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Conservation Objectives Series

Glanmore Bog SAC 001879

An Roinn Ealaíon, Oidhreachta,
Gnóthaí Réigiúnacha, Tuaithe agus Gaeltachta

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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***

001879	Glanmore Bog SAC
1029	Freshwater Pearl Mussel *Margaritifera margaritifera*
1421	Killarney Fern *Trichomanes speciosum*
3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)
3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
4010	Northern Atlantic wet heaths with *Erica tetralix*
6230	Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)*
7130	Blanket bogs (* if active bog)

Please note that this SAC is adjacent to Kenmare River SAC (002158). See map 2. The conservation objectives for this site should be used in conjunction with those for the adjacent site as appropriate.

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

NPWS Documents

Year :	1976
Title :	Abbreviated report of a botanical and malacological study performed in the southwestern part of Ireland
Author :	Visser, G; Zoer, J.A.
Series :	Unpublished report to NPWS
Year :	1991
Title :	Survey to locate mountain blanket bogs of scientific interest in Ireland
Author :	Mooney, E.; Goodwillie, R.; Douglas, C.
Series :	Unpublished report to NPWS
Year :	1999
Title :	A survey of four rivers in the south-west of Ireland for the freshwater pearl mussel, *Margaritifera margaritifera* (L.)
Author :	Ross, E.
Series :	Unpublished report to Duchas, the Heritage Service
Year :	2005
Title :	Initiation of a monitoring program for the freshwater pearl mussel, *Margaritifera margaritifera* (L.), in the Ownagappul River
Author :	Ross, E.
Series :	Unpublished report to Duchas, the Heritage Service
Year :	2008
Title :	NS II Freshwater pearl mussel sub-basin management plans: Report on biological monitoring of surface water quality in the Owenagappul catchment
Author :	Conservation Services
Series :	Unpublished report to NPWS
Year :	2009
Title :	NS II Freshwater pearl mussel sub-basin management plans: Monitoring of the freshwater pearl mussel in the Owenagappul
Author :	Ross, 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 :	2010
Title :	Second draft Ownagappul freshwater pearl mussel sub-basin management plan (2009-2015) March 2010
Author :	NPWS
Series :	Unpublished document to Department of the 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 :	2013
Title :	Irish semi-natural grasslands survey 2007-2012
Author :	O'Neill, F.H.; Martin, J.R.; Devaney, F.M.; Perrin, P.M.
Series :	Irish Wildlife Manual No. 78

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 :	2015
Title :	Habitats Directive Annex I lake habitats: a working interpretation for the purposes of site-specific conservation objectives and Article 17 reporting
Author :	O Connor, Á.
Series :	Unpublished document by NPWS
Year :	2015
Title :	Monitoring methods for the Killarney fern (*Trichomanes speciosum* Willd.) in Ireland
Author :	Ní Dhúill, E.; Smyth, N.; Waldren, S.; Lynn, D.
Series :	Irish Wildlife Manual No. 82
Year :	2015
Title :	Visit to Ownagappul River 21 April 2015
Author :	Killeen, I.J.; Moorkens, E.A.
Series :	Unpublished report to 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 :	2017
Title :	Ownagappul River, 2014 *Margaritifera* monitoring results
Author :	Ross, E.
Series :	Unpublished report to NPWS
Year :	2017
Title :	Glanmore Bog SAC (site code: 1879) Conservation objectives supporting document- blanket bogs and associated habitats V1
Author :	NPWS
Series :	Conservation objectives supporting document

Other References

Year :	1972
Title :	Verslag van een botanisch/malacologische studiereis naar Z.W. Ierland
Author :	Visser, G.; Zoer, J.A.
Series :	Unpublished Report; Rijksinstituut voor Natuurbeheer, Leersum, Netherlands

Year :	1982
Title :	Eutrophication of waters. Monitoring assessment and control
Author :	OECD
Series :	OECD, Paris
Year :	1984
Title :	Studies on the biology of freshwater mussels (Lamellibranchia: Unionacea) in Ireland
Author :	Ross, E.D.
Series :	Unpublished MSc Thesis. National University of Ireland, Galway
Year :	2000
Title :	Colour in Irish lakes
Author :	Free, G.; Allott, N.; Mills, P.; Kennelly, C.; Day, S.
Series :	Verhandlungen Internationale Vereinigung für theoretische und angewandte Limnologie, 27: 2620-2623
Year :	2002
Title :	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 :	Ecology of watercourses characterised by Ranunculion fluitantis and Callitricho-Batrachion vegetation
Author :	Hatton-Ellis, T.W.; Grieve, N.
Series :	Conserving Natura 2000 Rivers Ecology Series No. 11. English Nature, Peterborough
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 :	2008
Title :	Water Quality in Ireland 2004-2006
Author :	Clabby, K.J.; Bradley, C.; Craig, M.; Daly, D.; Lucey, J.; McGarrigle, M.; O'Boyle, S.; Tierney, D.; Bowman, J.
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 :	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 :	2012
Title :	Rare and threatened bryophytes of Ireland
Author :	Lockhart, N.; Hodgetts, N.; Holyoak, D.
Series :	National Museums Northern Ireland
Year :	2013
Title :	Interpretation manual of European Union habitats- Eur 28
Author :	European Commission- DG Environment
Series :	European Commission
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 :	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 :	A narrative for conserving freshwater and wetland habitats in England
Author :	Mainstone, C.; Hall, R.; Diack, I.
Series :	Natural England Research Reports Number 064

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 (map 3)
Year :	2013
Title :	Irish Semi-Natural Grassland Survey
GIS Operations :	Dataset clipped to the SAC boundary. Expert opinion used as necessary to resolve any issues arising
Used For :	6230 (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 :	2012
Title :	Margaritifera Sensitive Areas data revision
GIS Operations :	Relevant catchment boundaries identified. Expert opinion used as necessary to resolve any issues arising
Used For :	1029 (map 5)

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 Glanmore Bog 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 Glenbeg Lough (see map 3) in Glanmore Bog SAC. Lake habitat 3130 may also occur in this lake. Lake habitat 3160 is likely to occur in the small ponds and pools in the SAC. Two measures of extent should be used: 1. the area of the lake itself and; 2. the extent of the vegetation communities/zones that typify the habitat. Further information relating to all attributes is provided in the lake habitats supporting document for the purposes of site-specific conservation objectives and Article 17 reporting (O Connor, 2015)
Habitat distribution	Occurrence	No decline, subject to natural processes	As noted above, lake habitat 3110 is likely to occur in Glenbeg Lough. 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). As part of their botanical and malacological study, Visser and Zoer (1972, 1976) recorded *Elatine hexandra, Isoetes lacustris, Littorella uniflora, Lobelia dortmanna, Nitella flexilis, Phragmites australis, Potamogeton natans, P. perfoliatus* and *Sparganium angustifolium* in Glenbeg Lough. The co-occurrence of *I. lacustris* and *P. perfoliatus* suggests that lake habitat 3130 may occur. Glenbeg Lough is a Water Framework Directive (WFD) monitoring lake and regular macrophyte surveys are conducted by the Environmental Protection Agency (EPA); species recorded include *Callitriche obtusangula, Fontinalis antipyretica, Isoetes lacustris, Juncus bulbosus, Littorella uniflora, Lobelia dortmanna, Myriophyllum alterniflorum, Nitella* sp., *Potamogeton natans* and *P. obtusifolius*
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. EPA biologists have recorded vegetation to at least 5.5m in Glenbeg Lough
Hydrological regime: water level fluctuations	Metres	Maintain/restore 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 and drainage. 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. There is a drinking water abstraction from Glenbeg Lough that may have altered the natural hydrological regime of that lake and the outflowing Ownagappul River (see the conservation objective for freshwater pearl mussel (1029))

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. Transport of substratum particles from Glenbeg Lough to the Ownagappul River may also be important, both in terms of the natural replenishment of coarse gravel and cobble required by freshwater pearl mussel (*Margaritifera margaritifera*) and impacts on that species through increased losses of fine sediment (see the conservation objective for freshwater pearl mussel (1029)). Information on substratum may be available for WFD monitoring lakes
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
Water quality: nutrients	µg/l P; mg/l N	Maintain/restore the concentration of nutrients in the water column to sufficiently low levels to support the habitat and its typical species	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. Glenbeg Lough failed the nutrient target in 2007-09 (McGarrigle et al., 2010), but passed in 2010-12 (Bradley et al., 2015). Nutrient export to the Ownagappul River and potential impacts on freshwater pearl mussel (*Margaritifera margaritifera*) must also be considered (see the conservation objective for freshwater pearl mussel (1029))
Water quality: phytoplankton biomass	µg/l Chlorophyll *a*	Restore appropriate water quality to support the habitat, including high chlorophyll *a* status	Oligotrophic and WFD 'high' status targets apply to lake habitat 3110. Where a lake has a chlorophyll *a* concentration that is lower than this target, there should be no decline within class, i.e. no upward trend in phytoplankton biomass. The average growing season (March-October) chlorophyll *a* concentration must be <5.8µg/l. The annual average chlorophyll *a* concentration should be <2.5µg/l and the annual peak chlorophyll *a* concentration should be ≤8.0µg/l. See also The European Communities Environmental Objectives (Surface Waters) Regulations 2009. Glenbeg Lough failed the target in 2010-12, having moderate chlorophyll *a* status (Bradley et al., 2015). The export of this biomass to the Ownagappul River is also a concern (see the conservation objective for freshwater pearl mussel (1029))
Water quality: phytoplankton composition	EPA phytoplankton composition metric	Restore appropriate water quality to support the habitat, including high phytoplankton composition status	The EPA has developed a phytoplankton composition metric for nutrient enrichment of Irish lakes. As for other water quality indicators, lake habitat 3110 requires WFD high status. Glenbeg Lough failed the target in 2010-12, having moderate phytoplankton composition status (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, lake habitat 3110 requires high phytobenthos status. Glenbeg Lough had high phytobenthos status in 2010-12 (Bradley et al., 2015). Losses of algal biomass to the Ownagappul River would be a concern (potential source of fine particulate matter, dissolved organic matter and nutrients) (see the conservation objective for freshwater pearl mussel (1029))
Water quality: macrophyte status	EPA macrophyte metric (The Free Index)	Restore high macrophyte status	Nutrient enrichment can favour more competitive submerged macrophyte species that out-compete the typical and characteristic species for the lake habitat. The EPA monitors macrophyte status for WFD purposes using the 'Free Index'. The target for lake habitat 3110 is high status or an Ecological Quality Ratio (EQR) for lake macrophytes of ≥0.90, as defined in Schedule Five of the European Communities Environmental Objectives (Surface Waters) Regulations 2009. Glenbeg Lough failed the target in 2010-12, having good macrophyte status (Bradley et al., 2015)
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 WFD acidification status 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 13mg/l PtCo in Glenbeg Lough

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. Loss of DOC and decomposer biomass could also impact significantly on freshwater pearl mussel (*Margaritifera margaritifera*) in the Ownagappul River (see the conservation objective for freshwater pearl mussel (1029))
Turbidity	Nephelometric turbidity units/ mg/l SS/ other appropriate unit	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. Loss of fine sediment from Glenbeg Lough could also impact significantly on freshwater pearl mussel (*Margaritifera margaritifera*) in the Ownagappul River (see the conservation objective for freshwater pearl mussel (1029))
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. Glenbeg Lough shoreline may have heath, grassland, swamp or marsh communities, but may be altered owing to drawdown from the abstraction. 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

3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

To maintain the favourable conservation condition of Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation in Glanmore Bog SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Kilometres	Area stable or increasing, subject to natural processes	The description of habitat 3260 covers from upland rivers with bryophytes and macroalgae to lowland depositing rivers with pondweeds and starworts. The selection of Glanmore Bog SAC used this broad interpretation. Conservation objectives for habitat 3260 concentrate on the high conservation value sub-types; however, little is known of the habitats distribution or its sub-types in the SAC. The Ownagappul, the main lowland river, has an important freshwater pearl mussel (*Margaritifera margaritifera*) population. The large numbers of upland tributaries of the Glanmore River warrant further investigation. All are likely to be macroalgal and bryophyte dominated. Note: rooted macrophytes should be absent/trace (<5% cover) in pearl mussel habitat. The freshwater pearl mussel (1029) conservation objective takes precedence over this objective for habitat 3260 in the Ownagappul River within this SAC because the mussel requires environmental conditions closer to natural background levels
Habitat distribution	Occurrence	No decline, subject to natural processes	Further study is needed of Irish sub-types and their conservation value to interpret the broad description of habitat 3260 (European Commission, 2013). As noted above, little is known about the distribution of the habitat and its sub-types in Glanmore Bog SAC. The rivers and streams are generally fast-flowing, with cascades and waterfalls, and are likely to be dominated by macroalgae and bryophytes, with limited submerged or emergent higher plants. The Near Threatened betony (*Betonica officinalis*) (Wyse Jackson et al., 2016) occurs on the heathy banks of the Ownagappul River in the vicinity of Cappul Bridge. The Annex II and Flora (Protection) Order, 2015 listed species Killarney fern (*Trichomanes speciosum*) has been recorded from streams on steep slopes in the SAC. A number of Near Threatened bryophytes of damp rock near streams and waterfalls are known to occur in the SAC (Lockhart et al., 2012). See also the conservation objective for Killarney fern (1421)
Hydrological regime: river flow	Metres per second	Maintain appropriate hydrological regimes	Any high conservation value sub-types in the SAC will be associated with natural hydrology. A natural flow regime is required for both plant communities and channel geomorphology to be in favourable condition, exhibiting typical dynamics for the river type (Hatton-Ellis and Grieve, 2003). For many of the sub-types of this habitat, high flows are required to maintain the substratum necessary for the characteristic species. Flow variation can be particularly important, with high and flood flows being critical to the hydromorphology. Peatlands also have slow-flowing or ponded streams and rivers, with biotic communities likely to resemble those in associated lakes. Note: artificially low flows are impacting freshwater pearl mussel (*Margaritifera margaritifera*) in the Ownagappul River. See also the conservation objective for freshwater pearl mussel (1029)

Hydrological regime: groundwater discharge	Metres per second	Maintain appropriate hydrological regime	The groundwater contribution to rivers in Glanmore Bog SAC is likely to be small, owing to the geology and dominance of blanket peat soils. Even small groundwater contributions, however, can significantly alter the hydrochemistry, particularly where there is basic bedrock and/or subsoils
Substratum composition: particle size range	Millimetres	Maintain appropriate substratum particle size range, quantity and quality, subject to natural processes	Many of the high conservation value sub-types are dominated by coarse substrata, and bedrock, boulders, cobbles and coarse gravels are likely to be common in this SAC. The size and distribution of particles is largely determined by the river flow. The chemical composition (particularly minerals and nutrients) of the substratum is also important. The quality of finer sediment particles is a notable driver for rooted plant communities. Note: increased fine sediment is contributing to the unfavourable condition of the freshwater pearl mussel (*Margaritifera margaritifera*) in the Ownagappul River. See the freshwater pearl mussel (1029) conservation objective
Water quality	Various	Maintain appropriate water quality to support the natural structure and functioning of the habitat	The specific targets may vary among sub-types. The rivers within Glanmore Bog SAC are considered to be naturally very nutrient-poor and, therefore, to typically require Water Framework Directive high status, in terms of nutrient and oxygenation standards, and EQRs (Ecological Quality Ratios) for macroinvertebrates and phytobenthos. Nutrient enrichment leading to increased algal biomass is impacting on the freshwater pearl mussel (*Margaritifera margaritifera*) in the Ownagappul River. See the freshwater pearl mussel (1029) conservation objective
Typical species	Occurrence	Maintain typical species in good condition, including appropriate distribution and abundance	The sub-types of this habitat are poorly understood and their typical species have not yet been fully defined. The typical species may include higher plants, bryophytes, macroalgae and microalgae, and invertebrates
Floodplain connectivity	Hectares	Maintain floodplain connectivity necessary to support the typical species and vegetation composition of the habitat	River connectivity with the floodplain is important for the functioning of this habitat. Channels with a naturally functioning floodplain are better able to maintain habitat and water quality (Hatton-Ellis and Grieve, 2003). Floodplain connectivity is particularly important in terms of sediment sorting and nutrient deposition. High conservation value rivers are intimately connected to floodplain habitats and function as important wildlife corridors, connecting otherwise isolated or fragmented habitats in the wider countryside (Hatton-Ellis and Grieve, 2003; Mainstone et al., 2016)
Fringing habitats	Hectares	Maintain marginal fringing habitats that support the typical species and vegetation composition of the habitat	Riparian habitats (including those along lake shores), particularly natural/semi-natural woodlands and wetlands, are an integral part of the structure and functioning of river systems, even where they do not form part of a natural floodplain. Fringing habitats can contribute to the aquatic food web (e.g. allochthonous matter such as leaf fall), provide habitat (refuge and resources) for certain life-stages of fish, birds and aquatic invertebrates, assist in the settlement of fine suspended material, protect banks from erosion and contribute to nutrient cycling. Shade may also be important in suppressing algal 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 rivers and streams in Glanmore Bog SAC are likely to be fringed by upland grassland, blanket bog, heath, flush/poor fen and possibly riparian woodland

4010 Northern Atlantic wet heaths with Erica tetralix

To restore the favourable conservation condition of Northern Atlantic wet heaths with *Erica tetralix* in Glanmore Bog 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	Northern Atlantic wet heaths with *Erica tetralix* has not been mapped in detail for Glanmore Bog SAC, but from current available data the total area of the qualifying habitat is estimated to be approximately 341ha, covering 30% of the SAC (NPWS internal files). Further details on this and the following attributes can be found in the Glanmore Bog 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 typically forms a mosaic with dry heath, upland grassland, exposed rocks and blanket bog (Mooney et al., 1991; NPWS internal files). Further information can be found within Mooney et al. (1991), 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 wet heath vegetation communities have been recorded in this SAC (Mooney et al., 1991; NPWS internal files), 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: cross-leaved heath	Occurrence within 20m of a representative number of monitoring stops	Cross-leaved heath (*Erica tetralix*) present within a 20m radius of each monitoring stop	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 50%	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	Total cover of *Cladonia* and *Sphagnum* species, *Racomitrium lanuginosum* and pleurocarpous mosses at least 10%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: ericoid species and crowberry	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of ericoid species and crowberry (*Empetrum nigrum*) at least 15%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: dwarf shrub species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of dwarf shrubs less than 75%	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 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 20%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: bracken	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of bracken (*Pteridium aquilinum*) less than 10%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: soft rush	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of soft rush (*Juncus effusus*) 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	Less than 33% collectively of the last complete growing season's shoots of ericoids, crowberry (*Empetrum nigrum*) and bog-myrtle (*Myrica gale*) 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 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)
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)

6230 Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)

To restore the favourable conservation condition of Species-rich *Nardus* grassland, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe)* in Glanmore Bog 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	Species-rich *Nardus* grassland, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe)* was recorded and mapped as part of the Irish Semi-natural Grassland Survey (ISGS) in the sub-site Glanmore (ISGS site code 402) (O'Neill et al., 2013) to give a minimum area of 6.5ha in Glanmore Bog SAC (see map 4). NB further unsurveyed areas may be present within the SAC. Further details on this and the following attributes can be found in the Glanmore Bog SAC conservation objectives supporting document for blanket bogs and associated habitats
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 4	The habitat occurs on the western facing hillside below the Eskatarriff/Tooreennamna ridge (O'Neill et al., 2013). NB further unsurveyed areas may be present within the SAC. Further information can be found within O'Neill et al. (2013) 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	O'Neill et al. (2013) recorded a variety of species-rich *Nardus* grassland* vegetation communities in this SAC, one of which corresponds to a community 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: high quality indicator species	Number of species at a representative number of 2m x 2m monitoring stops	At least two high quality indicator species for base-rich examples of the habitat and at least one for base-poor examples of the habitat	Attribute and target based on Perrin et al. (2014), where the list of positive indicator species for this habitat is also presented
Vegetation composition: species richness	Number of species at a representative number of 2m x 2m monitoring stops	Species richness at each monitoring stop at least 25	Attribute and target based on Perrin et al. (2014)
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 or equal to 1%	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	Cover of negative indicator species individually less than or equal to 10% and collectively less than or equal to 20%	Attribute and target based on Perrin et al. (2014), where the list of negative indicator species for this habitat is also presented
Vegetation composition: *Sphagnum* cover	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of *Sphagnum* species less than or equal to 10%	Attribute and target based on Perrin et al. (2014)

Vegetation composition: *Polytrichum* cover	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of *Polytrichum* species less than or equal to 25%	Attribute and target based on Perrin et al. (2014)
Vegetation composition: shrubs, bracken and heath cover	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of shrubs, bracken (*Pteridium aquilinum*) and heath collectively less than or equal to 5%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: forb to graminoid ratio	Percentage cover at a representative number of 2m x 2m monitoring stops	Forb component of forb:graminoid ratio is 20-90%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: sward height	Sward height at a representative number of 2m x 2m monitoring stops	Proportion of the sward between 5cm and 50cm tall is at least 25%	Attribute and target based on Perrin et al. (2014)
Vegetation structure: litter cover	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of litter less than or equal to 20%	Attribute and target based on Perrin et al. (2014)
Physical structure: disturbed bare ground	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of disturbed bare ground less than or equal to 10%	Attribute and target based on Perrin et al. (2014)
Physical structure: grazing or disturbance	Area in local vicinity of a representative number of monitoring stops	Area of the habitat showing signs of serious grazing or disturbance less than 20m²	Attribute and target based on 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)

7130 Blanket bogs (* if active bog)

To restore the favourable conservation condition of Blanket bogs (* if active bog) in Glanmore Bog 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 Glanmore Bog SAC, but from current available data the total area of the qualifying habitat is estimated to be approximately 308ha, covering 27% of the SAC (NPWS internal files). Further details on this and the following attributes can be found in the Glanmore Bog SAC conservation objectives supporting document for blanket bogs and associated habitats
Habitat distribution	Occurrence	No decline, subject to natural processes	The habitat occurs on the stream valley floor at Glanmore, on the ridge near Eskatarriff and at Bunskellig (Mooney et al., 1991; NPWS internal files). Further information can be found within Mooney et al. (1991), 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 (Mooney et al., 1991; NPWS internal files), 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: 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)

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 and/or the red data lists (Lockhart et al., 2012; Wyse Jackson et al., 2016). The Near Threatened moss *Campylopus shawii* (Lockhart et al., 2012) occurs within flushed areas of the blanket bog in the SAC (NPWS internal files)

1029 Freshwater Pearl Mussel *Margaritifera margaritifera*

To restore the favourable conservation condition of Freshwater Pearl Mussel in Glanmore Bog SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Kilometres	Maintain distribution at 4.5km. See map 5	The conservation objective applies to the Ownagappul freshwater pearl mussel (*Margaritifera margaritifera*) population in Glanmore Bog SAC, which is of international importance and one of eight Irish populations prioritised for conservation action (Moorkens, 2010; NPWS, 2010). The distribution and abundance of the freshwater pearl mussel in the Ownagappul catchment was mapped by Ross (1999, 2005). The species extends through the Ownagappul from c.200m downstream of Glenbeg Lough to the brackish water c.100m downstream of the confluence of the Barrees Stream. It is also found in the lower stretch of the Lough Fadda Stream and through the Barrees Stream from above the Lough Fadda Stream confluence to the Ownagappul confluence. The target is for the species to be sufficiently widespread to maintain itself on a long-term basis as a viable component of the Ownagappul system. See NPWS (2010) for further information
Population size	Number of adult mussels	Restore Ownagappul population to at least 200,000 adult mussels	The Ownagappul population was estimated as 200,598 (Ross, 1999). Mussels were categorised as abundant along much of the Ownagappul channel, occasional in the Lough Fadda Stream and rare to abundant in the Barrees Stream (Ross, 1999, 2005). The maximum densities recorded in 1999 and 2005 were c.84/m² and c.184/m² (Ross, 1999, 2005) and average density in transects ranged from 1/m² to 28.6/m² (Ross, 2005). NPWS (2013) assumed that all priority populations had declined at a rate of 1% per year 2007-2012. Ross (2017) recorded a dramatic decline in adults in the lower Ownagappul. A kill of both adult and juvenile mussels was recorded in April 2015 resulting from hydromorphological changes and emersion of mussels (Killeen and Moorkens, 2015). The target is for the species to be sufficiently abundant to maintain itself on a long-term basis as a viable component of the Ownagappul 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 ≤65mm are considered 'young mussels' and may be found buried in the substratum and/or beneath adult mussels. Mussels ≤30mm are 'juvenile mussels' and are always buried in the substratum. See the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009. The Sub-basin Management Plan (NPWS, 2010) summarises the demographic work up to 2010 (Ross, 1984, 1999, 2005). In 2005, the smallest mussel was 10.8mm and 15% was ≤30mm (Ross, 2005). In 2009, the Ownagappul failed the ≤30mm target, with no juveniles recorded, but passed the young mussel target with 34.5% ≤65mm (Ross, 1999; NPWS, 2010). In 2014, the Ownagappul failed both targets and the smallest mussel (64.9mm) was the only mussel ≤65mm (Ross, 2017). The Ownagappul 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 Ownagappul 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 Ownagappul passed both targets in 2009 (Ross, 2009; NPWS, 2010). It failed both in 2014, when declines of 34% and 54% were recorded from the 2005 baseline, as well as 15% and 8% dead shells, at Transects 7 and 8 respectively (Ross, 2017). In 2015, a significant kill of both adult and juvenile mussels was recorded (Killeen and Moorkens, 2015). 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 Ownagappul system
Suitable habitat: extent	Kilometres	Restore suitable habitat in more than 4.5km in the Ownagappul system (see map 5) and any additional stretches necessary for salmonid spawning	The extent of the mussel habitat in the Ownagappul system is well-documented; it was first mapped in 1999 (Ross, 1999) and full baseline monitoring took place in 2005 (Ross, 2005). Most of the available habitat in the Ownagappul system is occupied by adult mussels; however, it is unsuitable for juvenile recruitment (Ross, 2009, 2017; NPWS, 2010; Killeen and Moorkens, 2015). Hydromorphological changes are a particular 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 Ownagappul 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 habitat 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 Ownagappul cannot support sufficient juvenile and adult 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 Ownagappul 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 Ownagappul system failed the macroinvertebrate target, but passed the diatom target (Conservation Services, 2008; 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 Ownagappul 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 Ownagappul failed both targets in 2009 (NPWS, 2010). It failed the algal target in 2014 (Ross, 2017). Data suggest that filamentous algal growth is a bigger concern than macrophytes for the Ownagappul freshwater pearl mussel habitat. Bacterial and fungal growth, and detritus accumulation are also significant concerns (Killeen and Moorkens, 2015; Ross, 2017). It is likely that waste material from livestock, decomposition of algae and allochthonous organic inputs are giving rise to the observed heterotrophic enrichment and detritus. 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 Ownagappul 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	Although silt plumes were not recorded at the two transects examined in 2009, overall, the Ownagappul failed the target as peaty-silt was recorded at a number of locations (Conservation Services, 2008; NPWS, 2010). A heavy silt plume and silt cover of up to 80% were recorded at Transect 7 in 2014 (Ross, 2017). Killeen and Moorkens (2015) recorded silt, along with decaying algae and iron/faecal bacterial growths, in acutely anoxic substrate. Sufficient survival of juvenile and adult 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 Ownagappul 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. Redox was not measured in the Ownagappul in 2009. In 2015, the average redox was 23.4% in the Ownagappul, with few patches of habitat having values below 20% (Ross, 2017). 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 Ownagappul system
Hydrological regime: flow variability	Metres per second	Restore appropriate hydrological regime	The availability of suitable 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. Artificially low flows are impacting Ownagappul mussels. 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 Ownagappul system

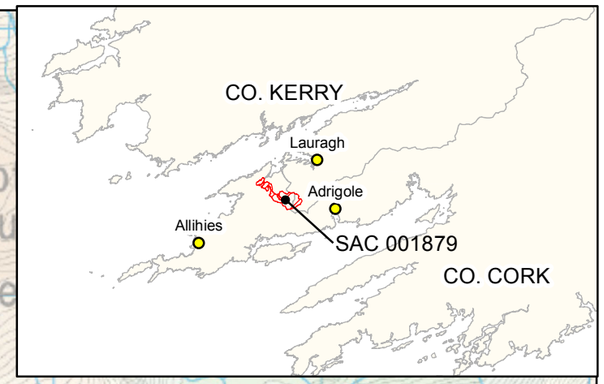
Host fish	Number	Maintain sufficient juvenile salmonids to host glochidial larvae	Salmonid fish are host to the larval stage of the freshwater pearl mussel and, thus, are essential to completion of the life cycle. 0+ and 1+ fish are typically used, both because of habitat overlaps and the development 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 not found on either salmon or trout in the Ownagappul (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, and 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, 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. Fringing habitats are also 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 Ownagappul system

1421 Killarney Fern *Trichomanes speciosum*

To maintain the favourable conservation condition of Killarney Fern in Glanmore Bog SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Distribution	Occurrence	No loss in geographical spread of populations, subject to natural processes	Killarney fern (*Trichomanes speciosum*) has been recorded from one area in Glanmore Bog SAC, within hectad V75. Exact locations are not mapped here on account of the threat posed by illegal collecting. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Number of populations	Number	No decline, subject to natural processes	One population of the species is known from the SAC. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Number of colonies	Number	No decline, subject to natural processes	The number of colonies is estimated to be three (possibly two). The species has been recorded on three occasions from the SAC, in 1967, 1979 and 2014, and each record would appear to relate to a different colony. However, on account of the use of different map bases and the lack of GPS technology in earlier surveys, it is possible that the records may actually refer to only two colonies; further survey to establish the distribution and extent of the species in the SAC is recommended. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Population: life-cycle stage	Type (sporophyte or gametophyte)	Maintain life-cycle stage composition of populations, subject to natural processes	Only the sporophyte (frond) stage has been recorded from the SAC. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Population size: area of occupancy	Square metres	No decline, subject to natural processes	Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Population size: living sporophyte fronds	Number	No decline, subject to natural processes	Estimated to be 15-16 (6 recorded in the 1967 colony, 3-4 in the 1979 colony and 6 in the 2014 colony). Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Population structure: young and unfurling fronds	Occurrence	Young (not fully expanded) and/or unfurling (crozier) fronds present in populations previously observed to have these, subject to natural processes	Young and/or unfurling fronds have not been recorded from the SAC to date. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Population structure: fertile fronds	Occurrence	Fertile fronds present in populations previously observed to have these, subject to natural processes	Fertile fronds have not been recorded from the SAC to date. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Population structure: juvenile sporophyte fronds emerging from gametophytes	Number	No decline, subject to natural processes	Juvenile sporophyte fronds emerging from gametophytes have not been recorded from the SAC to date. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Habitat extent	Hectares	No loss of suitable habitat, subject to natural processes	The species grows in deeply shaded, humid situations - dripping caves, overhangs and crevices on cliffs, rocky slopes, by waterfalls, in stream ravines and gullies, on rock or soil banks in woodlands and, occasionally, under fallen trees and on the floor of damp woodlands. Whilst also occurring in these habitats, the gametophyte (filamentous) stage can grow in drier areas that do not suit the sporophyte. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files

Hydrological conditions: wet/damp microhabitats	Occurrence	Maintain hydrological conditions at the locations of known populations - visible water source, with dripping or seeping water present and/or substrate wet/damp to touch, subject to natural processes	Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Hydrological conditions: relative humidity	Percentage	Maintain relative humidity levels at known colonies at not less than 80%, subject to natural processes	Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Hydrological conditions: desiccated fronds	Number	No increase, subject to natural processes	Presence of desiccated sporophyte fronds and gametophyte mats is indicative of unsuitable conditions. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Light levels: shading	Shade index score	At least 4 for woodland sporophyte-only and mixed colonies; at least 5 for open upland sporophyte-only and mixed colonies; at least 6 for gametophyte-only colonies, subject to natural processes	Shade Index: 4. Moderate shade, e.g. light-medium deciduous canopy with sun flecks. 5. Permanently shaded from direct sunlight but otherwise open to sky. 6. Deep woodland (e.g. coniferous or in ravine) shade, no sun flecks. 7. Perpetual deep shade, e.g. cave entrance, beneath boulder. Woodland colonies have not been recorded from the SAC to date. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Woodland canopy cover	Percentage	No loss of woodland canopy at, or in the vicinity of, the locations of known populations and canopy cover here maintained at more than 33%, subject to natural processes	Woodland management at or near to locations of known populations of the species must take account of its habitat requirements, in particular with regard to maintenance of sufficient canopy cover. Woodland colonies have not been recorded from the SAC to date. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files
Invasive species	Occurrence	Maintain absence of invasive non-native and vigorous native plant species at the locations of known populations or, if present, maintain vegetation cover of these at less than 10%, taking into account the habitat requirements of *T. speciosum*	In order to avoid negative impacts on the Killarney fern (*Trichomanes speciosum*), its habitat requirements (site hydrology, relative humidity, canopy cover, shading levels, etc.) must be taken into account in locations that are subject to or proposed for management actions to control invasive non-native and/or vigorous native plant species. Based on Ní Dhúill et al. (2015), NPWS (2013) and NPWS internal files



Legend

Glanmore Bog SAC 001879

An Roinn Ealaíon, Oidhreachta, Gnóthaí Réigiúnacha, Tuaithe agus Gaeltachta
Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs

MAP 1:
GLANMORE BOG SAC
CONSERVATION OBJECTIVES
SAC DESIGNATION

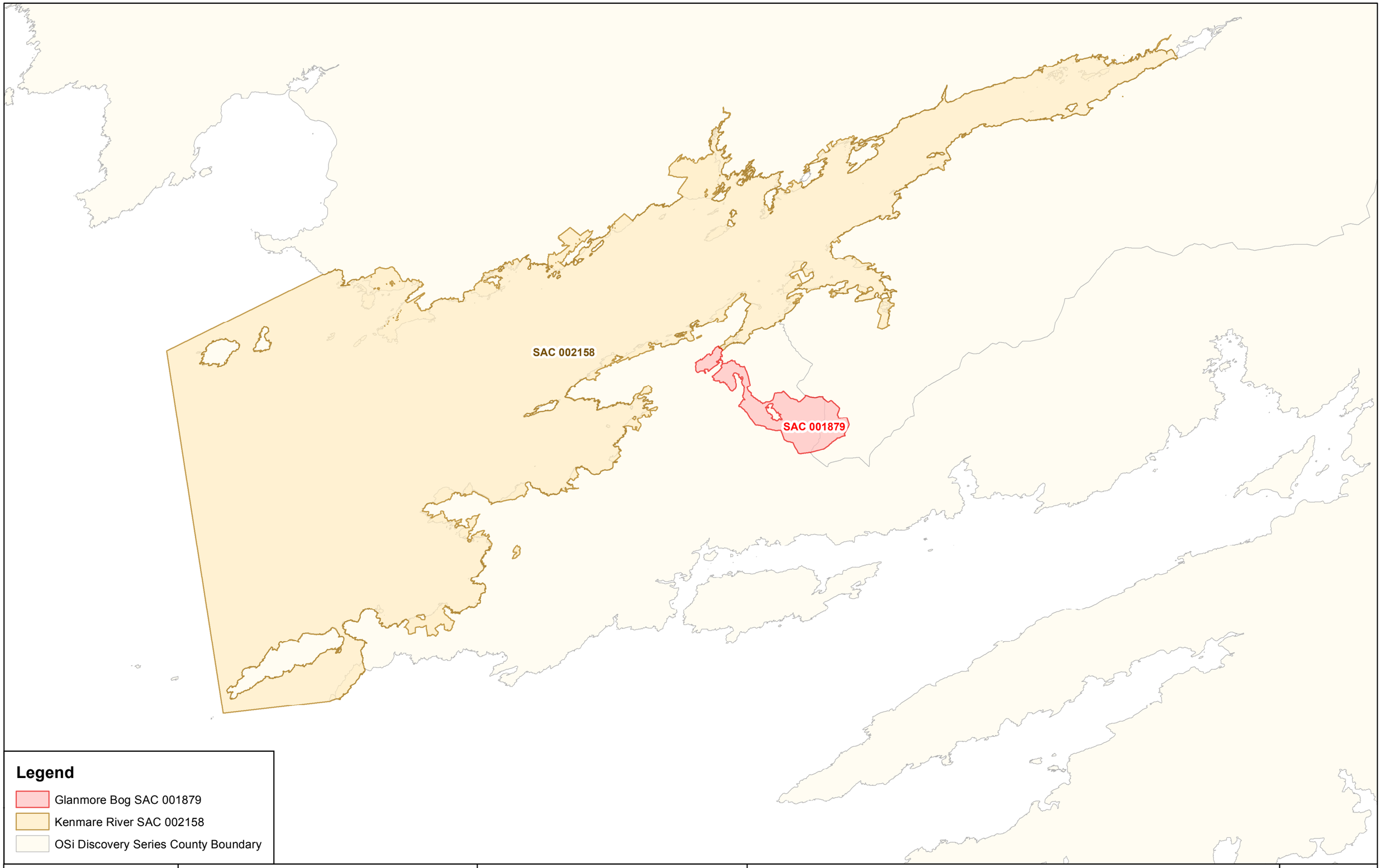
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001879; version 3.01.
CO. KERRY/ CO. CORK

0 0.25 0.5 0.75 1 km

N

Map Version 1
Date: May 2017



Legend

- Glanmore Bog SAC 001879
- Kenmare River SAC 002158
- OSi Discovery Series County Boundary

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

MAP 2: GLANMORE BOG SAC CONSERVATION OBJECTIVES ADJACENT / ADJOINING AND OVERLAPPING DESIGNATIONS

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

SITE CODE:
SAC 001879; version 3.01. SAC 002158; version 3.03.
Co. Cork / Kerry

0 1.5 3 4.5 6 km

N

Map Version 1
Date: May 2017

Glenbeg Lough

Legend

- Glanmore Bog SAC 001879
- Potential 3110 Potential oligotrophic waters containing very few minerals of sandy plains: Littorelletalia uniflorae.
- OSi Discovery Series County Boundary

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MAP 3:
GLANMORE BOG SAC
CONSERVATION OBJECTIVES
INDICATIVE LAKE HABITATS

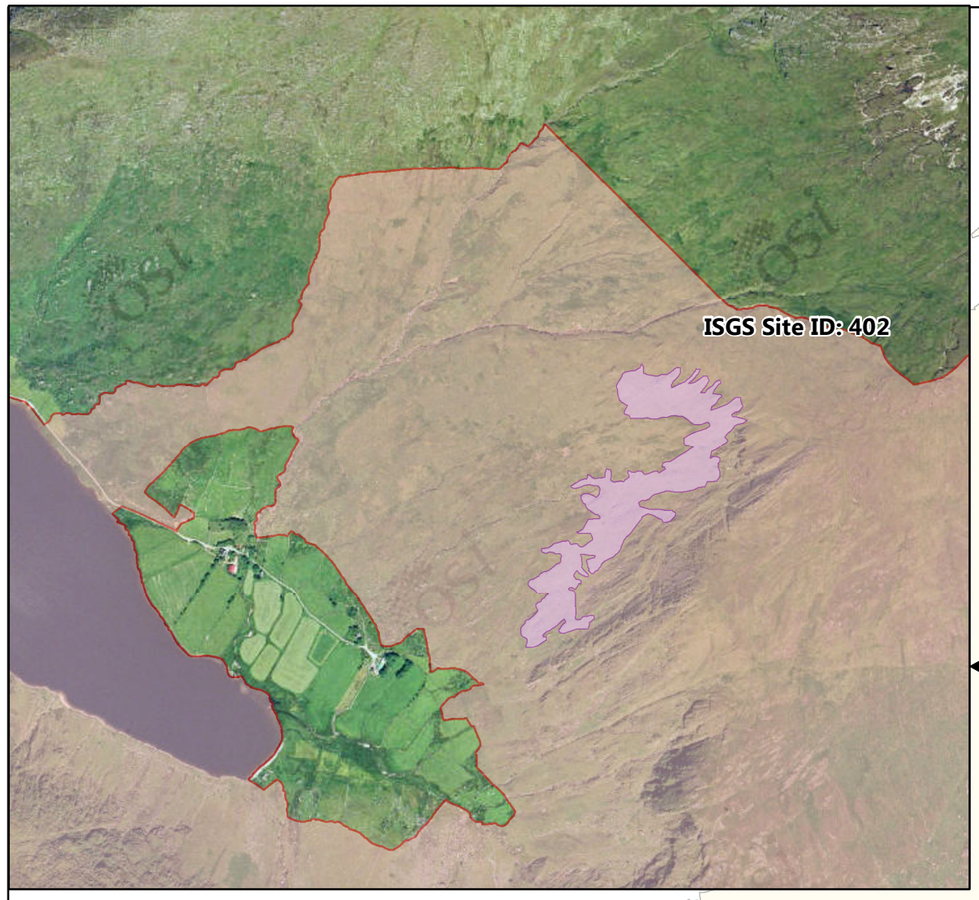
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE:
SAC 001879; version 3.01.
CO. CORK / CO. KERRY

0 0.3 0.6 0.9 1.2 km

N

Map Version 1
Date: May 2017



Legend

- 6230 Species-rich *Nardus* grassland, on siliceous substrates in mountain areas (and submountain areas in continental Europe)
- Glanmore Bog SAC 001879
- OSi Discovery Series County Boundary

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

MAP 4:
GLANMORE BOG SAC
CONSERVATION OBJECTIVES
GRASSLAND HABITATS

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

SITE CODE:
SAC 001879; version 3.01.
CO. CORK / CO. KERRY

0 0.5 1 1.5 2 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
- Glanmore Bog SAC 001879
- OSi Discovery Series County Boundary

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MAP 5:
GLANMORE BOG SAC
CONSERVATION OBJECTIVES
FRESHWATER PEARL MUSSEL

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

SITE CODE:
SAC 001879; version 3.01.
CO. CORK / CO. KERRY

0 0.4 0.8 1.2 1.6 km

N

Map Version 1
Date: May 2017