SAC. Significant areas of the habitat occur along the Garvoge River and at the mouth of the River Bonet (NPWS internal files). As part of the National Survey of Native Woodlands (NSNW), the sub-sites Conaghil (NSNW site code 371), Cleaveragh Demesne (1408) and Hazelwood Demesne (1409) were surveyed by Perrin et al. (2008). The conservation assessment scores of Hazelwood Demesne and Cleaveragh Demesne were ranked as joint first and joint second respectively in Co. Sligo. Hazelwood Demesne (site code 1409) was also included in a national monitoring survey (O'Neill and Barron, 2013; Daly et al., in prep.). Map 5 shows the minimum area of alluvial forests within the SAC, which is estimated to be 55.3ha. It is important to note that further unsurveyed areas may be present within the SAC
Habitat distribution	Occurrence	No decline, subject to natural processes. The surveyed woodland locations are shown on map 5	Distribution based on Perrin et al. (2008), with modifications to the boundary of the monitoring site at Hazelwood Demesne (NSNW site code 1409) by Daly et al. (in prep.). It is important to note that further unsurveyed areas may be present within the SAC
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, graminoids 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). See also the Irish Vegetation Classification (Perrin, 2016; www.biodiversityireland.ie/projects/ivc-classification-explorer). Kelly and Iremonger (1997) classified plots from Hazelwood as the Osmundo-Salicetum atrocineriae vegetation type and one plot from the mouth of the Bonet River as the Carici remotae-Fraxinetum vegetation type
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 (<i>Alnus glutinosa</i>), ash (<i>Fraxinus excelsior</i>) and willows (<i>Salix</i> 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. Drain blocking has been undertaken to reinstate natural hydrological functions at Hazelwood as part of a LIFE Project (LIFE05 NAT/IRL/000182) (Coillte: www.woodlandrestoration.ie/demonstration-sites-hazelwood.php)
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	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. Parts of the alluvial forest habitat at Cleaveragh Demesne (NSNW site code 1408) and Hazelwood Demesne (1409) have been categorised as Long-established Woodland (I) i.e. they appear on the 1830s 1st edition Ordnance Survey maps but no further evidence of antiquity could be found in older documentation (Perrin and Daly, 2010). The notable species bird cherry (<i>Prunus padus</i>) is abundant at Hazelwood Demesne (Perrin et al., 2008). See also the conservation objective for otter (<i>Lutra lutra</i> ; Annex II species code 1355) in this volume
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 (<i>Alnus glutinosa</i>), ash (<i>Fraxinus excelsior</i>) and willows (<i>Salix</i> spp.) (Daly et al., in prep.; O'Neill and Barron, 2013)
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 (<i>Alnus glutinosa</i>), ash (<i>Fraxinus excelsior</i>) and willows (<i>Salix</i> spp.). Positive indicator species for 91E0* are listed in Daly et al. (in prep.) and O'Neill and Barron (2013)
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. At Cleaveragh Demesne (1408), the non-native red-osier dogwood (<i>Cornus sericea</i>) forms thickets in the northern part of the site, and Rhododendron (<i>Rhododendron ponticum</i>) forms dense stands in western parts of the site. At Hazelwood Demesne (1409), Rhododendron and cherry laurel (<i>Prunus laurocerasus</i>) are dominant in a central part of the site and scattered elsewhere. Red-osier dogwood is frequent in wetter areas (Perrin et al., 2008). Horse-chestnut (<i>Aesculus hippocastanum</i>) is present and regenerating (Daly et al., in prep.). Substantial invasive species control work was undertaken to restore 24ha of alluvial forest at Hazelwood as part of a LIFE Project (LIFE05 NAT/IRL/000182) (Coillte: www.woodlandrestoration.ie/demonstration-sites-hazelwood.php) and further work is being undertaken by Coillte Nature on an additional 30ha

Vegetation composition: problematic native species	Percentage	Cover of common nettle (<i>Urtica dioica</i>) less than 75%	Common nettle (<i>Urtica dioica</i>) 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.)
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Conservation Objectives for : Lough Gill SAC [001976]

1092 White-clawed Crayfish *Austropotamobius pallipes*

To maintain the favourable conservation condition of White-clawed Crayfish (*Austropotamobius pallipes*) in Lough Gill SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Number of occupied 1km squares	No reduction from baseline. See map 6	Within Lough Gill SAC, the main population of white-clawed crayfish (<i>Austropotamobius pallipes</i>) is found in the Bonet River. Records indicate it is present on the main channel of the Bonet from Dromahair upstream to Glenade Lough (which is in an adjoining SAC). It is also found on the Shanvaus and Owenmore rivers and in Doon Lough, and in the stream that connects this lake to Lough Gill. There are likely to be crayfish populations in all 1km squares that overlap the designated sections of all these rivers; however, this would need to be proven by appropriate surveys. White-clawed crayfish are, however, not known to be present in Lough Gill itself (O'Connor et al., 2009)
Population structure: recruitment	Percentage occurrence of juveniles and females with eggs	Juveniles and females with eggs in at least 50% of positive samples taken at appropriate time and methodology	See Reynolds et al. (2010) for further details. Gammell et al. (2021) found juveniles at sites at sites along the River Bonet
Population size	Catch per unit effort	No reduction from baseline of 0.25	The population abundance grade at most sites sampled in Gammell et al. (2021) was low except in the upper reaches of the Bonet River. The catch per unit effort (CPUE) figure is based on the figures and methodologies in Gammell et al. (2021) and in O'Connor et al. (2009). This may be refined with further more detailed assessment of the stocks within this SAC and in the different habitats
Negative indicator species	Occurrence	No non-indigenous crayfish species present	Non-indigenous crayfish species (NICS) are identified as a major direct threat to the white-clawed crayfish and as a disease vector, in particular crayfish plague (<i>Aphanomyces astaci</i>), which is fatal to white-clawed crayfish. The possession, import and intentional release of five species of invasive alien crayfish is banned by Statutory Instrument No. 354/2018
Disease	Occurrence	No instances of disease	Crayfish plague, caused by the water-borne mould <i>Aphanomyces astaci</i> , is identified as major threat to the species in Ireland. Instances of crayfish plague have occurred in Ireland since 2015 causing local extinctions. There have been no confirmed or suspected outbreaks in this SAC
River water quality	EPA Q value	At least Q3-4 at all sites sampled by EPA	The Bonet system is monitored by the Environmental Protection Agency (EPA) and in the latest assessment the river is High in the upper reaches downstream of Glenade Lough to H8641. Below this, it changes progressively through Good and Moderate to Poor in the section downstream of Dromahair. The Shanavaus and Owenmore are both classified as High. The subcatchment that includes Doon Lough is classified as Poor. The target level is based on Demers and Reynolds (2002). Q values are based on triennial water quality surveys carried out by the EPA
Lake water quality	Water chemistry measures	Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat	White-clawed crayfish are not considered very sensitive of water quality but are intolerant of low pH and poorest water quality, and lack of calcareous influence. There should be no decline in the water quality as defined by the targets for the 3150 lake habitat, as these are more stringent than white-clawed crayfish requires. See the conservation objective for the lake habitat in this volume for further details

Habitat quality: heterogeneity	Occurrence of positive habitat features	No decline from the baseline	White-clawed crayfish need high habitat heterogeneity. Larger crayfish must have stones to hide under, or an earthen bank in which to burrow. Hatchlings shelter in vegetation, gravel and among fine tree roots. Smaller crayfish are typically found among weed and debris in shallow water. Larger juveniles in particular may also be found among cobbles and detritus such as leaf litter. These conditions and habitat features must be available on the whole length of occupied habitat. Gammell et al. (2021) scored the habitat heterogeneity and following this methodology a baseline score of 0.37, based on the mean score, is set
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Conservation Objectives for : Lough Gill SAC [001976]

1095 Sea Lamprey *Petromyzon marinus*

To restore the favourable conservation condition of Sea Lamprey (*Petromyzon marinus*) in Lough Gill SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution: extent of anadromy	Percentage of river accessible	Greater than 75% of main stem length of rivers accessible from estuary	Artificial barriers can block or impede the passage of upstream migrating lamprey, thereby restricting access to spawning areas (Gargan et al., 2011; Rooney et al., 2015). The weir on the Garavogue River in Sligo town is currently not considered an issue for sea lamprey. However, there is a significant natural barrier, consisting of a sequence of waterfalls, at the village of Dromahair in the lower reaches of the River Bonet. Only a small number of records exist for sea lamprey (<i>Petromyzon marinus</i>) in Lough Gill SAC. An individual lamprey was observed immediately downstream of the weir in Sligo in 2015 and there have been anecdotal records of sea lamprey nests in the Garavogue in Sligo town. Significantly, two juvenile lake-feeding sea lampreys were recorded from Lough Gill in 2018 attached to pike (King and O’Gorman, 2018)
Annual run size	Number of sea lamprey nests	Annual run size should reflect that expected under near-natural conditions	This target is based on guidance from JNCC (2015) and requires assessment of adult sea lamprey spawning activity in the form of annual nest counts. Sea lamprey do not exhibit complete fidelity to natal rivers and monitoring needs to occur over several years to build up a picture of inter-annual variation in spawning occurrence. Suitable spawning habitat for sea lamprey in Lough Gill SAC is limited to sections of the Garavogue River in Sligo town and downstream of Dromahair on the River Bonet. As stated above, few records exist for adult sea lampreys in this catchment and the sequence of waterfalls on the Bonet River at Dromahair represents a potential natural barrier to upstream migration
Larval lamprey in fine sediment	Larval lamprey/m ²	Larval lamprey present in SAC catchment	It is currently not possible to set a target mean density for this attribute. Sea lamprey larvae are rarely encountered in catchment-wide electro-fishing surveys and more information is required on larval habitat utilisation by this species. Targeted surveys may be required to establish presence/absence of sea lamprey larvae in Lough Gill SAC and new sampling techniques may need to be explored. An electro-fishing survey for larval lamprey was carried out on the Garavogue-Bonet catchment by Inland Fisheries Ireland (IFI) in 2009 (Inland Fisheries Ireland, 2010), with a repeat survey in 2016 (Gallagher et al., 2017). No sea lamprey larvae were recorded from these surveys

Extent and distribution of spawning and nursery habitat

m² and occurrence

No decline in extent and distribution of spawning and nursery beds

Sea lampreys spawn in well-oxygenated gravels where they excavate large nests. Suitable spawning habitat for sea lamprey in this SAC is limited to sections of the Garavogue River in Sligo town and downstream of Dromahair on the River Bonet, as stated above. The target for nursery beds is based on habitat mapping during targeted larval lamprey monitoring surveys. Of the 23 sites surveyed in the 2016 survey (Gallagher et al., 2017), 35% had no nursery habitat for larval lamprey. A high proportion of sites with no suitable nursery habitat reflects the fluvial geomorphology of this catchment which is predominantly a mid to high energy system. Some of the low-lying arerially drained sections were too deep for sampling using the electro-fishing technique. Approximately 30% of the catchment's water bodies were subjected to arterial drainage in the 1980s. Drainage maintenance has the potential to alter instream sediment dynamics which in turn affects larval lamprey populations

Conservation Objectives for : Lough Gill SAC [001976]

1096 Brook Lamprey *Lampetra planeri*

To restore the favourable conservation condition of Brook Lamprey (*Lampetra planeri*) in Lough Gill SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Percentage of river accessible	Access to all water courses down to first order streams	Artificial barriers can block or impede the passage of upstream migrating lamprey, thereby limiting their distribution to lower stretches and restricting access to spawning areas (Gargan et al., 2011; Rooney et al., 2015). Artificial barriers are not considered an issue for brook lamprey (<i>Lampetra planeri</i>) in Lough Gill SAC
Distribution in suitable habitat	Percentage of positive sites in 2nd order channels (and greater), downstream of spawning areas	Not less than 50% of sample sites with suitable habitat positive for larval brook/river lamprey	Larval lamprey live in fine sediments for up to six years. It is not possible to distinguish between larval brook lamprey (<i>Lampetra planeri</i>) and river lamprey (<i>L. fluviatilis</i>) in the field and they are therefore considered together in this and other attribute targets. A survey for larval lamprey was carried out on the Garavogue-Bonet catchment in 2009 (Inland Fisheries Ireland, 2010), with a repeat survey in 2016 (Gallagher et al., 2017). Results were broadly similar for both years. To achieve favourable condition, <i>Lampetra</i> spp. should, as a minimum, be present in not less than 50% of all sampling sites surveyed with suitable habitat present within the natural range (JNCC, 2015). Of the 23 sites sampled in 2016 (Gallagher et al., 2017), <i>Lampetra</i> spp. larvae were present in 47% of sites with suitable nursery habitat, indicating this catchment does not achieve favourable condition for this attribute
Population structure of larvae	Number of age/size classes	At least three age/size classes of larval brook/river lamprey present	The target of at least three age/size classes is based on guidance from JNCC (2015). Larvae typically range from 10-150mm in length and this corresponds to up to six age classes. A broad range of size classes (21-104mm) was recorded from the Garavogue-Bonet catchment-wide survey in 2016 (Gallagher et al., 2017) indicating favourable condition for this attribute
Larval lamprey density in fine sediment	Larval lamprey/m ²	Mean density of brook/river larval lamprey in sites with suitable habitat at least 5/m ²	A target mean density of at least 5/m ² larvae in sites with suitable habitat is required to achieve favourable condition (JNCC, 2015). A mean density of 1.5/m ² <i>Lampetra</i> spp. larvae was obtained in the 2009 electro-fishing survey of the Garavogue-Bonet catchment (Inland Fisheries Ireland, 2010), with no improvement (1.7/m ²) recorded in 2016 (Gallagher et al., 2017). Brook lamprey, therefore, do not achieve favourable condition for this attribute in Lough Gill SAC
Extent and distribution of spawning and nursery habitat	m ² and occurrence	No decline in extent and distribution of spawning and nursery beds	This target is based on habitat mapping during targeted larval lamprey monitoring surveys. Brook lamprey spawn in clean gravels where they excavate shallow nests (Rooney et al., 2013). While coarse substrate is required for spawning, the close proximity of nursery areas comprising mainly sand/silt are necessary for the development of larvae. Of the 23 sites surveyed in 2016 (Gallagher et al., 2017), 35% had no nursery habitat, with 43% of sites having no nearby spawning habitat. A high proportion of sites with no suitable nursery habitat reflects the fluvial geomorphology of this catchment which is predominantly a mid to high energy system. Some of the low-lying arterially drained sections were too deep for sampling using the electro-fishing technique. Approximately 30% of the catchment's water bodies were subjected to arterial drainage in the 1980s. Drainage maintenance has the potential to alter instream sediment dynamics which in turn affects larval lamprey populations

Conservation Objectives for : Lough Gill SAC [001976]

1099 River Lamprey *Lampetra fluviatilis*

To restore the favourable conservation condition of River Lamprey (*Lampetra fluviatilis*) in Lough Gill SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Percentage of river accessible	Access to all water courses down to first order streams	Artificial barriers can block or impede the passage of upstream migrating lamprey, thereby restricting access to spawning areas (Gargan et al., 2011; Rooney et al., 2015). There is a substantial weir on the Garavogue River in Sligo town, but this is currently not considered an issue for river lamprey (<i>Lampetra fluviatilis</i>) migration as there is a working fish pass and, failing that, one of the weir arches is open to enable fish passage. Of more significance is a possible natural barrier in the form of a substantial bedrock outcrop at the village of Dromahair in the lower reaches of the River Bonet. At this point, the river falls approximately 9m in a short distance over a series of bedrock outcroppings, creating a sequence of waterfalls. This feature poses a significant barrier to anadromous and catadromous fish species. At present, there are no records for adult river lamprey in the Garavogue-Bonet system
Distribution in suitable habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	Not less than 50% of sample sites with suitable habitat positive for larval brook/river lamprey	It is not possible to distinguish between larval brook lamprey (<i>Lampetra planeri</i>) and river lamprey (<i>L. fluviatilis</i>) in the field and they are therefore considered together in this and other targets. That said, it is likely that the majority, if not all, records are for brook lamprey, particularly those recorded above barriers to river lamprey upstream passage. A survey for larval lamprey was carried out on the Garavogue-Bonet catchment in 2009 (IFI, 2010), with a repeat survey in 2016 (Gallagher et al., 2017). Results were broadly similar for both years. To achieve favourable condition, <i>Lampetra</i> spp. should, as a minimum, be present in not less than 50% of all sampling sites surveyed with suitable habitat present within the natural range (JNCC, 2015). Of the 23 sites sampled in 2016, <i>Lampetra</i> spp. larvae were present in 47% of sites with suitable nursery habitat, indicating this catchment does not achieve favourable condition for this attribute
Population structure of larvae	Number of age/size classes	At least three age/size classes of larval brook/river lamprey present	The target of at least 3 age/size classes is based on guidance from JNCC (2015). Larvae typically range from 10-150mm in length and this corresponds to up to six age classes. A broad range of size classes (21-104mm) for <i>Lampetra</i> spp. was recorded from the Garavogue-Bonet catchment-wide survey in 2016 (Gallagher et al., 2017) indicating favourable condition for this attribute in Lough Gill SAC
Larval lamprey density in fine sediment	Larval lamprey/m ²	Mean density of brook/river larval lamprey in sites with suitable habitat at least 5/m ²	A target mean density of at least 5/m ² larvae in sites with suitable habitat is required to achieve favourable condition (JNCC, 2015). A mean density of 1.5/m ² <i>Lampetra</i> spp. larvae was obtained in the 2009 electro-fishing survey (Inland Fisheries Ireland, 2010), with no improvement (1.7/m ²) recorded in 2016 (Gallagher et al., 2017), indicating that the Garavogue-Bonet catchment does not achieve favourable condition for this attribute

Extent and distribution of spawning and nursery habitat	m ² and occurrence	No decline in extent and distribution of spawning and nursery beds	<p>This target is based on habitat mapping during targeted larval lamprey monitoring surveys. River lamprey spawn in clean gravels in flowing water where they excavate shallow nests. While coarse substrate is required for spawning, the close proximity of nursery areas comprising mainly sand/silt are necessary for the development of larvae. Of the 23 sites surveyed in 2016 (Gallagher et al., 2017), 35% had no nursery habitat, with 43% of sites having no nearby spawning habitat. A high proportion of sites with no suitable nursery habitat reflects the fluvial geomorphology of this catchment which is predominantly a mid to high energy system. Some of the low-lying arterially drained sections were too deep for sampling using the electro-fishing technique. Approximately 30% of the catchment's water bodies were subjected to arterial drainage in the 1980s. Drainage maintenance has the potential to alter instream sediment dynamics which in turn affects larval lamprey populations</p>
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Conservation Objectives for : Lough Gill SAC [001976]

1106 Salmon *Salmo salar*

To restore the favourable conservation condition of Atlantic Salmon (*Salmo salar*) in Lough Gill SAC, which is defined by the following list of attributes and targets:

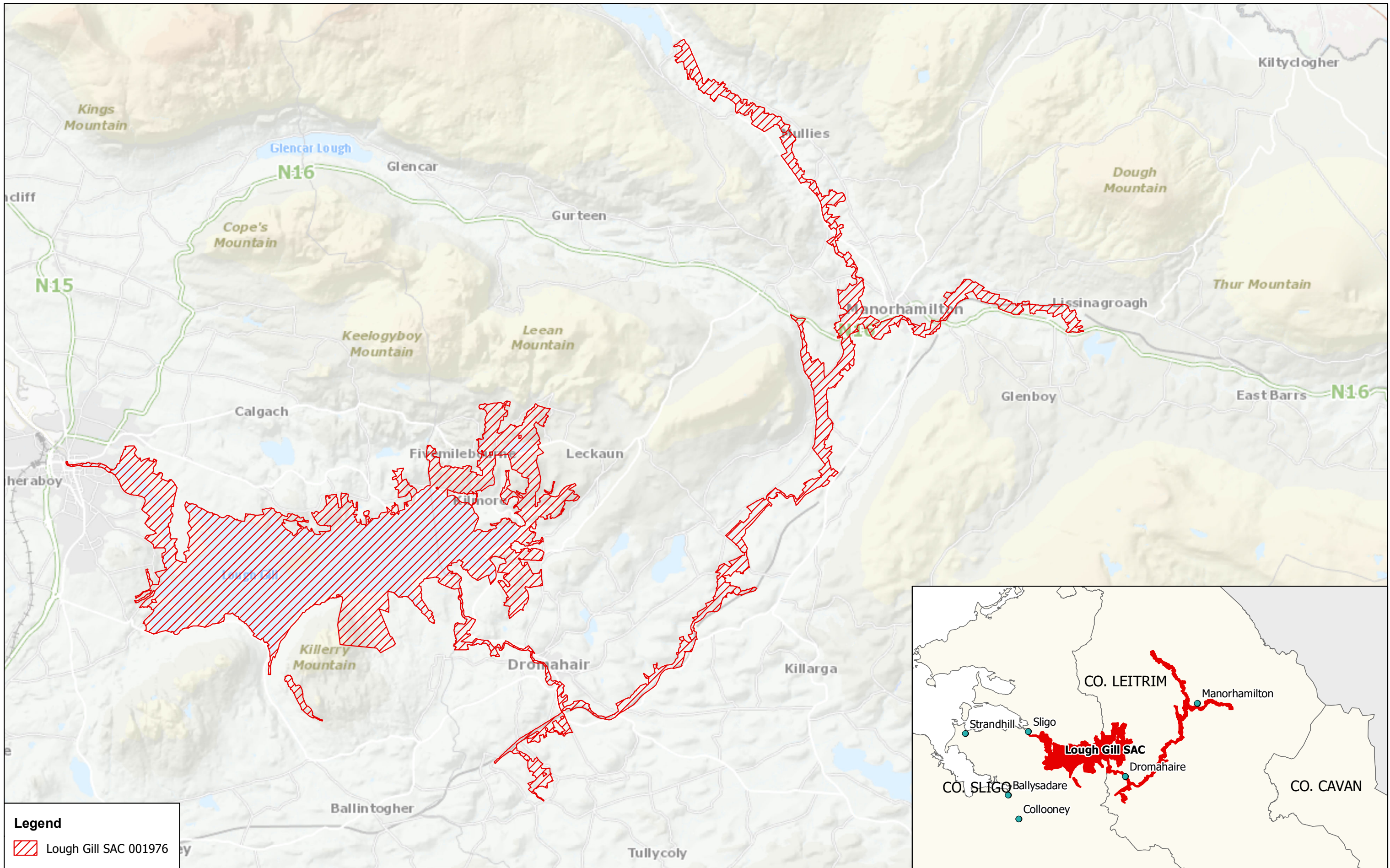
Attribute	Measure	Target	Notes
Distribution: extent of anadromy	Percentage of river accessible	100% of river channels down to second order accessible from estuary	Artificial barriers block salmon's upstream migration, thereby limiting species to lower stretches and restricting access to spawning areas
Adult spawning fish	Number	Conservation limit (CL) for each system consistently exceeded	A conservation limit (CL) is defined by the North Atlantic Salmon Conservation Organisation (NASCO) as "the spawning stock level that produces long-term average maximum sustainable yield as derived from the adult to adult stock and recruitment relationship". The target is based on the Technical Expert Group on Salmon's (TEGOS) annual model output of CL attainment levels. See Gargan et al. (2021) for further details. Stock estimates are either derived from direct counts of adults (rod catch, fish counter) or indirectly by fry abundance counts. Lough Gill SAC is just below its CL for one-sea-winter (1SW) and just above its CL for multi-sea-winter (MSW) salmon
Salmon fry abundance	Number of fry/5 minutes electrofishing	Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 minutes sampling	Target is threshold value for rivers currently exceeding their conservation limit (CL)
Out-migrating smolt abundance	Number	No significant decline	Smolt abundance can be negatively affected by a number of impacts such as estuarine pollution, predation and sea lice (<i>Lepeophtheirus salmonis</i>)
Number and distribution of redds	Number and occurrence	No decline in number and distribution of spawning redds due to anthropogenic causes	Salmon spawn in clean gravels. There is restricted habitat for salmon in the system in this SAC
Water quality	EPA Q value	At least Q4 at all sites sampled by EPA	Q values based on triennial water quality surveys carried out by the Environmental Protection Agency (EPA)

Conservation Objectives for : Lough Gill SAC [001976]


1355 Otter *Lutra lutra*

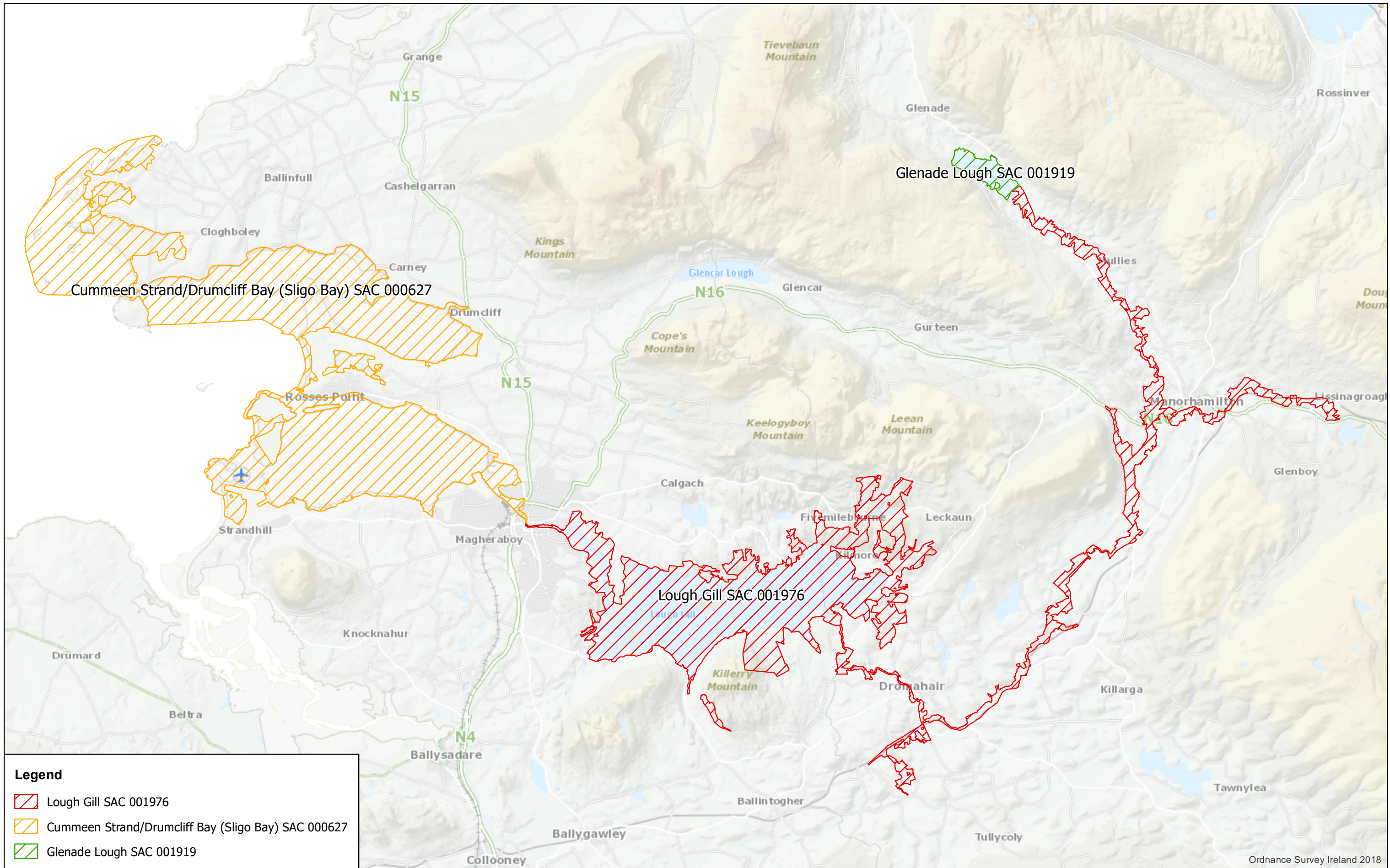
To maintain the favourable conservation condition of Otter (*Lutra lutra*) in Lough Gill SAC, which is defined by the following list of attributes and targets:

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 193.91ha 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 80.38km	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 353.39ha	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 7	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



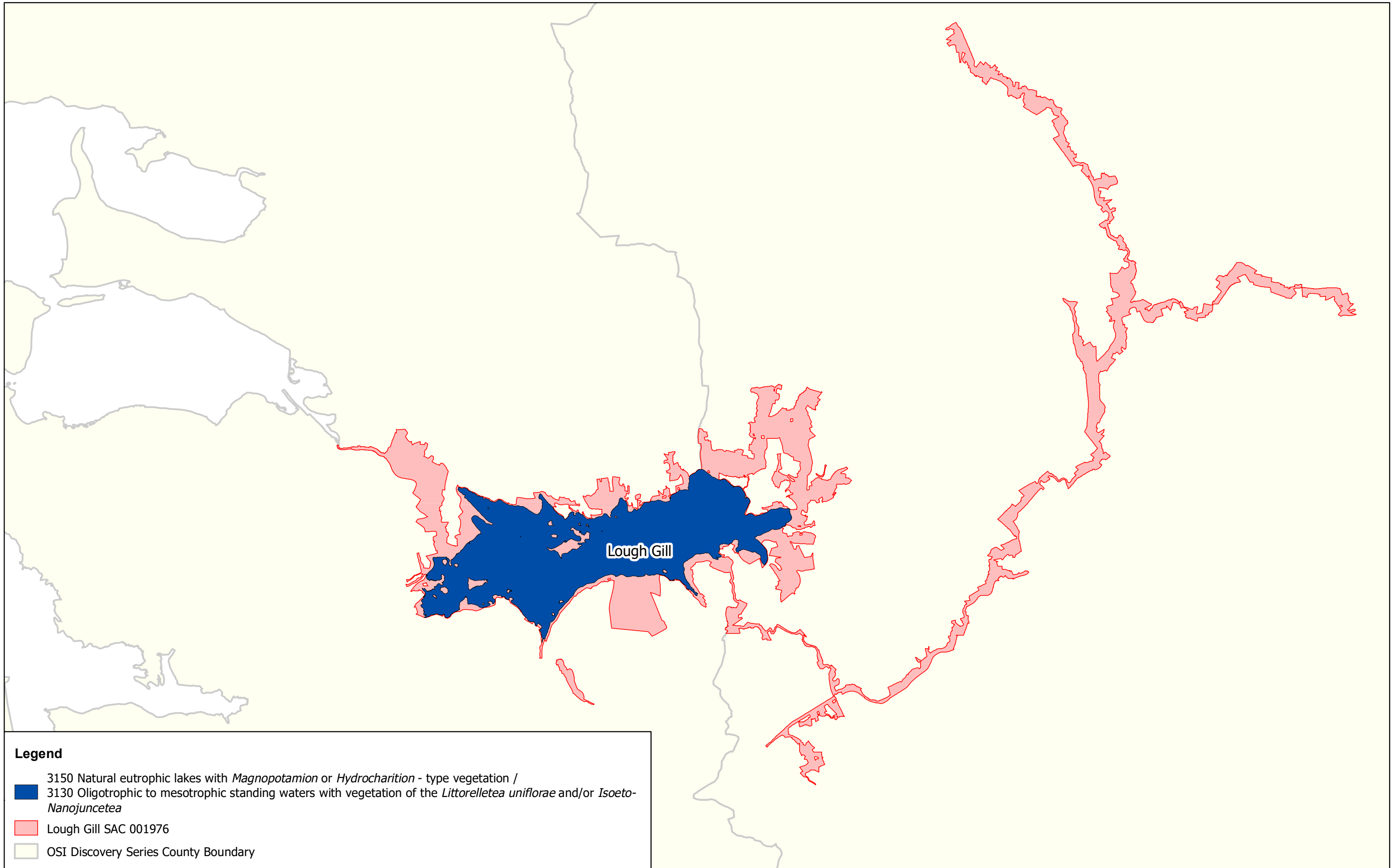
Legend

 Lough Gill SAC 001976



Legend

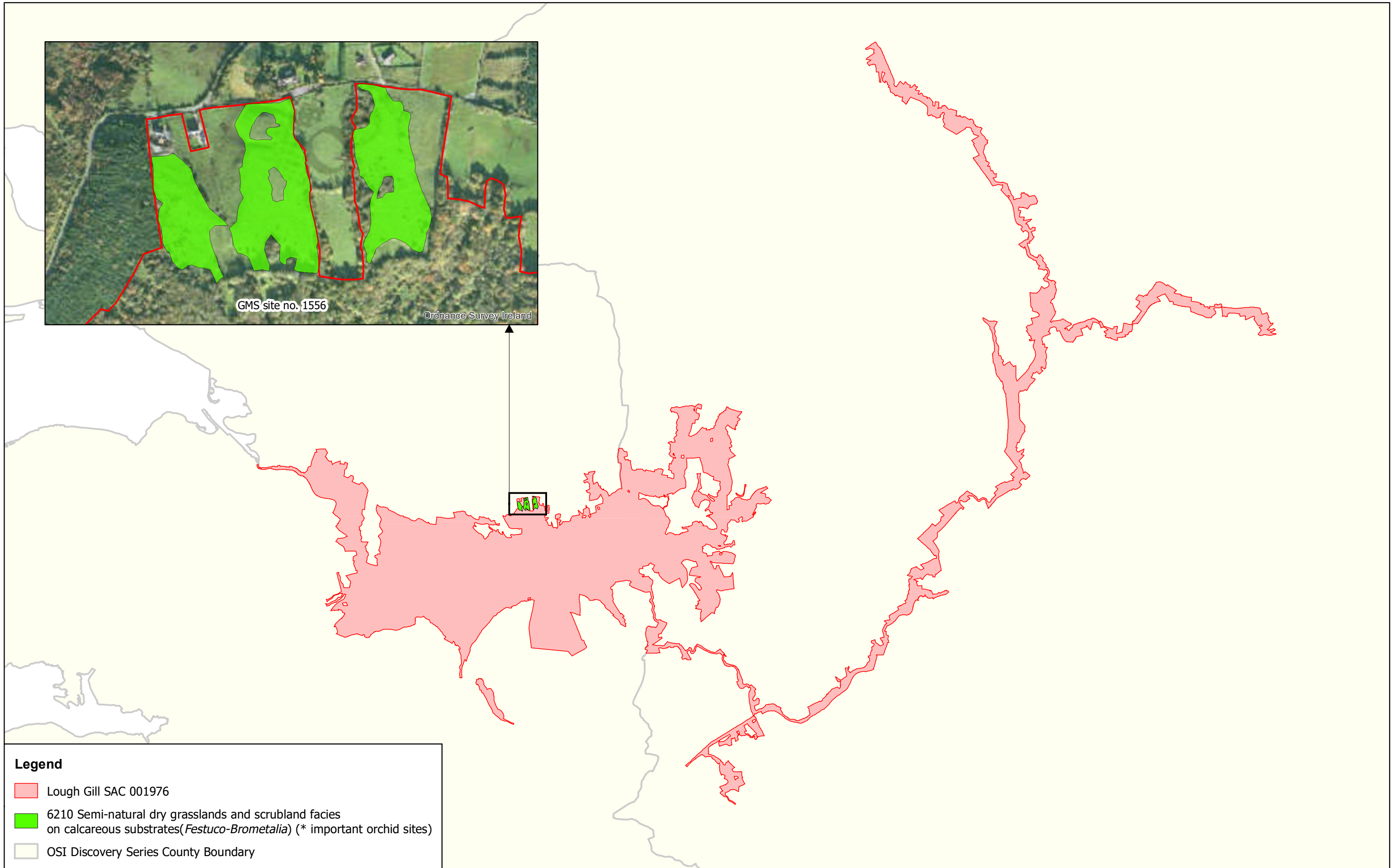
- Lough Gill SAC 001976
- Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC 000627
- Glenade Lough SAC 001919



Legend

- 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation / 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*
- Lough Gill SAC 001976
- OSI Discovery Series County Boundary

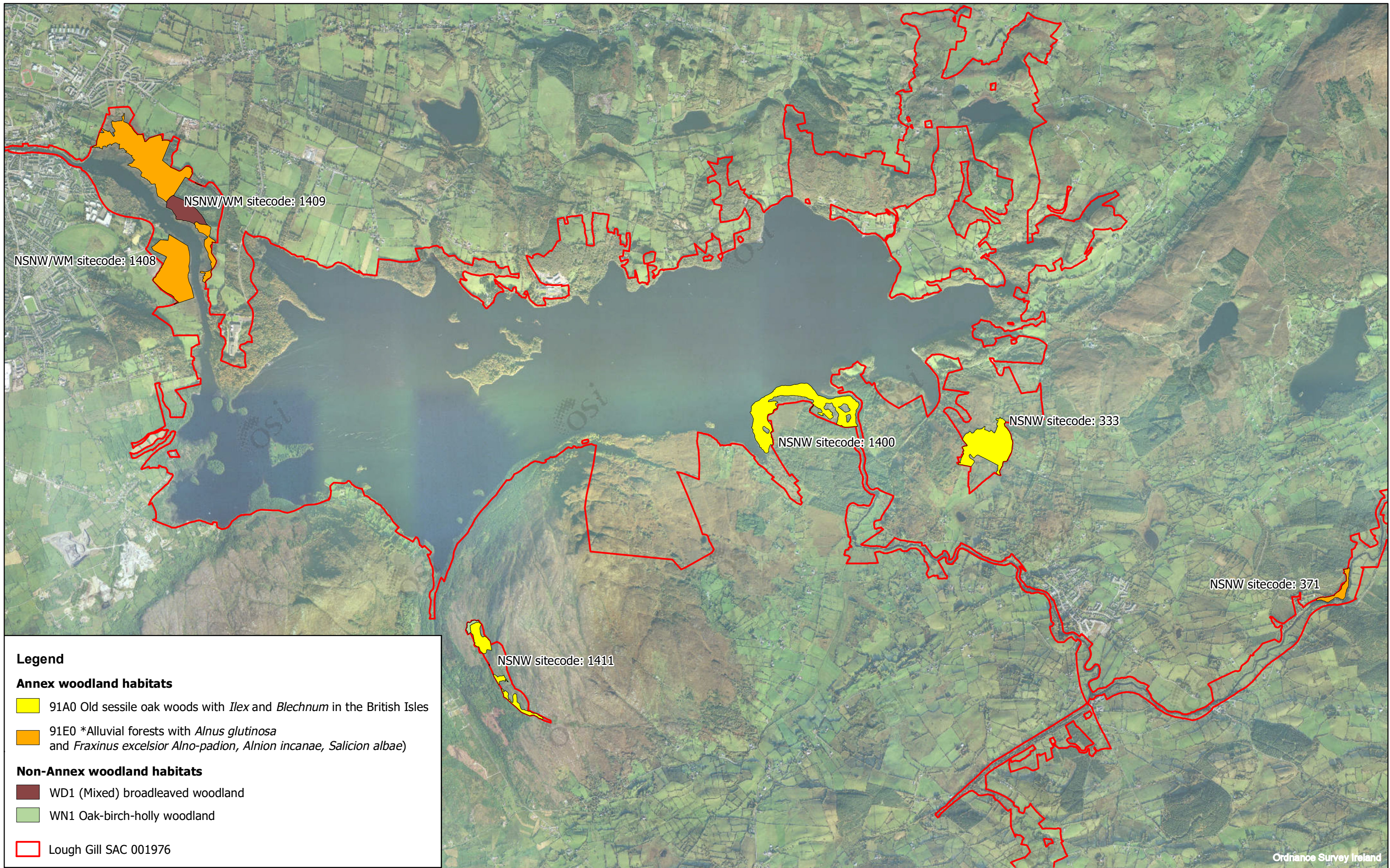




Legend

- Lough Gill SAC 001976
- 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates(*Festuco-Brometalia*) (* important orchid sites)
- OSI Discovery Series County Boundary





Legend

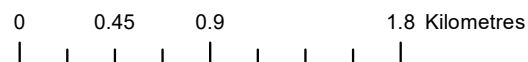
Annex woodland habitats

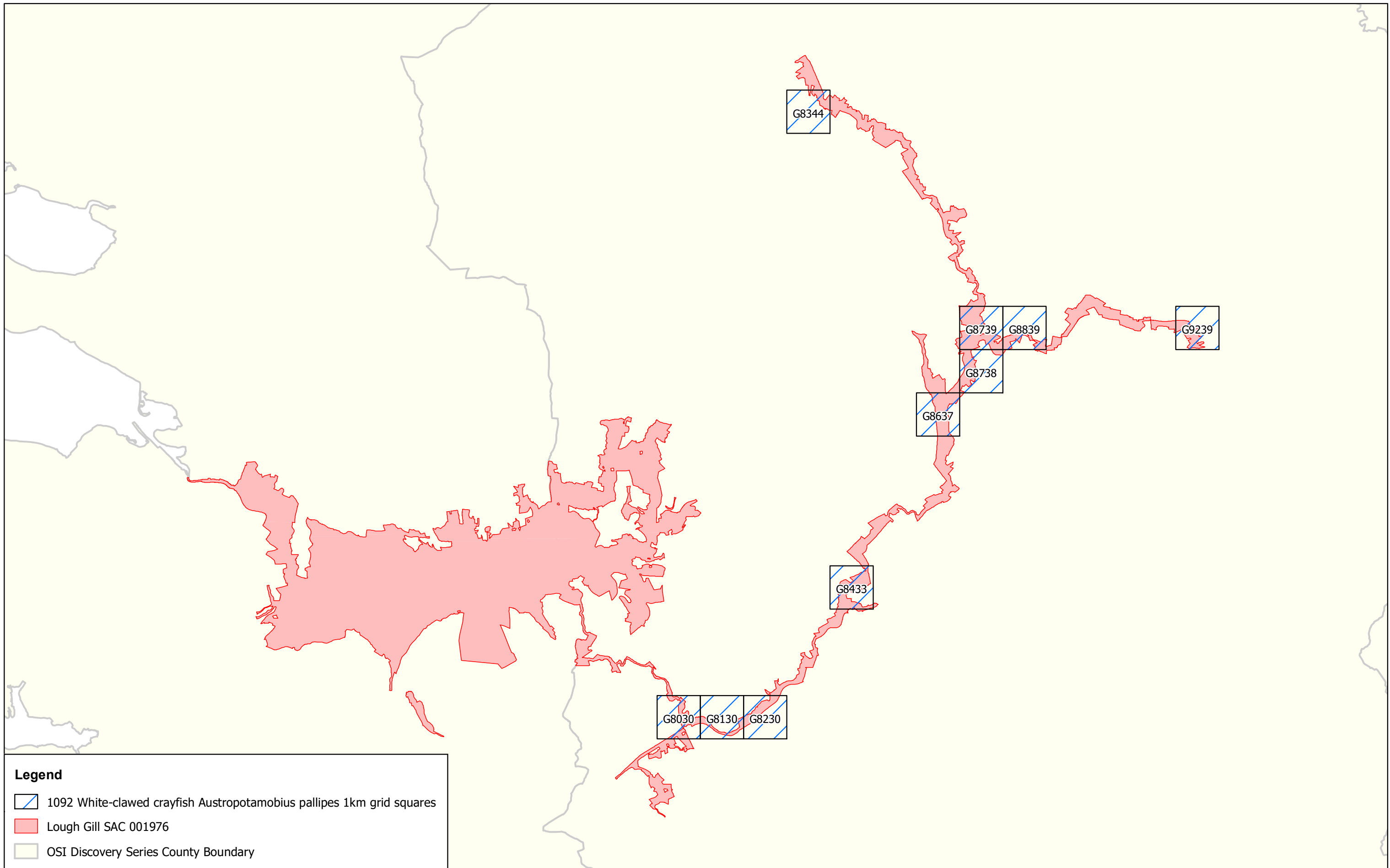
- 91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles
- 91E0 *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-padion*, *Alnion incanae*, *Salicion albae*)

Non-Annex woodland habitats




- WD1 (Mixed) broadleaved woodland
- WN1 Oak-birch-holly woodland
- Lough Gill SAC 001976

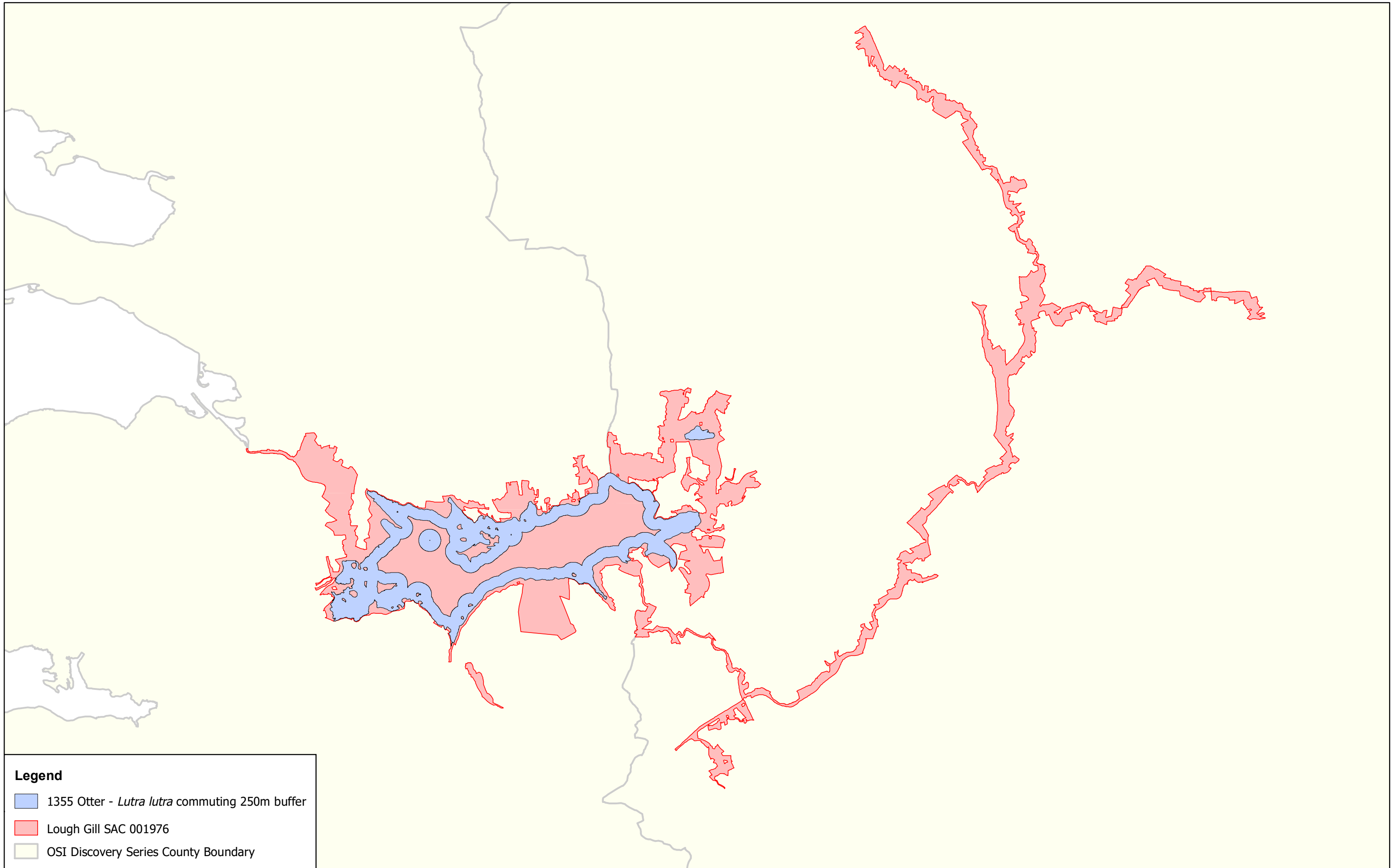
Ordnance Survey Ireland





Legend

-  1092 White-clawed crayfish *Austropotamobius pallipes* 1km grid squares
-  Lough Gill SAC 001976
-  OSI Discovery Series County Boundary



Legend

- 1355 Otter - *Lutra lutra* commuting 250m buffer
- Lough Gill SAC 001976
- OSI Discovery Series County Boundary