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Conservation Objectives Series

The Twelve Bens/Garraun Complex SAC 002031

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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***

002031	The Twelve Bens/Garraun Complex SAC
1029	Freshwater Pearl Mussel *Margaritifera margaritifera*
1106	Salmon *Salmo salar*
1355	Otter *Lutra lutra*
1833	Slender Naiad *Najas flexilis*
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
4060	Alpine and Boreal heaths
7130	Blanket bogs (* if active bog)
7150	Depressions on peat substrates of the Rhynchosporion
8110	Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani)
8210	Calcareous rocky slopes with chasmophytic vegetation
8220	Siliceous rocky slopes with chasmophytic vegetation
91A0	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

Please note that this SAC is adjacent to Maumturk Mountains SAC (002008), Connemara Bog Complex SAC (002034) and West Connacht Coast SAC (002998). See map 2. The conservation objectives for this site should be used in conjunction with those for the adjacent sites as appropriate.

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

NPWS Documents

Year :	1984
Title :	The vegetation of Irish lakes
Author :	Heuff, H.
Series :	Unpublished report to NPWS
Year :	1987
Title :	Survey to locate lowland blanket bogs of scientific interest in Connemara, Co. Galway
Author :	Douglas, C.; Grogan, H.
Series :	Unpublished report to the Wildlife Service
Year :	1989
Title :	A survey to locate blanket bogs in Co. Galway. Part 2
Author :	Douglas, C.; Garvey, L.; Kelly, L.; O'Sullivan, A.
Series :	Unpublished report to the Wildlife Service
Year :	2002
Title :	*Najas flexilis* in Donegal
Author :	Roden, C.M.
Series :	Unpublished report to NPWS
Year :	2004
Title :	The distribution of *Najas flexilis* in Ireland 2002-2004
Author :	Roden, C.M.
Series :	Unpublished report to NPWS
Year :	2006
Title :	Otter survey of Ireland 2004/2005
Author :	Bailey, M.; Rochford, J.
Series :	Irish Wildlife Manual 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 :	Rapid assessment of rivers with prior records of *Margaritifera margaritifera*
Author :	Moorkens, E.; Killeen, I.
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 :	2008
Title :	Survey of Dawros river
Author :	Moorkens, E.
Series :	unpublished report to NPWS

Year :	2009
Title :	NS II freshwater pearl mussel sub-basin management plans: fisheries survey. Stage 1 report
Author :	Paul Johnston Associates
Series :	Unpublished report to NPWS
Year :	2009
Title :	NS II Freshwater Pearl Mussel Sub-basin Management Plans: Report on Biological Monitoring of Surface Water Quality in Dawros Catchment, Co. Galway
Author :	Williams, L.
Series :	Unpublished report to 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 Manual No. 46
Year :	2010
Title :	Second draft Dawros freshwater pearl mussel sub-basin management plan (2009-2015). March 2010
Author :	NPWS
Series :	Unpublished document to the Department of Environment, Heritage and Local Government
Year :	2012
Title :	Ireland Red List No. 8: Bryophytes
Author :	Lockhart, N.; Hodgetts, N.; Holyoak, D.
Series :	Ireland Red List series, NPWS
Year :	2012
Title :	Catchment Assessment Report Manual
Author :	Monaghan, F.
Series :	Unpublished report to 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 Manual No. 76
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 :	The status of EU protected habitats and species in Ireland. Volume 3. Species assessments
Author :	NPWS
Series :	Conservation assessments
Year :	2014
Title :	Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland, Version 2.0
Author :	Perrin, P.M.; Barron, S.J.; Roche, J.R.; O'Hanrahan, B.
Series :	Irish Wildlife Manual No. 79
Year :	2014
Title :	Targeted survey of *Najas flexilis*
Author :	Roden, C.; Murphy, P.
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 :	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 :	2016
Title :	Survey and Condition Assessment of the population of the freshwater pearl mussel *Margaritifera margaritifera* in the Dawros River, County Galway
Author :	Moorkens, E.
Series :	Unpublished report to NPWS
Year :	2017
Title :	The Twelve Bens/Garraun Complex SAC (site code: 2031) Conservation objectives supporting document- blanket bogs and associated habitats V1
Author :	NPWS
Series :	Conservation objectives supporting document
Year :	2017
Title :	The Twelve Bens/Garraun Complex SAC (site code: 2031) Conservation objectives supporting document- *Najas flexilis* V1
Author :	NPWS
Series :	Conservation objectives supporting document

Other References

Year :	1970
Title :	The lichens and lichen parasites of Derryclare Wood, Connemara
Author :	Folan, A.C.M.; Mitchell, M.E.
Series :	Proceedings of the Royal Irish Academy. Section B: Biological, Geological, and Chemical Science, 70: 163-170
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 :	1987
Title :	An account of the flora and vegetation of Derryclare Wood, Connemara (Co. Galway), Western Ireland
Author :	Ferguson, D.K.; Westhoff, V.
Series :	Proceedings of the Koninklijke Nederlandee Akadamie van Wetenschappen, Series C 90(2): 139-172
Year :	1988
Title :	The reproductive biology of freshwater mussels in Ireland, with observations on their distribution and demography
Author :	Ross, E.D.
Series :	Unpublished Ph.D. Thesis, National University of Ireland, Galway

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 :	1999
Title :	Diet of otters (*Lutra lutra*) on Inishmore, Aran Islands, west coast of Ireland
Author :	Kingston, S.; O'Connell, M.; Fairley, J.S.
Series :	Biology and Environment: Proceedings of the Royal Irish Academy, 99B: 173-182
Year :	1999
Title :	Derryclare Woods: a multidisciplinary study of its structure and age
Author :	Fahy, O.; Fuller, M.; Gabbett, M.; Gormally, M.; Sheehy Skeffington, M.
Series :	Report to the Heritage Council, Kilkenny
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 :	2001
Title :	Aquatic plants in Britain and Ireland
Author :	Preston, C.D.; Croft, J.M.
Series :	Harley Books, Colchester
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 :	Survey of the Pearl Mussel Population - 2003. Dawros River Co. Galway
Author :	Aster Environmental Consultants
Series :	Report to The Heritage Council, Kilkenny
Year :	2004
Title :	The ecology of *Najas flexilis*
Author :	Wingfield, R.A.; Murphy, K.J.; Hollingsworth, P.; Gaywood, M.J.
Series :	Scottish Natural Heritage Commissioned Report No. 017 (ROAME No. F98PA02)
Year :	2006
Title :	Otters - ecology, behaviour and conservation
Author :	Kruuk, H.
Series :	Oxford University Press
Year :	2006
Title :	The status of host fish populations and fish species richness in European freshwater pearl mussel (*Margaritifera margaritifera*) streams
Author :	Geist, J.; Porkka, M.; Kuehn, R.
Series :	Aquatic Conservation: Marine and Freshwater Ecosystems, 16: 251-266

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 :	EPA, Wexford
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 :	2010
Title :	Otter tracking study of Roaringwater Bay
Author :	De Jongh, A.; O'Neill, L.
Series :	Unpublished draft report to NPWS
Year :	2010
Title :	Addressing the conservation and rehabilitation of *Margaritifera margaritifera* populations in the Republic of Ireland within the framework of the habitats and species directive
Author :	Moorkens, E.
Series :	Journal of Conchology, 40: 339
Year :	2010
Title :	Water quality in Ireland 2007-2009
Author :	McGarrigle, M.; Lucey, J.; Ó Cinnéide, M.
Series :	EPA, Wexford
Year :	2014
Title :	Assessing near-bed velocity in a recruiting population of the endangered freshwater pearl mussel (*Margaritifera margaritifera*) in Ireland
Author :	Moorkens, E.; Killeen, I.
Series :	Aquatic Conservation: Marine and Freshwater Ecosystems, 24(6): 853-862
Year :	2014
Title :	The impact of rural land management changes on soil hydraulic properties and runoff processes: results from experimental plots in upland UK
Author :	Marshall, M.R.; Ballard, C.E.; Frogbrook, Z.L.; Solloway, I.; McIntyre, N.; Reynolds, B.; Wheater, H.S.
Series :	Hydrological Processes, 28: 2617–2629
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 :	EPA, Wexford
Year :	2016
Title :	The Status of Irish Salmon Stocks in 2015 with Precautionary Catch Advice for 2016
Author :	SSCS (Standing Scientific Committee on Salmon)
Series :	Independent Scientific Report to Inland Fisheries Ireland

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 (map 3)
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 (map 4)
Year :	2017
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 :	1029 (map 5)
Year :	Revision 2012
Title :	Margaritifera Sensitive Areas data
GIS Operations :	Relevant catchment boundaries identified. Expert opinion used as necessary to resolve any issues arising
Used For :	1029 (map 5)
Year :	2010
Title :	OSi 1:5000 IG vector dataset
GIS Operations :	Creation of 80m buffer on the aquatic side of lake data; creation of 10m buffer on the terrestrial side of lake data. These datasets combined with the derived OSi Discovery Series river and canal datasets. 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 6)
Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	Creation of a 10m buffer on the terrestrial side of river banks data; creation of 20m buffer applied to canal centreline data. Creation of a 20m buffer applied to river and stream centreline data; These datasets combined with the 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 (no map)
Year :	2013
Title :	Najas flexilis data
GIS Operations :	Lake habitat for species clipped to SAC boundary
Used For :	1833 (map 7)

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

To maintain the favourable conservation condition of Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) in The Twelve Bens/Garraun 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 is considered likely to occur in most lakes in The Twelve Bens/Garraun Complex SAC, notably in Loughs Inagh, Derryclare, Fee, Nahillion and Muck. In line with Article 17 reporting (NPWS, 2013), all lakes larger than 1ha have been mapped as potential 3110 (see map 3). It is likely, however, that the habitat also occurs in many of the smaller lakes and ponds in the SAC. In lakes/ponds in blanket bog, lake habitat 3160 may co-occur. Lake habitat 3110 is likely to co-occur with lake habitat 3130 in Pollacappul and Kylemore Loughs. 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, all lakes larger than 1ha have been mapped as potential 3110, but the habitat is likely to be even more widespread in the SAC (see map 3)
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 assessment for 3110 (NPWS, 2013) and the lake habitats supporting document (O Connor, 2015). See Heuff (1984) and The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for *Najas flexilis* for information on Pollacappul and Kylemore Loughs. Derryclare, Kylemore and Pollacappul Loughs are Water Framework Directive (WFD) monitoring lakes and regular macrophyte surveys are conducted by the Environmental Protection Agency (EPA)
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)
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 lakes in The Twelve Bens/Garraun Complex SAC within undisturbed peatland and uplands; however, pressures such as overgrazing, forestry and peat-cutting may have reduced vegetation depth in some lakes
Hydrological regime: water level fluctuations	Metres	Maintain appropriate natural 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. It is possible that the hydrological regimes of some of the lakes have been altered by historic overgrazing (faster run-off, higher flood peaks, lower base flows, etc.; see Marshall et al., 2014)

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
Water quality: transparency	Metres	Maintain 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. Free et al. (2009) found high isoetid abundance in lakes with Secchi depths of more than 3m. Heuff (1984) recorded transparency greater than lake depth (1.75m) in Pollacappul and 2.2m in Kylemore. Roden (2004) stated transparency in Pollacappul was excellent. Free et al. (2006) give Secchi depth of 4.1m in Kylemore
Water quality: 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) Regulations 2009. Derryclare, Kylemore and Pollacappul all had high nutrient status in 2007-09 and 2010-12 (McGarrigle et al., 2010; Bradley et al., 2015)
Water quality: phytoplankton biomass	µg/l Chlorophyll *a*	Maintain 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) Regulations 2009. Derryclare, Kylemore and Pollacappul all had high chlorophyll *a* status in 2007-09 and 2010-12 (McGarrigle et al., 2010; Bradley et al., 2015)
Water quality: 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. Kylemore had high phytoplankton composition status in 2010-12 (Bradley et al., 2015)
Water quality: attached algal biomass	Algal cover and EPA phytobenthos metric	Maintain trace/absent attached algal biomass (<5% cover) and high phytobenthos status	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). EPA phytobenthos can be used as an indicator of changes in attached algal biomass. As for other water quality indicators, habitat 3110 requires high phytobenthos status. Kylemore had high phytobenthos status in 2010-12 (Bradley et al., 2015)

Water quality: macrophyte status	EPA macrophyte metric (The Free Index)	Maintain/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 Schedule Five of the European Communities Environmental Objectives (Surface Waters) Regulations 2009. Kylemore Lough failed the target in 2007-2009 and 2010-2012, having good macrophyte status (McGarrigle et al., 2010; Bradley et al., 2015). Derryclare and Pollacappul had high macrophyte status in both periods
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 *Sphagnum* mosses and *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 lake 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 Schedule Five of the European Communities Environmental Objectives (Surface Waters) Regulations 2009. See McGarrigle et al. (2010) and Bradley et al. (2015) for acidification status for the WFD monitoring lakes in the SAC in the 2007-09 and 2010-12 periods
Water colour	mg/l PtCo	Maintain 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 lake habitat 3110, where the peatland in the lake's catchment is intact. Free et al. (2006) reported colour of 27mg/l PtCo in Derryclare, 25mg/l PtCo in Fee, 21mg/l PtCo in Inagh and 23mg/l PtCo in Kylemore. Overgrazing and other peatland degradation may have increased colour in some lakes in the SAC
Dissolved organic carbon (DOC)	mg/l	Maintain 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. Overgrazing and other peatland degradation is also likely to have increased DOC in some lakes in The Twelve Bens/Garraun Complex SAC

Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate units	Maintain 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. Increased loads of fine organic and inorganic particles from overgrazing may have increased turbidity in lakes in the SAC
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of 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 The Twelve Bens/Garraun Complex SAC, lake shorelines are likely to have acid grassland, swamp, heath, blanket bog and rock communities. 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 Isoeto-Nanojuncetea

To maintain the favourable conservation condition of Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea in The Twelve Bens/Garraun 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 3130 is considered likely to occur in Pollacappul Lough, and possibly also Kylemore Lough in The Twelve Bens/Garraun Complex SAC (see map 3). In both lakes, habitat 3130 is likely to co-occur with lake habitat 3110. 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) and The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for *Najas flexilis* (1833)
Habitat distribution	Occurrence	No decline, subject to natural processes	The characteristics and distribution of lake habitat 3130 in Ireland are not yet fully understood. The Annex II macrophyte *Najas flexilis* (slender naiad) is considered to be characteristic of the habitat and occurs in Pollacappul and Kylemore Loughs. As noted above, Pollacappul and Kylemore have been mapped as potential 3130, but the habitat may be more widespread in the SAC (see map 3). See O Connor (2015) and The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for *Najas flexilis* for further information
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 assessment for 3130 (NPWS, 2013), O Connor (2015) and The Twelve Bens/Garraun Complex SAC *Najas flexilis* conservation objectives supporting document. Kylemore and Pollacappul Loughs are Water Framework Directive (WFD) monitoring lakes and regular macrophyte surveys are conducted by the Environmental Protection Agency (EPA)
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 3130 (see O Connor, 2015)
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 3130. Pollacappul is a relatively shallow lake, Kylemore is deeper. Maximum depth should be large in lakes in the SAC within undisturbed peatland and uplands; however, pressures such as overgrazing, forestry and peat-cutting may have reduced vegetation depth in some lakes

Hydrological regime: water level fluctuations	Metres	Maintain appropriate natural 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. It is possible that the hydrological regimes of some of the lakes have been altered by historic overgrazing (faster run-off, higher flood peaks, lower base flows, etc.; see Marshall et al., 2014)
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 3130 is associated with a range of substrate types that are more productive/base-rich relative to the substratum of lake habitat 3110. Substratum particle size is likely to vary with depth and along the shoreline within a single lake; however, it should be noted that *Najas flexilis* is typically found on soft substrata of mud, silt or fine sand (Preston and Croft, 2001; Roden, 2002, 2004). For further information see the lake habitats supporting document (O Connor, 2015) and the *Najas flexilis* supporting document
Water quality: transparency	Metres	Maintain 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 3130 (O Connor, 2015). Habitat 3130 is associated with clear water, as evidenced by the growth of the character species *Najas flexilis* at depths of up to 10m. There is likely to be some variation in Secchi depth across lakes with habitat 3130, and site-specific conditions should also be considered. 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. Heuff (1984) recorded transparency greater than lake depth (1.75m) in Pollacappul and 2.2m in Kylemore. Roden (2004) stated transparency in Pollacappul was excellent. Free et al. (2006) give Secchi depth of 4.1m in Kylemore
Water quality: 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	Lake habitat 3130 is associated with high water quality, with naturally low dissolved nutrients. It is naturally more productive than lake habitat 3110, probably reflecting higher concentrations of nutrients such as calcium, rather than P alone. Lake habitat 3130 may reach favourable condition slightly above the oligotrophic boundary for nutrients, but in the absence of habitat-specific targets, the targets are WFD 'High Status' or oligotrophic (OECD, 1982). The "good-moderate" boundary is too enriched to support the habitat. 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) Regulations 2009. Kylemore and Pollacappul had high nutrient status in 2007-09 and 2010-12 (McGarrigle et al., 2010; Bradley et al., 2015)

Water quality: phytoplankton biomass	µg/l Chlorophyll *a*	Maintain appropriate water quality to support the habitat, including high chlorophyll *a* status	Lake habitat 3130 is associated with high water quality, and naturally low algal growth. As for nutrients, the targets are WFD 'High Status' or oligotrophic (OECD, 1982). The "good-moderate" boundary is too enriched to support the habitat. 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. 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. See also The European Communities Environmental Objectives (Surface Waters) Regulations 2009. Kylemore and Pollacappul had high chlorophyll *a* status in 2007-09 and 2010-12 (McGarrigle et al., 2010; Bradley et al., 2015)
Water quality: 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 3130 requires WFD high status. Kylemore had high phytoplankton composition status in 2010-12 (Bradley et al., 2015)
Water quality: attached algal biomass	Algal cover and EPA phytobenthos metric	Maintain trace/absent attached algal biomass (<5% cover) and high phytobenthos status	Nutrient enrichment can favour epiphytic and epipelic algae that can out-compete the submerged vegetation. The cover abundance of attached algae in lake habitat 3130 should, therefore, be trace/absent (<5% cover). EPA phytobenthos can be used as an indicator of changes in attached algal biomass. As for other water quality indicators, lake habitat 3130 requires high phytobenthos status. Kylemore had high phytobenthos status in 2010-12 (Bradley et al., 2015)
Water quality: macrophyte status	EPA macrophyte metric (The Free Index)	Maintain/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 3130 is high status or an Ecological Quality Ratio (EQR) for lake macrophytes of ≥0.90, as defined in Schedule Five of the European Communities Environmental Objectives (Surface Waters) Regulations 2009. Kylemore failed the target in 2007-2009 and 2010-2012, having good macrophyte status (McGarrigle et al., 2010; Bradley et al., 2015). Pollacappul had high macrophyte status in both periods
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 lake habitat 3130. Acidification reduces the abundance and reproductive capacity of *Najas flexilis* (Wingfield et al., 2004). The specific requirements of lake habitat 3130, in terms of water and sediment pH, alkalinity and cation concentration, have not been determined. In line with targets for *Najas flexilis*, median pH values should be greater than 7 pH units. Water and sediment alkalinity and concentrations of cations (notably calcium) should be appropriate to the habitat. The target for WFD Acidification/Alkalisation status is high. Maximum pH should be <9.0 pH units, in line with the surface water standards. See Schedule Five of the European Communities Environmental Objectives (Surface Waters) Regulations 2009. See McGarrigle et al. (2010) and Bradley et al. (2015) for acidification status for the WFD monitoring lakes in the SAC in the 2007-09 and 2010-12 periods

Water colour	mg/l PtCo	Maintain 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 is generally <30mg/l PtCo or, more naturally, <20mg/l PtCo in lakes with habitat 3130, where the peatland in the lake's catchment is intact. Free et al. (2006) reported colour of 23mg/l PtCo in Kylemore. Overgrazing and other peatland degradation may have increased colour in some lakes in The Twelve Bens/Garraun Complex SAC
Dissolved organic carbon (DOC)	mg/l	Maintain 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. Overgrazing and other peatland degradation is also likely to have increased DOC in some lakes in the SAC
Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate units	Maintain 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. Increased loads of fine organic and inorganic particles from overgrazing may have increased turbidity in lakes in the SAC
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of habitat 3130	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 The Twelve Bens/Garraun Complex SAC, lake shorelines are likely to have acid grassland, swamp, heath, blanket bog and rock communities. 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

4060 Alpine and Boreal heaths

To restore the favourable conservation condition of Alpine and Boreal heaths in The Twelve Bens/Garraun 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	Alpine and Boreal heaths habitat has not been mapped in detail for The Twelve Bens/Garraun Complex SAC, but from current available data the total area of the qualifying habitat is estimated to be approximately 225ha, covering c.1% of the SAC (NPWS internal files). Further details on this and the following attributes can be found in The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for blanket bogs and associated habitats
Habitat distribution	Occurrence	No decline, subject to natural processes	The habitat occurs at high altitudes throughout the SAC, and is associated with exposed rock and scree. It is present on several hillsides and summits including Benglenisky, Benbaun, Muckanaght, Bencullagh, Maumonght, Benbrack, Knockbrack, Bengooria, Doughruagh and Altnagaighera (NPWS internal files). Further information can be found within NPWS internal files and the blanket bogs and associated habitats supporting document
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range	See the blanket bogs and associated habitats supporting document for further details
Community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	A variety of Alpine and Boreal heath vegetation communities have been recorded in this SAC (NPWS internal files; R. Hodd, pers. comm.), two of which correspond to communities recorded in the National Survey of Upland Habitats and listed in the provisional list of vegetation communities described in Perrin et al. (2014). Further information on vegetation communities associated with this habitat is presented in Perrin et al. (2014)
Vegetation composition: lichens and bryophytes	Number of species at a representative number of 2m x 2m monitoring stops	Number of bryophyte or non-crustose lichen species present at each monitoring stop is at least three	Attribute and target based on Perrin et al. (2014)
Vegetation composition: positive indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of positive indicator species at least 66%	Attribute and target based on Perrin et al. (2014), where the list of positive indicator species for this habitat is also presented
Vegetation composition: dwarf shrub species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of dwarf shrub species at least 10%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Total cover of negative indicator species less than 10%	Attribute and target based on Perrin et al. (2014), where the list of negative indicator species for this habitat is also presented
Vegetation composition: non-native species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of non-native species less than 1%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: signs of grazing	Percentage of leaves grazed at a representative number of 2m x 2m monitoring stops	Less than 10% collectively of the live leaves of specific graminoids showing signs of grazing	Attribute and target based on Perrin et al. (2014). See the blanket bogs and associated habitats supporting document for the list of specific graminoids

Vegetation structure: signs of browsing	Percentage of shoots browsed at a representative number of 2m x 2m monitoring stops	Less than 33% collectively of the last complete growing season's shoots of ericoids and crowberry (*Empetrum nigrum*) showing signs of browsing	Attribute and target based on Perrin et al. (2014)
Vegetation structure: burning	Occurrence in local vicinity of a representative number of monitoring stops	No signs of burning within the habitat	Attribute and target based on Perrin et al. (2014)
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of disturbed bare ground less than 10%	Attribute and target based on Perrin et al. (2014)
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 and no decline in status of hepatic mats associated with this habitat	This includes species listed in the Flora (Protection) Order, 2015 (FPO) and/or the red data lists (Lockhart et al., 2012; Wyse Jackson et al., 2016). The Near Threatened alpine clubmoss (*Diphasiastrum alpinum*) (Wyse Jackson et al., 2016) is present within the SAC (NPWS internal files). This species is known to be associated with this habitat type. The FPO listed and Vulnerable bryophytes *Adelanthus lindenbergianus* and *Bazzania pearsonii*, the FPO and Near Threatened *Mastigophora woodsii* and the FPO and Endangered *Plagiochila carringtonii* (Lockhart et al., 2012) are all associated with this habitat (NPWS internal files). Hepatic mats are present in this habitat in the SAC (R. Hodd, pers. comm.)

7130 Blanket bogs (* if active bog)

To restore the favourable conservation condition of Blanket bogs (* if active bog) in The Twelve Bens/Garraun 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	Blanket bog has not been mapped in detail for The Twelve Bens/Garraun Complex SAC, but from current available data the total area of the qualifying habitat is estimated to be approximately 5,325ha, covering 33% of the SAC (NPWS internal files). Further details on this and the following attributes can be found in The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for blanket bogs and associated habitats
Habitat distribution	Occurrence	No decline, subject to natural processes	The habitat is documented to occur throughout the SAC. It is best developed in low-lying basins and is present on the flanks of mountains up to an altitude of c.200m. Examples of this habitat can be found at Glenmore, Kylemore, Tooreenacoona, Owenglin, east of the Dawros River, on the western slopes of Bealnascalpa Mountain and on the flanks of Cregg Hill (NPWS internal files). Further information can be found in Douglas and Grogan (1987), Douglas et al. (1989), NPWS internal files and the blanket bogs and associated habitats supporting document
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range	See the blanket bogs and associated habitats supporting document for further details
Ecosystem function: peat formation	Active blanket bog as a proportion of the total area of Annex I blanket bog habitat	At least 99% of the total Annex I blanket bog area is active	See the blanket bogs and associated habitats supporting document for further details
Ecosystem function: hydrology	Flow direction, water levels, occurrence of drains and erosion gullies	Natural hydrology unaffected by drains and erosion	Further details and a brief discussion of restoration potential is presented in the blanket bogs and associated habitats supporting document
Community diversity	Abundance of variety of vegetation communities	Maintain variety of vegetation communities, subject to natural processes	A variety of blanket bog vegetation communities have been recorded in this SAC (Douglas and Grogan, 1987; Douglas et al., 1989; NPWS internal files), six of which correspond to communities recorded in the National Survey of Upland Habitats and listed in the provisional list of vegetation communities described in Perrin et al. (2014). Further information on vegetation communities associated with this habitat is presented in Perrin et al. (2014)
Vegetation composition: positive indicator species	Number of species at a representative number of 2m x 2m monitoring stops	Number of positive indicator species present at each monitoring stop is at least seven	Attribute and target based on Perrin et al. (2014), where the list of positive indicator species for this habitat is also presented
Vegetation composition: lichens and bryophytes	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of bryophytes or lichens, excluding *Sphagnum fallax*, at least 10%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: potential dominant species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of each of the potential dominant species less than 75%	Attribute and target based on Perrin et al. (2014). See the blanket bogs and associated habitats supporting document for the list of potential dominant species
Vegetation composition: negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Total cover of negative indicator species less than 1%	Attribute and target based on Perrin et al. (2014), where the list of negative indicator species for this habitat is also presented

Vegetation composition: non-native species	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of non-native species less than 1%	Attribute and target based on Perrin et al. (2014). Rhododendron (*Rhododendron ponticum*) was recorded as encroaching on this habitat (Douglas et al., 1989; NPWS internal files)
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 Perrin et al. (2014)
Vegetation structure: *Sphagnum* condition	Condition at a representative number of 2m x 2m monitoring stops	Less than 10% of the *Sphagnum* cover is crushed, broken and/or pulled up	Attribute and target based on Perrin et al. (2014)
Vegetation structure: signs of browsing	Percentage of shoots browsed at a representative number of 2m x 2m monitoring stops	Last complete growing season's shoots of ericoids, crowberry (*Empetrum nigrum*) and bog-myrtle (*Myrica gale*) showing signs of browsing collectively less than 33%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: burning	Occurrence in local vicinity of a representative number of monitoring stops	No signs of burning in sensitive areas, into the moss, liverwort or lichen layer or exposure of peat surface due to burning	Attribute and target based on Perrin et al. (2014), where the list of sensitive areas for this habitat is also presented
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of disturbed bare ground less than 10%	Attribute and target based on Perrin et al. (2014)
Physical structure: drainage	Percentage area in local vicinity of a representative number of monitoring stops	Area showing signs of drainage from heavy trampling, tracking or ditches less than 10%	Attribute and target based on Perrin et al. (2014)
Physical structure: erosion	Percentage area in local vicinity of a representative number of monitoring stops	Less than 5% of the greater bog mosaic comprises erosion gullies and eroded areas	Attribute and target based on Perrin et al. (2014)
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	This includes species listed in the Flora (Protection) Order, 2015 (FPO) and/or the red data lists (Lockhart et al., 2012; Wyse Jackson et al., 2016). The FPO listed and Vulnerable marsh clubmoss (*Lycopodiella inundata*) (Wyse Jackson et al., 2016) is present within the SAC (NPWS internal files), but this species cannot be specifically assigned to this habitat

7150 Depressions on peat substrates of the Rhynchosporion

To restore the favourable conservation condition of Depressions on peat substrates of the Rhynchosporion in The Twelve Bens/Garraun 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	Depressions on peat substrates of the Rhynchosporion has not been mapped in detail for The Twelve Bens/Garraun Complex SAC and thus the total area of the qualifying habitat in the SAC is unknown. Further details on this and the following attributes can be found in The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for blanket bogs and associated habitats
Habitat distribution	Occurrence	No decline, subject to natural processes	The habitat is documented to occur around pools, in wet hollows, quaking areas and in flushed areas within the SAC (NPWS internal files). Examples of this habitat can be found at Tooreenacoona, Glenmore, Kylemore and Owenglin. Further information can be found within Douglas and Grogan (1987), Douglas et al. (1989), NPWS internal files and the blanket bogs and associated habitats supporting document
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range	See the blanket bogs and associated habitats supporting document for further details
Vegetation composition: positive indicator species	Number of species at a representative number of 2m x 2m monitoring stops	Number of positive indicator species at each monitoring stop is at least five	Attribute and target based on Perrin et al. (2014), where the list of positive indicator species for this habitat is also presented
Vegetation composition: *Rhynchospora* spp.	Percentage cover at a representative number of 2m x 2m monitoring stops	Total cover of white beaked sedge (*Rhynchospora alba*) and brown beaked sedge (*R. fusca*) at least 10%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: potential dominant species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of each of the potential dominant species individually less than 35%	Attribute and target based on Perrin et al. (2014). See the blanket bogs and associated habitats supporting document for the list of potential dominant species
Vegetation composition: negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Total cover of negative indicator species less than 1%	Attribute and target based on Perrin et al. (2014), where the list of negative indicator species for this habitat is also presented
Vegetation composition: non-native species	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of non-native species less than 1%	Attribute and target based on Perrin et al. (2014)
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 Perrin et al. (2014)
Vegetation structure: *Sphagnum* condition	Condition at a representative number of 2m x 2m monitoring stops	Less than 10% of the *Sphagnum* cover is crushed, broken and/or pulled up	Attribute and target based on Perrin et al. (2014)
Vegetation structure: signs of browsing	Percentage of shoots browsed at a representative number of 2m x 2m monitoring stops	Last complete growing season's shoots of ericoids, crowberry (*Empetrum nigrum*) and bog-myrtle (*Myrica gale*) showing signs of browsing collectively less than 33%	Attribute and target based on Perrin et al. (2014)

Vegetation structure: burning	Occurrence in local vicinity of a representative number of monitoring stops	No signs of burning in sensitive areas, into the moss, liverwort or lichen layer or exposure of peat surface due to burning	Attribute and target based on Perrin et al. (2014), where the list of sensitive areas for this habitat is also presented
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of disturbed bare ground less than 10%	Attribute and target based on Perrin et al. (2014)
Physical structure: drainage	Percentage area in local vicinity of a representative number of monitoring stops	Area showing signs of drainage from heavy trampling, tracking or ditches less than 10%	Attribute and target based on Perrin et al. (2014)
Physical structure: erosion	Percentage area in local vicinity of a representative number of monitoring stops	Less than 5% of the greater bog mosaic comprises erosion gullies and eroded areas	Attribute and target based on Perrin et al. (2014)
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	This includes species listed in the Flora (Protection) Order, 2015 (FPO) and/or the red data lists (Lockhart et al., 2012; Wyse Jackson et al., 2016). The Near Threatened brown beak-sedge (*Rhynchospora fusca*) (Wyse Jackson et al., 2016) can be specifically assigned to this habitat in the SAC (Douglas et al., 1989). The FPO and Vulnerable marsh clubmoss (*Lycopodiella inundata*) (Wyse Jackson et al., 2016) is present within the SAC (NPWS internal files), but this species cannot be specifically assigned to this habitat

8110 Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani)

To restore the favourable conservation condition of Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani) in The Twelve Bens/Garraun 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	Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani) has not been mapped in detail for The Twelve Bens/Garraun Complex SAC but from current available data the total area of the qualifying habitat is estimated to be approximately 162ha, covering 1% of the SAC (NPWS internal files). Further details on this and the following attributes can be found in The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for blanket bogs and associated habitats
Habitat distribution	Occurrence	No decline, subject to natural processes	The habitat occurs on hillsides throughout the SAC. Example locations include Bencullagh, Muckanaght, Benbaun, Bengower, Derryclare and Doughruagh (NPWS internal files). Further information can be found within NPWS internal files and the blanket bogs and associated habitats supporting document
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range	See the blanket bogs and associated habitats supporting document for further details
Vegetation composition: lichens and bryophytes	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of bryophytes and non-crustose lichen species at least 5%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Proportion of vegetation composed of negative indicator species less than 1%	Attribute and target based on Perrin et al. (2014), where the list of negative indicator species for this habitat is also presented
Vegetation composition: non-native species	Percentage cover at a representative number of 2m x 2m monitoring stops	Proportion of vegetation composed of non-native species less than 1%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: positive indicator species	Number of species in local vicinity of a representative number of monitoring stops	At least one positive indicator species present in vicinity of each monitoring stop in block scree	Attribute and target based on Perrin et al. (2014). The list of positive indicator species for this habitat is also presented in Perrin et al. (2014) and is the same as for 8220 Siliceous rocky slopes
Vegetation composition: grass species and dwarf shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of grass species and dwarf shrubs less than 20%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: bracken, native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of bracken (*Pteridium aquilinum*), native trees and shrubs less than 25%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: grazing and browsing	Percentage of leaves/shoots grazed/browsed at a representative number of 2m x 2m monitoring stops	Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing or browsing collectively less than 50%	Attribute and target based on Perrin et al. (2014)
Physical structure: disturbance	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Ground disturbed by human and animal paths, scree running, vehicles less than 10%	Attribute and target based on Perrin et al. (2014)

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 and no decline in status of hepatic mats associated with this habitat	This includes species listed in the Flora (Protection) Order, 2015 (FPO) and/or the red data lists (Lockhart et al., 2012; Wyse Jackson et al., 2016). The FPO listed and Vulnerable parsley fern (*Cryptogramma crispa*) (Wyse Jackson et al., 2016) and the Near Threatened beech fern (*Phegopteris connectilis*) (Wyse Jackson et al., 2016) have previously been recorded within the SAC (NPWS internal files), but these species cannot be assigned specifically to this habitat. Hepatic mats are present within this habitat in the SAC (R. Hodd, pers. comm.)

8210 Calcareous rocky slopes with chasmophytic vegetation

To restore the favourable conservation condition of Calcareous rocky slopes with chasmophytic vegetation in The Twelve Bens/Garraun 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 rocky slopes with chasmophytic vegetation has not been mapped in detail for The Twelve Bens/Garraun Complex SAC, but from current available data the total area of the qualifying habitat is estimated to be approximately 105ha, covering c.1% of the SAC (NPWS internal files). Further details on this and the following attributes can be found in The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for blanket bogs and associated habitats
Habitat distribution	Occurrence	No decline, subject to natural processes	The habitat occurs throughout the SAC. Locations where this habitat is present include the northern slopes of Muckanaght, west of Bengower, Benbaun, Barrlugwaum on the south-east slopes of Benchoona, Altnagaighera, Garraun, Doughruagh and Benlettery (NPWS internal files). Further information can be found within NPWS internal files and the blanket bogs and associated habitats supporting document
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range	See the blanket bogs and associated habitats supporting document for further details
Vegetation composition: positive indicator fern and *Saxifraga* species	Number of species in local vicinity of a representative number of monitoring stops	Number of ferns and *Saxifraga* indicators at each monitoring stop is at least one	Attribute and target based on Perrin et al. (2014), where the list of positive indicator species for this habitat is also presented
Vegetation composition: positive indicator species	Number of species in local vicinity of a representative number of monitoring stops	Number of positive indicator species at each monitoring stop is at least three	Attribute and target based on Perrin et al. (2014), where the list of positive indicator species for this habitat is also presented
Vegetation composition: non-native species	Percentage cover in local vicinity of a representative number of monitoring stops	Proportion of vegetation composed of non-native species less than 1%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: bracken, native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of bracken (*Pteridium aquilinum*), native trees and shrubs less than 25%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: grazing and browsing	Percentage of leaves/ shoots grazed/browsed in local vicinity of a representative number of monitoring stops	Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing or browsing collectively less than 50%	Attribute and target based on Perrin et al. (2014)
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	This includes species listed in the Flora (Protection) Order, 2015 and/or the red data lists (Lockhart et al., 2012; Wyse Jackson et al., 2016). The Vulnerable alpine saw-wort (*Saussurea alpina*) and holly-fern (*Polystichum lonchitis*), and the Near Threatened beech fern (*Phegopteris connectilis*) and Irish saxifrage (*Saxifraga rosacea* subsp. *rosacea*) (Wyse Jackson et al., 2016) were recorded within this habitat in the SAC (NPWS internal files). The Near Threatened bryophytes *Mnium thomsonii* and *Eremonotus myriocarpus* (Lockhart et al., 2012) are present within the SAC (NPWS internal files) and are known to be associated with this habitat type

8220 Siliceous rocky slopes with chasmophytic vegetation

To restore the favourable conservation condition of Siliceous rocky slopes with chasmophytic vegetation in The Twelve Bens/Garraun 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	Siliceous rocky slopes with chasmophytic vegetation has not been mapped in detail for The Twelve Bens/Garraun Complex SAC, but from current available data the total area of the qualifying habitat is estimated to be approximately 121ha, covering c.1% of the SAC (NPWS internal files). Further details on this and the following attributes can be found in The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for blanket bogs and associated habitats
Habitat distribution	Occurrence	No decline, subject to natural processes	The habitat occurs throughout the SAC including the slopes of Bengower, Benbreen, Bencollaghduff, Bencorr, Bencorrbeg, Derryclare, Bencullagh, Muckanaght, Benbaun, Doughruagh, Benchoona and Garraun (NPWS internal files). Further information can be found within NPWS internal files and the blanket bogs and associated habitats supporting document
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range	See the blanket bogs and associated habitats supporting document for further details
Vegetation composition: positive indicator species	Number of species in local vicinity of a representative number of monitoring stops	At least one positive indicator species present in vicinity of each monitoring stop	Attribute and target based on Perrin et al. (2014). The list of positive indicator species for this habitat is also presented in Perrin et al. (2014) and is the same as for 8110 Siliceous screes
Vegetation composition: non-native species	Percentage cover in local vicinity of a representative number of monitoring stops	Proportion of vegetation composed of non-native species less than 1%	Attribute and target based on Perrin et al. (2014). New Zealand willowherb (*Epilobium brunnescens*) is present within this habitat in the SAC (NPWS internal files)
Vegetation composition: bracken, native trees and shrubs	Percentage cover in local vicinity of a representative number of monitoring stops	Total cover of bracken (*Pteridium aquilinum*), native trees and shrubs less than 25%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: grazing and browsing	Percentage of leaves/ shoots grazed/browsed in local vicinity of a representative number of monitoring stops	Live leaves of forbs and shoots of dwarf shrubs showing signs of grazing or browsing collectively less than 50%	Attribute and target based on Perrin et al. (2014)
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 and no decline in status of hepatic mats associated with this habitat	This includes species listed in the Flora (Protection) Order, 2015 (FPO) and/or the red data lists (Lockhart et al., 2012; Wyse Jackson et al., 2016). The Near Threatened beech fern (*Phegopteris connectilis*) (Wyse Jackson et al., 2016) and the Vulnerable bryophytes *Arctoa fulvella*, *Dicranodontium uncinatum* and *Lophozia opacifolia* (Lockhart et al., 2012) are present within the SAC (NPWS internal files). These species are known to be associated with this habitat type. The FPO listed and Vulnerable parsley fern (*Cryptogramma crispa*) (Wyse Jackson et al., 2016) has previously been recorded within the SAC (NPWS internal files), but it cannot be assigned specifically to this habitat. Hepatic mats are present in this habitat in the SAC (R. Hodd, pers. comm.)

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

To maintain the favourable conservation condition of Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles in The Twelve Bens/Garraun 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; at least 9.5ha for the sub-site (Derryclare Wood, NSNW site code 1601) surveyed. See map 4 for surveyed area	The best examples of old sessile oak woods with *Ilex* and *Blechnum* in the British Isles in The Twelve Bens/Garraun Complex SAC occur at Kylemore and Derryclare Woods, but scattered fragments also occur near Salrock House at the head of Killary Bay Little, in steep ravines north of Ballinahinch Lake and on islands in Lough Inagh and Derryclare Lough (NPWS internal files). As part of the National Survey of Native Woodlands (NSNW), Derryclare Wood (NSNW site code 1601) was surveyed by Perrin et al. (2008). Derryclare Wood is also a statutory Nature Reserve (Statutory Instrument No. 177 of 1980) and is well-studied. Map 4 shows tha woodland area surveyed by the NSNW, including the area classified as 91A0 (9.5ha). NB further unsurveyed areas are present within the SAC
Habitat distribution	Occurrence	No decline, subject to natural processes. The surveyed woodland location is shown on map 4	Distribution based on Perrin et al. (2008). It is important to note that there are additional areas of oak woodland, which were not mapped by the NSNW, 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 and metres	Diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi-mature trees and shrubs; and well-developed herb layer	Described in Perrin et al. (2008) and NPWS internal files. See also Fahy et al. (1999)
Woodland structure: community diversity and extent	Hectares	Maintain diversity and extent of community types	Described in Perrin et al. (2008) and NPWS internal files. See also Ferguson and Westhoff (1987)
Woodland structure: natural regeneration	Seedling:sapling:pole ratio	Seedlings, saplings and pole age-classes occur in adequate proportions to ensure survival of woodland canopy	Oak (*Quercus petraea*) generally regenerates poorly. In suitable sites, ash (*Fraxinus excelsior*) can regenerate in large numbers although few seedlings reach pole size
Woodland structure: dead wood	m^3 per hectare; number per hectare	At least $30m^3$/ha of fallen timber greater than 10cm diameter; 30 snags/ha; both categories should include stems greater than 40cm diameter	Dead wood is a valuable resource and an integral part of a healthy, functioning woodland ecosystem
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 disctinctiveness	Occurrence	No decline	Includes ancient or long-established woodlands (Perrin and Daly, 2010), archaeological and geological features as well as red data and other rare or localised species. Perrin and Daly (2010) identified Derryclare Wood (NSNW site code 1601) as possible ancient woodland. There is a well-developed fungus and lichen flora present (Folan and Mitchell, 1970). Many rare and protected bryophytes occur in the Kylemore woods, e.g. the Endangered liverwort *Cephalozia crassifola* and the Near Threatened bryophytes *Lejeunea hibernica, L. eckloniana, Grimmia funalis* and *Telaranea europaea* (Lockhart et al., 2012). *Lejeunea hibernica* and *L. eckloniana* are listed on the Flora (Protection) Order, 2015
Vegetation composition: native tree cover	Percentage	No decline. Native tree cover not less than 95%	Species reported in Perrin et al. (2008) and NPWS internal files
Vegetation composition: typical species	Occurrence	A variety of typical native species present, depending on woodland type, including oak (*Quercus petraea*) and birch (*Betula pubescens*)	Species reported in Perrin et al. (2008) and NPWS internal files
Vegetation composition: negative indicator species	Occurrence	Negative indicator species, particularly non-native invasive species, absent or under control	The following are the most common non-native invasive species in this woodland type: beech (*Fagus sylvatica*), sycamore (*Acer pseudoplatanus*) and rhododendron (*Rhododendron ponticum*). The woods at Kylemore are infested with rhododendron. Beech is also present and substantial areas of the woods are underplanted with conifers (NPWS internal files)

1029 Freshwater Pearl Mussel *Margaritifera margaritifera*

To restore the favourable conservation condition of Freshwater Pearl Mussel in The Twelve Bens/Garraun Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Kilometres	Maintain distribution at 6.43km. See map 5	The conservation objective applies to the Dawros freshwater pearl mussel (*Margaritifera margaritifera*) population in The Twelve Bens/Garraun Complex SAC, which is of international importance and one of eight Irish populations prioritised for conservation action (Moorkens, 2010; NPWS, 2010). It is listed on the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (Statutory Instrument No. 296 of 2009). The distribution and abundance of the species in the Dawros was mapped in 2003 and 2008 (Aster, 2003; Moorkens, 2008; Moorkens and Killeen, 2008). The species is known to extend from above Tullywee Bridge to the tidal limit downstream of Dawros Bridge; however, the stretch upstream of Tullywee Bridge has been little surveyed and requires further investigation. The target is for the species to be sufficiently widespread to maintain itself on a long-term basis as a viable component of the Dawros system. See NPWS (2010) for further information
Population size	Number of adult mussels	Restore Dawros population to at least 800,000 adult mussels	Aster (2003) estimated a population of between 10,750 and 19,322 per linear kilometre of the Dawros River. Moorkens (2008) estimated the total Dawros population at 800,000 to 1 million. Aster (2003) mapped the distribution and abundance from downstream of Tullywee Bridge to Dawros Bridge and categorised mussels as frequent or abundant throughout most of this length. The maximum density recorded in 2008 was 256 per square metre and an average abundance of 148 mussels per linear metre calculated from 9 samples (Moorkens, 2008; Moorkens and Killeen, 2008). NPWS (2013) in producing a national population estimate, assumed that all priority populations had declined at a rate of 1% per year from 2007 to 2012. The target is for the species to be sufficiently abundant to maintain itself on a long-term basis as a viable component of the Dawros system
Population structure: recruitment	Percentage per size class	Restore to at least 20% of population no more than 65mm in length; and at least 5% of population no more than 30mm in length	Mussels of no more than 65mm are considered 'young mussels' and may be found buried in the substratum and/or beneath adult mussels. Mussels of no more than 30mm are 'juvenile mussels' and are always buried in the substratum. See the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009. Size profile studies in the Dawros by Ross (1988) and Moorkens (2008) are summarised in NPWS (2010). In 2008, the smallest mussel was 22mm, and the Dawros failed both targets with 3.7% ≤65mm and 1.86% ≤30mm (Moorkens, 2008; Moorkens and Killeen, 2008). No juveniles were found in 2016, and 10% was ≤65mm (Moorkens, 2016). The Dawros population is unsustainable owing to lack of survival of juvenile mussels. The target is for sufficient juvenile recruitment to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system

Population structure: adult mortality	Percentage	No more than 5% decline from previous number of live adults counted; dead shells less than 1% of the adult population and scattered in distribution	5% is considered the cut-off between the combined errors associated with natural fluctuations and sampling methods and evidence of true population decline. 1% of dead shells is considered to be indicative of natural losses. The Dawros passed both targets in 2008 (Moorkens, 2008; Moorkens and Killeen, 2008; NPWS, 2010). The occurrence of dead and moribund mussels in 2016 indicated an unnatural decline in adult numbers (Moorkens, 2016). The target is for sufficient survival of adults to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Suitable habitat: extent	Kilometres	Restore suitable habitat in more than 4.8km in the Dawros system (see map 5) and any additional stretches necessary for salmonid spawning	The extent of the mussel habitat in the Dawros system downstream of Tullywee Bridge is well-documented and corresponds with its distribution (Aster, 2003; Moorkens, 2008; Moorkens and Killeen, 2008). Stretches upstream of Tullywee Bridge require further survey. Most of the mapped habitat in the Dawros system is occupied by adult mussels; however, it is unsuitable for juvenile recruitment (Moorkens, 2008, 2016; Moorkens and Killeen, 2008; NPWS, 2010). Hydromorphological changes, including bank erosion/slumping and siltation, are key impacts on the Dawros mussel habitat. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Suitable habitat: condition	Kilometres	Restore condition of suitable habitat	The species' habitat is a combination of 1) the area of habitat adult and juvenile mussels can occupy; 2) the area of spawning and nursery habitats the host fish can occupy. Fish nursery habitat typically overlaps with mussel habitat. Fish spawning habitat is generally adjacent to mussel habitat, but may lie upstream of the generalised mussel distribution. Only those spawning areas that can regularly contribute juvenile fish to areas occupied by adult mussels should be considered. The availability of mussel and fish spawning/nursery habitats is determined by flow and substratum conditions. It is highly sensitive to hydromorphological changes, sedimentation and nutrient enrichment. Pressures throughout the catchment (map 5) contribute to such impacts. The habitat in the Dawros cannot support sufficient juvenile survival. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Water quality: macroinvertebrate and phytobenthos (diatoms)	Ecological quality ratio (EQR)	Restore water quality - macroinvertebrates: EQR greater than 0.90 (Q4-5 or Q5); phytobenthos: EQR greater than 0.93	The EQR targets correspond to high ecological status for these two Water Framework Directive biological quality elements. They represent high water quality with very low nutrient concentrations (oligotrophic conditions). In 2009, the habitat in the Dawros system failed the macroinvertebrate target, but passed the diatom target (Williams, 2009; NPWS, 2010). See also The European Communities Environmental Objectives (Surface Waters) Regulations 2009. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system

Substratum quality: filamentous algae (macroalgae); macrophytes (rooted higher plants)	Percentage	Restore substratum quality - filamentous algae: absent or trace (less than 5%); macrophytes: absent or trace (less than 5%)	The Dawros failed both targets in 2009 (NPWS, 2010). Up to 70% algal cover was recorded in mussel habitat, while high macrophyte cover (particularly *Myriophyllum*) was frequent (Williams, 2009; NPWS, 2010). In 2016, 91% of quadrats were in moderate or poor condition, mostly owing to algal cover (Moorkens, 2016). Bacterial and fungal growth and detritus accumulation also require further investigation in the Dawros, given the loading of organic fine sediment entering the river (Williams, 2009; Monaghan, 2012). Sufficient recruitment of juvenile mussels is being prevented by the poor condition of the river substratum. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Substratum quality: sediment	Occurrence	Restore substratum quality - stable cobble and gravel substrate with very little fine material; no artificially elevated levels of fine sediment	The Dawros failed the target for the Sub-basin Management Plan, with fine sediment recorded throughout the mussel habitat in 2008 and 2009 (Moorkens, 2008; Moorkens and Killeen, 2008; Williams, 2009; NPWS, 2010). There was a clear relationship between heavy siltation and higher macrophyte cover abundance. In 2016, the Dawros passed the target and silt plumes were restricted to marginal areas, suggesting siltation is episodic and deposited fine sediments are periodically flushed-out by high flows (Moorkens, 2016). Sufficient survival of juvenile mussels is being prevented by the poor condition of the river substratum. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Substratum quality: oxygen availability	Redox potential	Restore to no more than 20% decline from water column to 5cm depth in substrate	Differences in redox potential between the water column and the substrate correlate with differences in oxygen levels. Juvenile mussels require full oxygenation while buried in gravel. In suitable habitat, there should be very little loss of redox potential between the water column and underlying gravels. The Dawros failed the redox target in 2008, with an average loss of 35% redox potential at 5cm (Moorkens, 2008; Moorkens and Killeen, 2008; NPWS, 2010). In 2016, 92% of redox measurements in the Dawros passed the target and the overall average was 16% (Moorkens, 2016). The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system
Hydrological regime: flow variability	Metres per second	Restore appropriate hydrological regime	The availability of suitable freshwater pearl mussel habitat is largely determined by flow (catchment geology being the other important factor). In order to restore the habitat for the species, flow variability over the annual cycle must be such that: 1) high flows can wash fine sediments from the substratum; 2) high flows are not artificially increased so as to cause excessive scour of mussel habitat; 3) low flows do not exacerbate the deposition of fine sediment or growth of algae/macrophytes and 4) low flows do not cause stress to mussels in terms of exposure, water temperatures, food availability or aspects of the reproductive cycle; see Moorkens and Killeen (2014). Groundwater inflow to the substratum also contributes to water-cycling and favourable habitat condition. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system

Host fish	Number	Maintain sufficient juvenile salmonids to host glochidial larvae	Salmonid fish are host to the larval stage of the freshwater pearl mussel and, thus, are essential to completion of the life cycle. 0+ and 1+ fish are typically used, both because of habitat overlaps and the development of immunity with age in fish. Fish presence is sufficient, as higher fish density and biomass is indicative of enriched conditions in mussel rivers. Geist et al. (2006) found that higher densities of host fish coincided with eutrophication, poor substrate quality for mussels and a lack of mussel recruitment, while significantly lower densities and biomass of host fish were associated with high numbers of juvenile mussels. Fish movements must be such that 0+ fish remain in the mussel habitat until their 1+ summer. No fish stocking should occur within the mussel habitat, nor any works that may change the salmonid balance or residency time. In 2009, glochidia were found on salmon, but not trout, in the Dawros (Johnston, 2009; NPWS, 2010)
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the population	Riparian habitats, including those along lake fringes, particularly natural/semi-natural woodlands and wetlands, even where they do not form part of a natural floodplain, are an integral part of the structure and functioning of river systems. Fringing habitats aid in the settlement of fine suspended material, protect banks from erosion and contribute to nutrient cycling and to the aquatic food web (e.g. allochthonous matter such as leaf fall), and provide habitat (refuge and resources) for certain life-stages of fish, birds and aquatic invertebrates. Shade may also be important in suppressing algal and macrophyte growth in enriched rivers and moderating temperatures. Equally, fringing habitats are dependent on rivers/lakes, particularly their water levels, and support wetland communities and species of conservation concern. The target is for sufficient habitat in favourable condition to allow the species to maintain itself on a long-term basis as a viable component of the Dawros system

1106 Salmon *Salmo salar*

To maintain the favourable conservation condition of Atlantic Salmon in The Twelve Bens/Garraun Complex 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 salmons' 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 Standing Scientific Committee on Salmon (SSCS) annual model output of CL attainment levels. See SSCS (2016). Attainment of CL estimates are derived from direct counts of adults (rod catch, fish counter) or indirectly by fry abundance counts. The Owenglin River is currently achieving CL
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	The target is the 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 (*Lepeophtheirus salmonis*)
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
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)

1355 Otter *Lutra lutra*

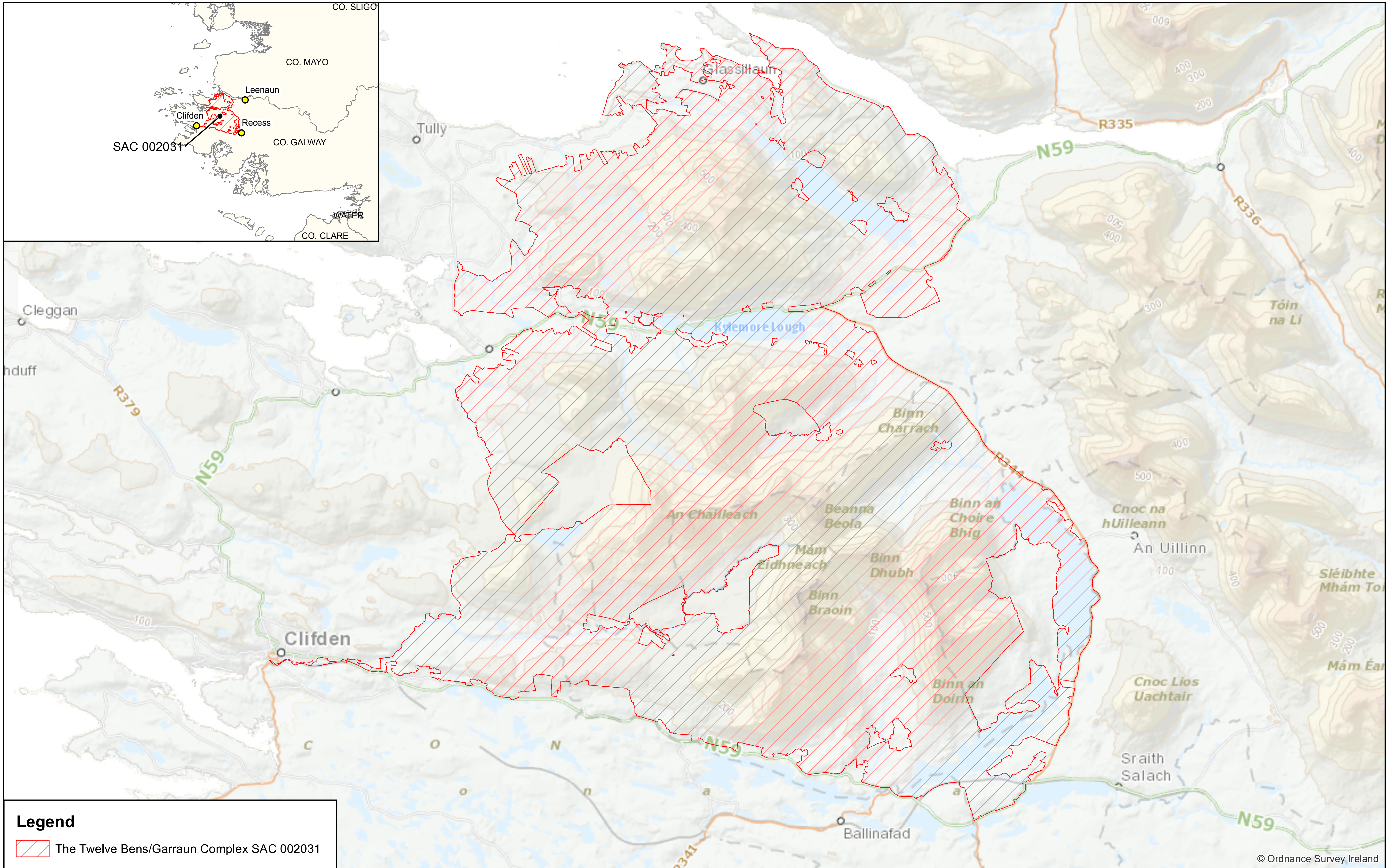
To maintain the favourable conservation condition of Otter in The Twelve Bens/Garraun Complex SAC, which is defined by the following list of attributes and targets:

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 854.66ha	No field survey. Areas mapped to include 10m terrestrial buffer along shoreline (above high water mark (HWM) and along river banks) identified as critical for otters (NPWS, 2007)
Extent of marine habitat	Hectares	No significant decline. Area mapped and calculated as 53.81ha	No field survey. Area mapped based on evidence that otters tend to forage within 80m of the shoreline (HWM) (Kruuk, 2006; NPWS, 2007)
Extent of freshwater (river) habitat	Kilometres	No significant decline. Length mapped and calculated as 382.7km	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 540.7ha	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) and wrasse and rockling in coastal waters (Kingston et al., 1999)
Barriers to connectivity	Number	No significant increase. For guidance, see map 6	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

1833 Slender Naiad *Najas flexilis*

To maintain the favourable conservation condition of Slender Naiad in The Twelve Bens/Garraun Complex SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population extent	Hectares; distribution	No change to the spatial extent of *Najas flexilis* within Pollacappul and Kylemore Loughs, subject to natural processes. See map 7 for known locations	The selection of The Twelve Bens/Garraun Complex SAC for *Najas flexilis* (slender naiad) was based on its presence in Loughs Pollacappul and Kylemore. Pollacappul is considered to support a large population of the species, while the species' status in considered uncertain in Kylemore Lough (Roden and Murphy, 2014). See The Twelve Bens/Garraun Complex SAC conservation objectives supporting document for *Najas flexilis* for further details
Population depth	Metres	No change to the depth range of *Najas flexilis* within the lakes, subject to natural processes	See the *Najas flexilis* supporting document for further details
Population viability	Plant traits	No decline in plant fitness, subject to natural processes	See the *Najas flexilis* supporting document for further details
Population abundance	Square metres	No change to the cover abundance of *Najas flexilis*, subject to natural processes	See the *Najas flexilis* supporting document for further details
Species distribution	Occurrence	No decline, subject to natural processes	See the *Najas flexilis* supporting document for further details
Habitat extent	Hectares	No decline, subject to natural processes	See the *Najas flexilis* supporting document for further details
Hydrological regime: water level fluctuations	Metres	Maintain/restore appropriate natural hydrological regime necessary to support the habitat for the species	See the *Najas flexilis* supporting document for further details
Lake substratum quality	Various	Maintain appropriate substratum type, extent and chemistry to support the populations of the species	See the *Najas flexilis* supporting document for further details
Water quality	Various	Maintain/restore appropriate water quality to support the populations of the species	See the *Najas flexilis* supporting document for further details
Acidification status	pH units; mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the populations of *Najas flexilis*, subject to natural processes	See the *Najas flexilis* supporting document for further details
Water colour	mg/l PtCo	Maintain appropriate water colour to support the populations of *Najas flexilis*	See the *Najas flexilis* supporting document for further details
Associated species	Species composition and abundance	Maintain appropriate associated species and vegetation communities to support the populations of *Najas flexilis*	See the *Najas flexilis* supporting document for further details
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the populations of *Najas flexilis*	See the *Najas flexilis* supporting document for further details



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MAP 1:
THE TWELVE BENS / GARRAUN COMPLEX SAC
CONSERVATION OBJECTIVES
SAC DESIGNATION

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

SITE CODE:
SAC 002031; version 3.01. CO. GALWAY

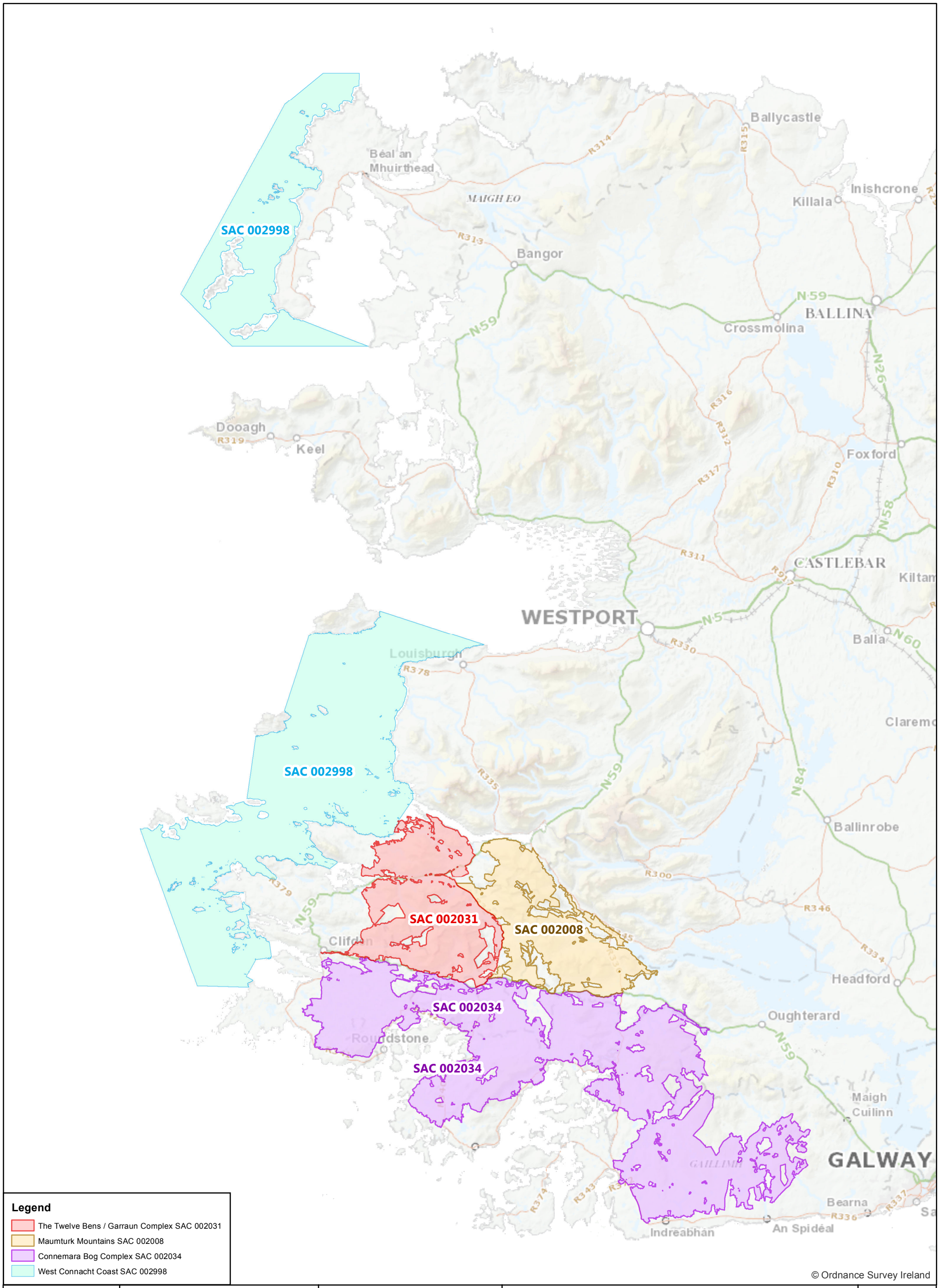
0 1 2 3 4 5 km

The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision.

Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Suirbhéaracht Ordonáis na hÉireann Ceadúnas

N

Map Version 1
Date: May 2017


SAC 002998
SAC 002998
SAC 002031
SAC 002008
SAC 002034
SAC 002034
Béal an Mhuirthead
MAIGH EO
Bangor
Ballycastle
Killala
Inishcrone
Crossmolina
BALLINA
Dooagh
Keel
Foxford
CASTLEBAR
WESTPORT
Louisburgh
Balla
Ballinrobe
Clifden
Roundstone
Oughterard
Maigh Cuilinn
GALWAY
Indreabhán
An Spidéal
Bearna
Headford
R314
R315
R313
N59
R316
R312
R317
R310
N58
R311
R917
N5
R330
N60
R378
R335
N84
R379
R300
R346
R334
R374
R343
R336
R337
N26
Legend
The Twelve Bens / Garraun Complex SAC 002031
Maumturk Mountains SAC 002008
Connemara Bog Complex SAC 002034
West Connacht Coast SAC 002998
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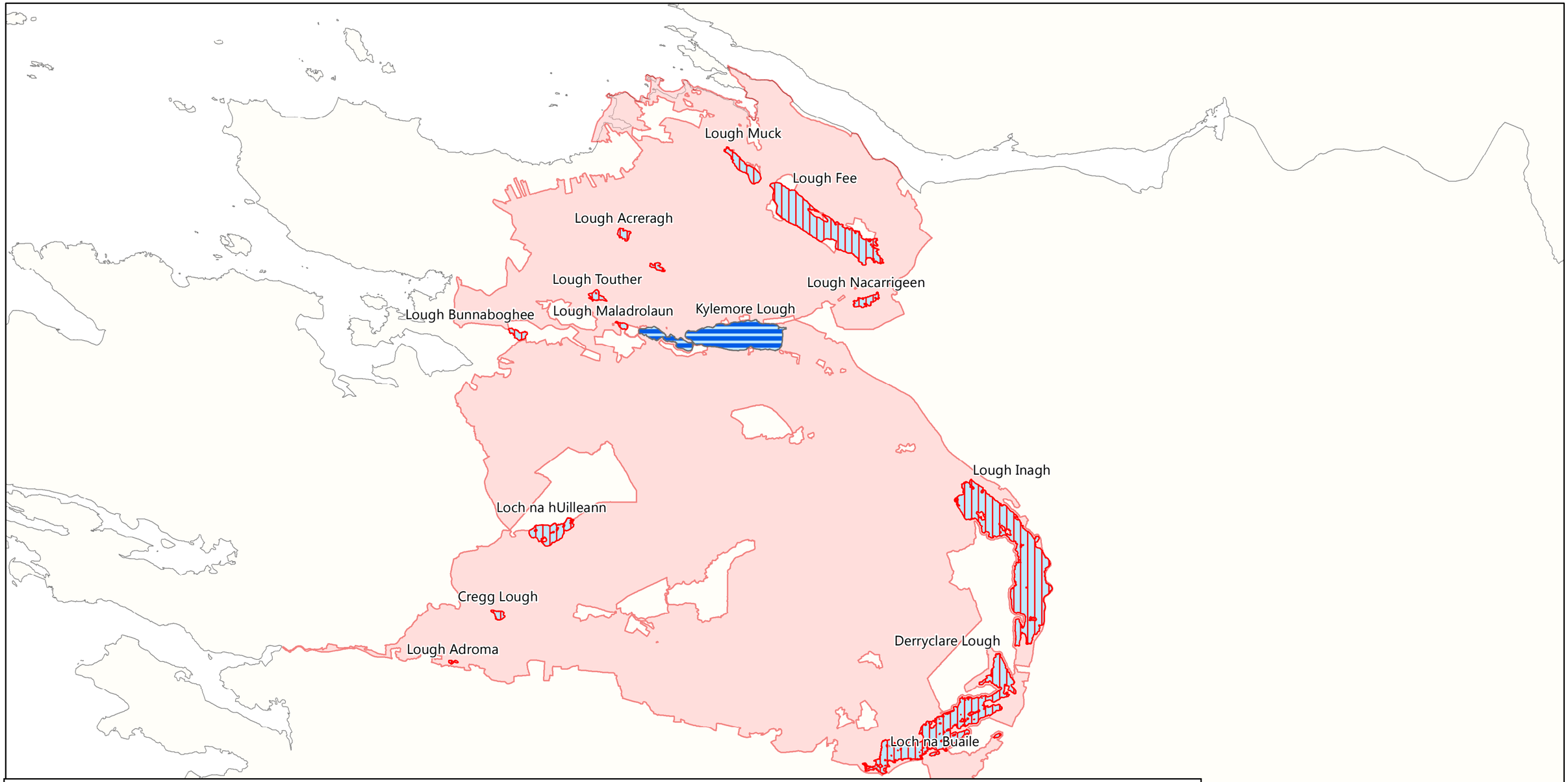
MAP 2:
THE TWELVE BENS / GARRAUN COMPLEX SAC
CONSERVATION OBJECTIVES
ADJACENT / ADJOINING AND
OVERLAPPING DESIGNATIONS
Map to be read in conjunction with the NPWS Conservation Objectives Document.
SITE CODE:
SAC 002031; version 3.01. SAC 002998; version 3.03
SAC 002008; version 3. SAC 002034 version 3.01.
CO. GALWAY
0 2.5 5 7.5 10 12.5 km
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision.
Ordnance Survey of Ireland Licence No EN 0059216. © Ordnance Survey of Ireland Government of Ireland
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Suirbhéarachta Ordonáis na hÉireann Ceadúnas
N
Map Version 1
Date: May 2017



Legend

The Twelve Bens / Garraun Complex SAC 002031

OSi Discovery Series County Boundary

Indicative Lake Habitats

Potential 3110 Potential oligotrophic waters containing very few minerals of sandy plains: Littorelletalia uniflorae

Potential 3130 / Potential 3110 Potential oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea / Potential oligotrophic waters containing very few minerals of sandy plains: Littorelletalia uniflorae

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MAP 3:
THE TWELVE BENS / GARRAUN COMPLEX SAC
CONSERVATION OBJECTIVES
INDICATIVE LAKE HABITATS

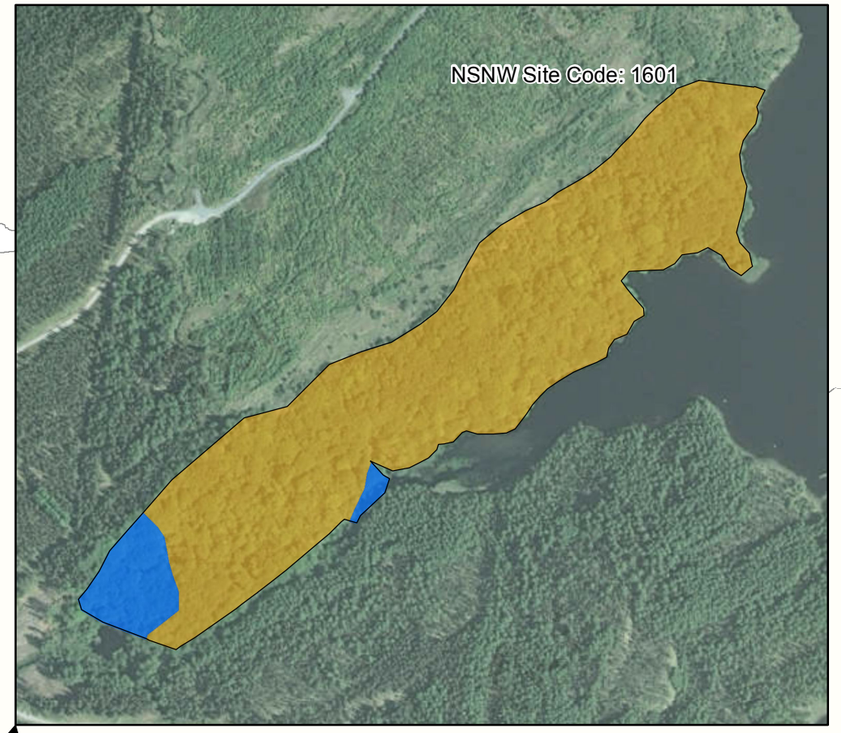
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 002031; version 3.01. CO. GALWAY

0 1 2 3 4 5 km

N

Map Version 1
Date: May 2017



Legend

Woodland Habitats Qualifying Interests

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

Woodland Habitats Non Qualifying Interests

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

The Twelve Bens / Garraun Complex SAC 002031

OSi Discovery Series County Boundary

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Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs

MAP 4:
THE TWELVE BENS / GARRAUN COMPLEX SAC
CONSERVATION OBJECTIVES
WOODLAND HABITATS

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

SITE CODE:
SAC 002031; version 3.01. CO. GALWAY

0 1 2 3 4 5 km

N

Map Version 1
Date: May 2017

Legend

- 1029 Freshwater Pearl Mussel *Margaritifera margaritifera* Distribution Target
- 1029 Freshwater Pearl Mussel *Margaritifera margaritifera* Suitable Habitat Target
- 1029 Freshwater Pearl Mussel *Margaritifera margaritifera* Catchment
- The Twelve Bens / Garraun Complex SAC 002031
- OSi Discovery Series County Boundary

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MAP 5:
THE TWELVE BENS / GARRAUN COMPLEX SAC
CONSERVATION OBJECTIVES
FRESHWATER PEARL MUSSEL

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

SITE CODE:
SAC 002031; version 3.01. CO. GALWAY

0 1 2 3 4 5 km

N

Map Version 1
Date: May 2017

Legend

- 1355 Otter *Lutra lutra* Commuting 250m
- The Twelve Bens / Garraun Complex SAC 002031
- OSi Discovery Series County Boundary

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MAP 6:
THE TWELVE BENS / GARRAUN COMPLEX SAC
CONSERVATION OBJECTIVES
OTTER COMMUTING

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

SITE CODE:
SAC 002031; version 3.01. CO. GALWAY

0 1 2 3 4 km

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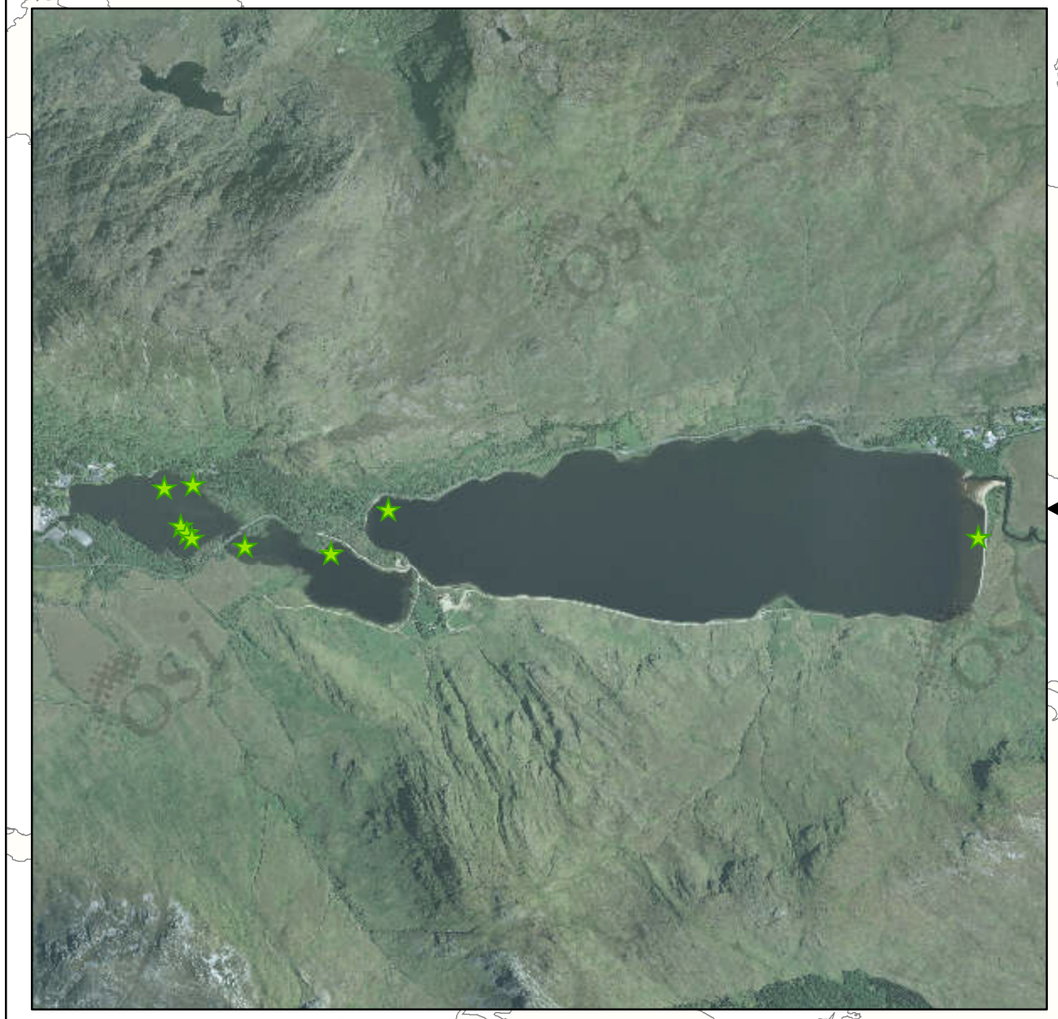
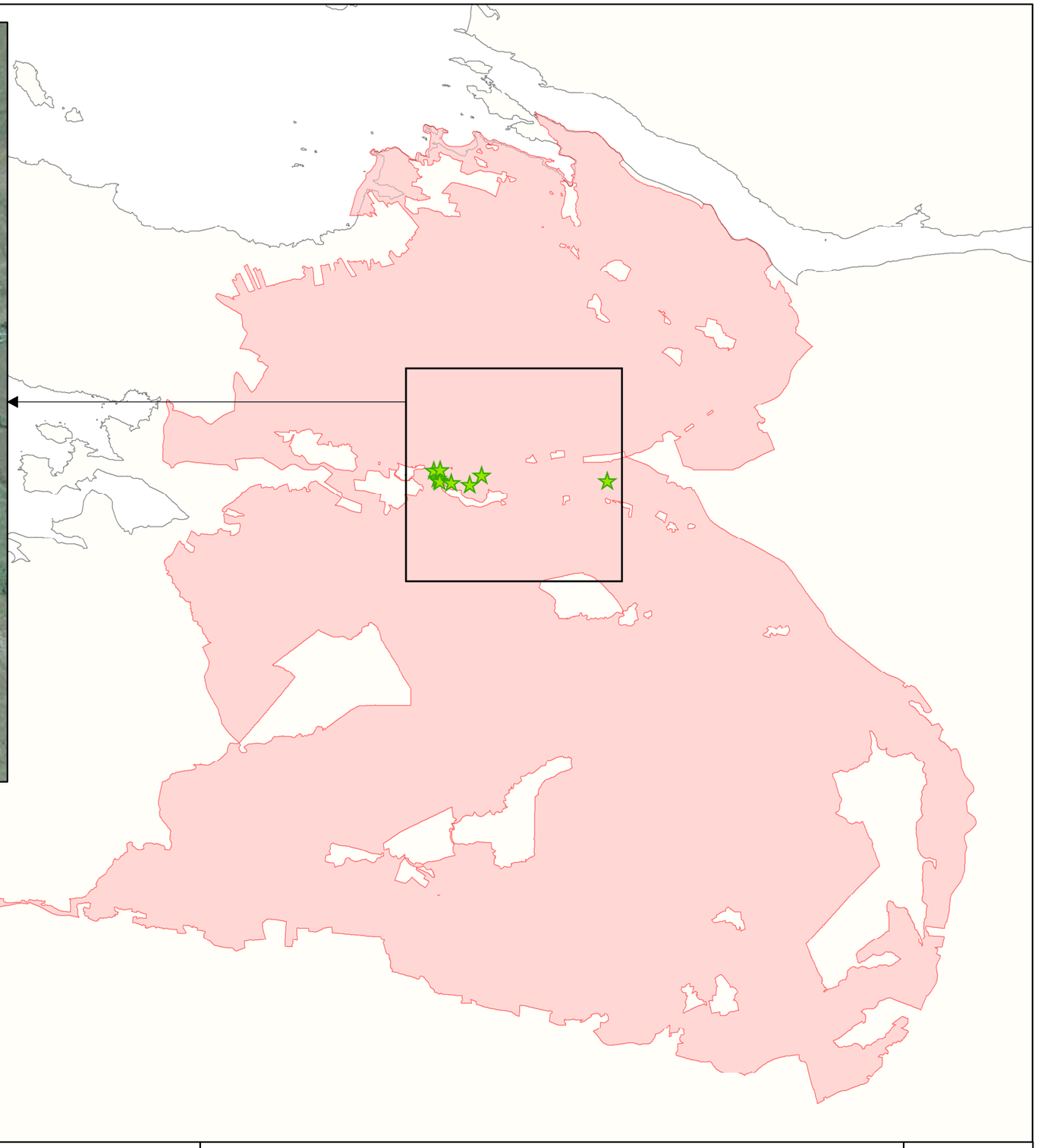
Map Version 1
Date: May 2017





Legend

- 1833 Sender Naiad *Najas flexilis*
- The Twelve Bens / Garraun Complex SAC 002031
- OSi Discovery Series County Boundary

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MAP 7:
THE TWELVE BENS / GARRAUN COMPLEX SAC
CONSERVATION OBJECTIVES
SLENDER NAIAD

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

SITE CODE:
SAC 002031; version 3.01. CO. GALWAY

0 1 2 3 4 5 km

N

Map Version 1
Date: May 2017