NPWS

Lough Cahasy, Lough Baun and Roonah Lough SAC (site code: 001529)

Conservation objectives supporting document- Coastal habitats

Version 1

January 2017

Contents

Please note that the opinions expressed in the site reports from the Coastal Monitoring Project (CMP) are those of the authors and do not necessarily reflect the opinion or policy of NPWS.

Please note that this document should be read in conjunction with the following report: NPWS (2017) Conservation Objectives: Lough Cahasy, Lough Baun and Roonah Lough SAC 001529. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

1 Introduction

Achieving Favourable Conservation Status (FCS) is the overall objective to be reached for all Annex I habitat types and Annex II species of European Community interest listed in the Habitats Directive 92/43/EEC (European Commission, 2013). It is defined in positive terms, such that a habitat type or species must be prospering and have good prospects of continuing to do so.

Lough Cahasy, Lough Baun and Roonah Lough SAC is situated 1.5km south of Roonah Quay and 7km south-west of Louisburgh, Co. Mayo. It comprises a complex of coastal habitats forming a dynamic system of dunes, shingle bars and a lagoon (Roonah Lough). Lough Cahasy and Lough Baun are classified as freshwater lakes, but may be subject to some brackish influences at times. A sandy beach occurs along the shoreline, with outcrops of exposed bedrock. The main landuse within the site is grazing, with recreational activities occurring along the beaches and sand dunes (NPWS, 2013).

Lough Cahasy, Lough Baun and Roonah Lough SAC (site code: 001529) is selected for perennial vegetation of stony banks, coastal lagoons and shifting dunes. The following two coastal habitats are included in the list of Qualifying Interests for the SAC:

1220	Perennial vegetation of stony banks
2120	Shifting dunes along the shoreline with *Ammophila arenaria*

The known distribution of perennial vegetation of stony banks and sand dune habitats within the SAC is presented in Appendix I.

2 Conservation Objectives

A conservation objective aims to define the favourable conservation condition of a habitat or species at a particular site. Implementation of the objective will help to ensure that the habitat or species achieves favourable conservation status at a national level.

This supporting document sets out the conservation objectives for the two coastal habitats listed above in Lough Cahasy, Lough Baun and Roonah Lough SAC, which are defined by a list of parameters, attributes and targets. The main parameters are (a) Range (b) Area and (c) Structure and Functions, the last of which is broken down into a number of attributes, including physical structure, vegetation structure and vegetation composition.

The targets set for **perennial vegetation of stony banks** are based in part on the findings of the National Shingle Beach Survey (NSBS), which was carried out in 1999 on behalf of the National Parks and Wildlife Service (NPWS) (Moore and Wilson, 1999).

The NSBS visited the following two sub-sites within Lough Cahasy, Lough Baun and Roonah Lough SAC:

1. White Strand (NSBS site ID: 0054)
2. Sruhir Strand (NSBS site ID: 0055)

Profiles and transects were recorded from each shingle beach and each site was assigned a crude High/Medium/Low interest ranking. A 'high interest' ranking denotes a site that is of high conservation value. The site may be of interest botanically or geomorphologically. A 'medium interest' ranking implies the site may be extensive but not of particular interest either botanically or geomorphologically. A 'low interest' ranking is reserved for small sites, highly damaged sites or sites that are of a very common classification.

Both White Strand and Sruhir Strand, while both extensive areas of boulders and cobble, were rated as being of medium interest due to sparse vegetation. The shingle habitat at both sites is classified as a vegetated lagoonal system type (Moore and Wilson, 1999).

The Coastal Monitoring Project (CMP) also noted the presence of vegetated shingle within the sub-site Lough Cahasy (CMP site ID: 109) (Ryle *et al*., 2009).

The vegetated shingle habitat was not mapped at any of the sub-sites, but the vegetation was recorded, as were the human impacts and alterations at the site, which are useful tools for assessing the Structure and Functions of the habitat.

The targets set for the **sand dune habitats** are based primarily on the results of the Coastal Monitoring Project (Ryle *et al*., 2009) and this document should be read in conjunction with that report.

The CMP surveyed, mapped and assessed a single sub-site associated with Lough Cahasy, Lough Baun and Roonah Lough SAC (Ryle *et al*., 2009):

Lough Cahasy (CMP site ID: 109)

The distribution of sand dune habitats within Lough Cahasy, Lough Baun and Roonah Lough SAC is presented in Appendix I. As part of the Coastal Monitoring Project (CMP), a detailed individual report and habitat map were produced for the Lough Cahasy sub-site and these are included in Appendix II.

The conservation objectives for the sand dune habitats in Lough Cahasy, Lough Baun and Roonah Lough SAC are based on the findings of the CMP, combined with the results of Gaynor (2008). It is thought that the sub-site as surveyed by the CMP represents the entire area of sand dunes within Lough Cahasy, Lough Baun and Roonah Lough SAC.

3 Perennial vegetation of stony banks

Perennial vegetation of stony banks is vegetation that is found at or above the mean high water spring tide mark on shingle beaches (i.e. beaches composed of cobbles and pebbles). It is dominated by perennial species (i.e. plants that continue to grow from year to year). The first species to colonise are annuals or short-lived perennials that are tolerant of periodic displacement or overtopping by high tides and storms. Level, or gently-sloping, high-level mobile beaches, with limited human disturbance, support the best examples of this vegetation. More permanent ridges are formed by storm waves. Several of these storm beaches may be piled against each other to form extensive structures.

3.1 Overall Objective

The overall objective for 'Perennial vegetation of stony banks' in Lough Cahasy, Lough Baun and Roonah Lough SAC is to '*maintain the favourable conservation condition'*.

This objective is based on an assessment of the recorded condition of the habitat under a range of attributes and targets. The assessment is divided into three main headings: (a) Range, (b) Area and (c) Structure and Functions.

3.2 Area

3.2.1 Habitat extent

Habitat extent is a basic attribute to be assessed when determining the condition of a particular habitat. The target for favourable condition is that there is no decrease in extent from the established baseline. Bearing in mind that coastal systems are naturally dynamic and subject to change, even within a season, this target is assessed subject to natural processes, including erosion and succession.

The exact current extent of this habitat in Lough Cahasy, Lough Baun and Roonah Lough SAC is unknown.

The NSBS described the site at White Strand as a sizable mixed cobble and boulder barrier and at Sruhir Strand as a massive expanse of boulders and cobble. Both sites are sparsely vegetated however (Moore and Wilson, 1999).

The Coastal Monitoring Project (CMP) described an extensive and high boulder/shingle ridge occurring along much of the shoreline within the Lough Cahasy sub-site, although much of this was unvegetated (Ryle *et al*., 2009).

The sparse vegetation cover is likely to be a direct reflection of the highly dynamic nature of the site, which frequently overwashes in storm conditions.

The general target is that the area should be stable or increasing, subject to natural processes, including erosion and succession.

3.3 Range

3.3.1 Habitat distribution

The full distribution of vegetated shingle within Lough Cahasy, Lough Baun and Roonah Lough SAC is unknown; however, the recorded location of shingle sites in the SAC is presented in Appendix I.

Lough Cahasy is fronted by a shingle bar. An extensive and high boulder/shingle ridge occurs along much of the shoreline at this site (Ryle *et al*., 2009). The site is of ecological importance owing in part to the extent and volume of the shingle/cobble that has built up along the ridge (Ryle *et al*., 2009).

White Strand is divided from Sruhir Strand by the mixed sand and gravel beach at Gortnagarryan (Moore and Wilson, 1999).

The target is that there should be no decline or change in the distribution of this habitat, unless it is the result of natural processes, including erosion and succession.

3.4 Structure and Functions

A fundamental aim of shingle conservation is to facilitate natural mobility. Shingle beaches are naturally dynamic systems, making them of geomorphological interest, as well as ecological interest. They are constantly changing and shingle features are rarely stable in the long term.

3.4.1 Physical structure: functionality and sediment supply

The health and on-going development of this habitat relies on a continuing supply of shingle sediment. This may occur sporadically as a response to storm events rather than continuously. Interference with the natural coastal processes, through offshore extraction or coastal defence structures in particular, can interrupt the supply of sediment and lead to beach starvation.

The shingle beaches within Lough Cahasy, Lough Baun and Roonah Lough SAC consist of shingle bars and cobble banks, which occur along much of the shoreline and are largely unvegetated due to their exposure and highly dynamic nature (Ryle *et al*., 2009).

A major threat to coastal habitats is the removal of beach material including sand and shingle (Ryle *et al*., 2009). Extraction was noted as an impact at Sruhir Strand by the NSBS (Moore and Wilson, 1999), although there was little obvious evidence that it was occurring at the time of the CMP survey (Ryle *et al*., 2009).

The target is to maintain, or where necessary restore, the natural circulation of sediment and organic matter, without any physical obstructions.

3.4.2 Vegetation structure: zonation

Ecological variation in this habitat type depends on stability, the amount of fine material accumulating between the pebbles, climatic conditions, width of the foreshore and past management of the site. The ridges and lows also influence the vegetation patterns, resulting in characteristic zonations of vegetated and bare shingle. In the frontal, less stable areas of shingle, the vegetation tends to be dominated by annuals and short-lived salt-tolerant perennials. Where the shingle is more stable, the vegetation becomes more perennial in nature and may include grassland, heathland and scrub, depending on the exact nature of the site. The presence of lichens indicates long term stability of the shingle structure. Transitions to sand dune habitats occur at this site.

The boulder/shingle ridge that runs the length of the site is backed by sand hills and dune grassland. Below the boulder/shingle ridge is a fine sandy beach (NPWS, 2013).

The NSBS noted that the cobble and boulder barrier at White Strand was backed by wet fields prone to flooding. The habitat at Sruhir Strand was backed by a lagoon (Roonah Lough) (Moore and Wilson, 1999).

The target is to maintain the range of coastal habitats, including transitional zones, subject to natural processes including erosion and succession.

3.4.3 Vegetation composition: typical species and sub-communities

The degree of exposure, as well as the coarseness and stability of the substrate determines species diversity.

Much of the shingle ridge is largely unvegetated, which is not uncommon on exposed storm beaches (Ryle *et al*., 2009). Sparse vegetation was noted at both White Strand and Sruhir Strand (Moore and Wilson, 1999).

At Lough Cahasy, the CMP noted that the occurrence of typical species of perennial vegetation of stony banks was infrequent, with all of them occurring as scattered individuals. These included sea mayweed (*Tripleurospermum maritimum*), sea sandwort (*Honckenya peploides*), silverweed (*Potentilla anserina*), curled dock (*Rumex crispus*) and sea holly (*Eryngium maritimum*). Though not extensive, the vegetation is representative of low-lying and shifting habitat (Ryle *et al*., 2009).

At White Strand, the NSBS recorded marram (*Ammophila arenaria*), spear-leaved orache (*Atriplex prostrata*), smooth hawksbeard (*Crepis capillaris*), sea milkwort (*Glaux maritima*), common bird's-foot trefoil (*Lotus corniculatus*), sea plantain (*Plantago maritima*), curled dock, groundsel (*Senecio vulgaris*), perennial sow-thistle (*Sonchus arvensis*), red clover (*Trifolium pratense*) and sea mayweed (Moore and Wilson, 1999).

Marram, sea milkwort, common bird's-foot trefoil, sea plantain and sea mayweed were recorded at Sruhir Strand (Moore and Wilson, 1999).

The Vulnerable species oysterplant (*Mertensia maritima*) (Wyse Jackson *et al*., 2016), which is listed on the Flora (Protection) Order, 2015 (Statutory Instrument No. 356 of 2015) and is typical of shingle habitat, has been recorded in the SAC in the past, but not during the NSBS or the CMP.

The target for this attribute is to ensure that the typical flora of vegetated shingle is maintained, as are the range of sub-communities within the different zones.

3.4.4 Vegetation composition: negative indicator species

Where the shingle becomes more stabilised, negative indicator species can become an issue. Negative indicator species can include non-native species (e.g. *Centranthus ruber, Lupinus arboreus*), species indicative of changes in nutrient status (e.g. *Urtica dioica*) and species not considered to be typical of the habitat (e.g. *Pteridium aquilinum*).

The target for this attribute is that negative indicator species (including non-native species) should make up less than 5% of the vegetation cover.

4 Sand dune habitats

Sand dunes are hills of wind-blown sand that have become progressively more stabilised by a cover of vegetation. In general, most sites display a progression through strandline, foredunes, mobile dunes and fixed dunes. Where the sandy substrate is decalcified, fixed dunes may give way to dune heath. Wet hollows, or dune slacks, occur where the dunes have been eroded down to the level of the water table. Transitional communities can occur between dune habitats and they may also form mosaics with each other. Dune systems are in a constant state of change and maintaining this natural dynamism is essential to ensure that all of the habitats present at a site achieve favourable conservation condition.

In Ireland, there are nine sand dune habitats (including annual vegetation of drift lines) listed under Annex I of the EU Habitats Directive (92/43/EEC) (* denotes a priority habitat):

- Annual vegetation of drift lines (1210)
- Embryonic shifting dunes (2110)
- **Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120)**
- Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130) *
- Decalcified dunes with *Empetrum nigrum* (2140) *
- Atlantic decalcified fixed dune (Calluno-Ulicetea) (2150) *
- Dunes with *Salix repens* subsp. *argentea* (Salicion arenariae) (2170)
- Humid dune slacks (2190)
- Machairs (21A0) *

Five sand dune habitats were recorded by Ryle *et al*. (2009) from Lough Cahasy, Lough Baun and Roonah Lough SAC, only one of which, indicated in **bold** above, is listed as a Qualifying Interest for the SAC. Annual vegetation of drift lines, embryonic shifting dunes, fixed coastal dunes with herbaceous vegetation and machair were also recorded by the CMP, but these habitats are not Qualifying Interests for the SAC.

Annual vegetation of drift lines is found on beaches along the high tide mark, where tidal litter accumulates. It is dominated by a small number of annual species (i.e. plants that complete their life-cycle within a single season). Tidal litter contains the remains of marine algal and faunal material, as well as a quantity of seeds. Decaying detritus in the tidal litter releases nutrients into what would otherwise be a nutrient-poor environment. The habitat is often represented as patchy, fragmented stands of vegetation that are short-lived and subject to frequent re-working of the sediment. The vegetation is limited to a small number of highly specialised species that are capable of coping with salinity, wind exposure, an unstable substrate and lack of soil moisture. Typical species include spear-leaved orache (*Atriplex prostrata*), frosted orache (*A. laciniata*), sea rocket (*Cakile maritima*), sea sandwort (*Honckenya peploides*) and prickly saltwort (*Salsola kali*).

Embryonic dunes are low accumulations of sand that form above the strandline. They are sometimes referred to as foredunes, pioneer dunes or embryo dunes, as they can represent the primary stage of dune formation. They are characterised by the presence of the salt-tolerant dune grasses sand couch (*Elytrigia juncea*) and lyme-grass (*Leymus arenarius*), which act as an impediment to airborne sand. Strandline species can remain a persistent element of the vegetation.

Where sand accumulation is more rapid than in the embryonic dunes, marram grass (*Ammophila arenaria*) invades, initiating the transition to mobile dunes (Shifting dunes along the shoreline with *Ammophila arenaria*). Marram growth is actively stimulated by sand accumulation. These unstable and mobile areas are sometimes referred to as 'yellow dunes' (or 'white dunes' in some European countries), owing to the areas of bare sand visible between the tussocks of marram.

Fixed dunes refer to the more stabilised area of dune systems, generally located in the shelter of the mobile dune ridges, where the wind speed is reduced and the vegetation is removed from the influence of tidal inundation and salt spray. This leads to the development of a more or less closed or 'fixed' carpet of vegetation dominated by a range of sand-binding species (Gaynor, 2008).

Machair (21A0) is a highly specialised and complex dune habitat that is confined globally to the north-west coasts of Ireland and Scotland. It comprises a flat or gently undulating sandy plain that develops in an oceanic location with a cool moist climate. Machair systems are highly calcareous, the sediments usually containing a high percentage of shell fragments and having pH values in excess of 7. The vegetation is herbaceous, with a low frequency of sand-binding species (Gaynor, 2006).

All of the dune habitats indicated above occur as a complex mosaic of constantly changing and evolving vegetation communities. They are inextricably linked in terms of their ecological functioning and should be regarded as single geomorphological units. As such, no dune habitat should be considered in isolation from the other dune habitats present at a site, or the adjoining semi-natural habitats with which they often form important transitional communities.

Detailed descriptions from the Coastal Monitoring Project (Ryle *et al*., 2009) of each sand dune habitat recorded in the Lough Cahasy sub-site (CMP site ID: 109) are found in Appendix II. A total area of 54.75ha of sand dune habitats was mapped within Lough Cahasy, Lough Baun and Roonah Lough SAC, 0.9ha (1.6%) of which represents the mobile dune habitat that is listed as a Qualifying Interest for this particular SAC.

4.1 Overall objectives

The overall objective for 'Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)' in Lough Cahasy, Lough Baun and Roonah Lough SAC is to '*maintain the favourable conservation condition*'.

The objective is based on an assessment of the recorded condition of the habitat under a range of attributes and targets. The assessment is divided into three main headings: (a) Area (b) Range and (c) Structure and Functions.

4.2 Area

4.2.1 Habitat area

Habitat extent is a basic attribute to be assessed when determining the condition of a particular habitat. A baseline habitat map was produced for the sand dune habitats in the Lough Cahasy sub-

site during the Coastal Monitoring Project (Ryle *et al*., 2009). This map is included with the individual site report in Appendix II.

The total area of shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) within Lough Cahasy, Lough Baun and Roonah Lough SAC as estimated by Ryle *et al*. (2009) is 0.9ha.

The target for this attribute is that the area should be stable or increasing. Bearing in mind that coastal systems are naturally dynamic and subject to change, this target is always assessed subject to natural processes, including erosion and succession.

4.3 Range

4.3.1 Habitat distribution

The distribution of sand dune habitats at Lough Cahasy, Lough Baun and Roonah Lough SAC, as mapped by Ryle *et al.* (2009), is presented in Appendix I.

The mobile dunes are not extensive and are mainly confined to a narrow band along Gortnagarryan strand. Four separate areas of mobile dunes were mapped, mostly confined to the northern end of the site and largely occur on recycled sand from the eroding dune face. Windblown sand however does accumulate as was the case to the seaward side of Lough Cahasy itself (Ryle *et al*., 2009).

The target is that there should be no decline or change in the distribution of the sand dune habitat, unless it is the result of natural processes, including erosion, accretion and succession.

4.4 Structure and Functions

The location, character and dynamic behaviour of sand dunes are governed by a combination of geographic, climatic, edaphic and anthropogenic factors. Sand dunes are highly complex, dynamic systems, where the habitats occur in a complex and constantly evolving and changing mosaic. They function as systems in terms of geomorphology and hydrology and maintaining the favourable conservation condition of the habitats present depends on allowing these processes to continue unhindered. Maintaining the favourable conservation condition of the mobile dune habitat in Lough Cahasy, Lough Baun and Roonah Lough SAC in terms of structure and functions depends on a range of attributes for which targets have been set as outlined below.

4.4.1 Physical structure: functionality and sediment supply

Coastlines naturally undergo a constant cycle of erosion and accretion. There are two main causes of erosion: (a) those resulting from natural causes and (b) those resulting from human interference. Natural causes include the continual tendency towards a state of equilibrium between coasts and environmental forces, climatic change (particularly an increase in the frequency of storms or a shift in storm tracks), relative sea level rise and natural changes in the sediment supply. Human interference is usually associated with changes in the sediment budget, either directly, through the removal of beach or inshore sediment, or indirectly, by impeding or altering sediment movement. It

is important to recognise that the process of coastal erosion is part of a natural tendency towards equilibrium. Natural shorelines attempt to absorb the energy entering the coastal zone by redistributing sediment.

Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Sediment supply is especially important in the embryonic dunes and mobile dunes, as well as the strandline communities where accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. The construction of physical barriers, such as sea defences, can interrupt longshore drift, leading to beach starvation and increased rates of erosion. Sediment circulation and erosion also has a role to play in the more stabilised dune habitats. Cycles of erosion and stabilisation are part of a naturally functioning dune system, where the creation of new bare areas allows pioneer species and vegetation communities to develop, thus increasing biodiversity. The construction of physical barriers can interfere with the sediment circulation by cutting the dunes off from the beach resulting in fossilisation or over-stabilisation of dunes.

It is considered that the highly mobile dune system in the SAC will persist owing to the continuous input of fresh sand from longshore drift (Ryle *et al*., 2009).

The target for this attribute is to maintain the natural circulation of sediment and organic matter throughout the entire dune system, without any physical obstructions.

4.4.2 Vegetation structure: zonation

The range of vegetation zones on a dune system should be maintained. Gaynor (2008) highlights the highly transitional nature of much of the vegetation; therefore, it is important that the transitional communities are also conserved, including those to saltmarsh communities.

A boulder/shingle ridge runs the length of the SAC and is backed by sand hills and dune grassland (NPWS, 2013).

The target is to maintain the range of coastal habitats, including transitional zones, subject to natural processes, including erosion and succession.

4.4.3 Vegetation composition: plant health of dune grasses

This attribute applies to the mobile dune habitat where blown sand is a natural feature. The health of the dune grasses (particularly *Ammophila arenaria* and *Elytrigia juncea*) are assessed by the plant parts above the ground (they should be green) and the presence of flowering heads. This gives a clear indication of the status of the supply of blown sand, which is required for these species to thrive.

Overall, the vegetation was comparatively healthy and bare ground ranges accounted for between 10% and 25% of the mobile dune habitat in the SAC (Ryle *et al*., 2009).

The target for this attribute is that more than 95% of the dune grasses should be healthy.

4.4.4 Vegetation composition: typical species and sub-communities

Species diversity and plant distribution in dunes is strongly controlled by a range of factors, including mobility of the substrate, grazing intensities, moisture gradients, nutrient gradients and human disturbance. In the younger, more mobile dunes, marram grass (*Ammophila arenaria*) is common, while groundsel (*Senecio vulgaris*), sea rocket (*Cakile maritima*) and dandelion (*Taraxacum* spp.) are also present. The fixed, more stable dune vegetation includes lady's bedstraw (*Galium verum*), common bird's-foot trefoil (*Lotus corniculatus*), wild thyme (*Thymus polytrichus*), kidney vetch (*Anthyllis vulneraria*), wild pansy (*Viola tricolor*) and biting stonecrop (*Sedum acre*).

The mobile dunes at Lough Cahasy, Lough Baun and Roonah Lough SAC are characterised by the presence of marram (*Ammophila arenaria*) which ranged in abundance from 75% to 90%. Other species include sand couch (*Elytrigia juncea*) and dandelion (*Taraxacum* agg.). It was noticeable that the marram tussocks were common where sand had built up in patches within the cobble bank (Ryle *et al*., 2009).

The target for this attribute is to maintain a typical flora for the mobile dune habitat.

4.4.5 Vegetation composition: negative indicator species

Negative indicators include non-native species (e.g. *Hippophae rhamnoides*), species indicative of changes in nutrient status (e.g. *Urtica dioica*) and species not considered characteristic of the habitat. Sea buckthorn (*Hippophae rhamnoides*) should be absent or effectively controlled.

The main invasive species identified in Gaynor (2008) were bracken (*Pteridium aquilinum*) and sea buckthorn (*Hippophae rhamnoides*). The invasion of non-native species compromises the typical plant community structure. Bracken is becoming increasingly dominant, particularly where sites have been abandoned or where grazing levels have been significantly reduced. The vegetation retains many elements of the original vegetation cover, but there is a reduction in biodiversity. As the canopy becomes taller and ranker, many of the low-growing species disappear. In this case, the vegetation is treated as a sub-community of the original community that was invaded. This is always the case unless the original vegetation cover has been completely destroyed, as can happen with sea buckthorn, which can form dense impenetrable thickets.

The occurrence of the negative indicator species common ragwort (*Senecio jacobaea*) in the mobile dunes was negligible (Ryle *et al*., 2009).

The target is that negative indicators (including non-native species) should represent less than 5% of the vegetation cover.

5 References

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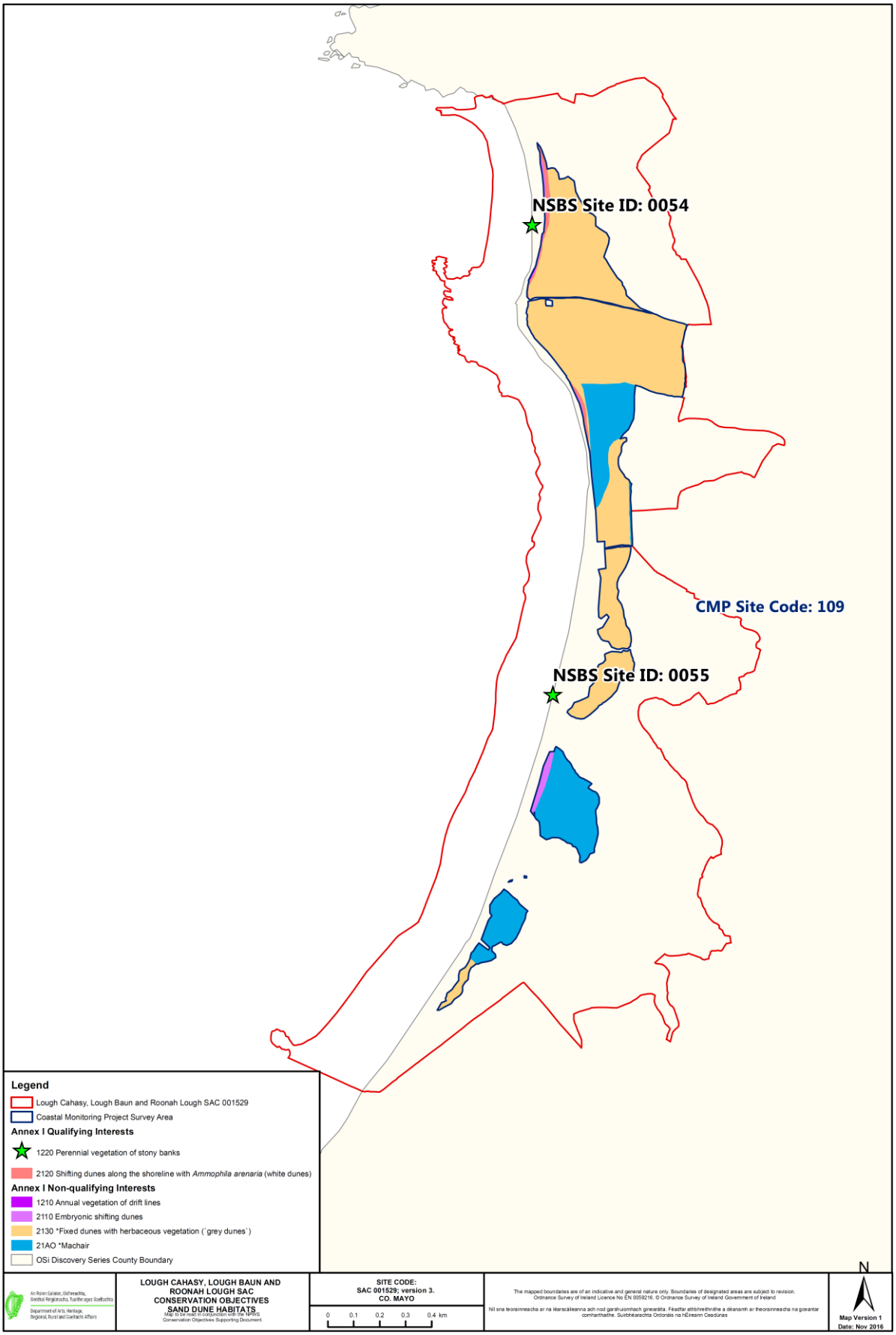
Appendix I – Distribution map of perennial vegetation of stony banks and sand dunes habitats within Lough Cahasy, Lough Baun and Roonah Lough SAC



Appendix II – Lough Cahasy site report and habitat map from the Coastal Monitoring Project (Ryle *et al*., 2009)

LOUGH CAHASY

SITE DETAILS

CMP06 site name: Lough Cahasy **CMP06 site code:** 109 **CMP Map No.:** 107

County: Mayo **Discovery map:** 37 **Grid Reference:** L 751 779

6 inch Map No.: Ma 095

Aerial photographs (2000 series): O 2196-B, D; O 2260-A, B, C, D; O 2323-A, B

NPWS Site Name: Lough Cahasy, Lough Baun and Roonah Lough

NPWS designation: pNHA: 1529 cSAC: 1529

Ranger Area: Mayo

MPSU Plan: Draft 0, Short Format – undated

Report Author: Tim Ryle

SITE DESCRIPTION

Situated two kilometres around the coast from Roonah Quay/Emlagh Point, Lough Cahasy is one of a number of sedimentary lakes or lagoons fronted by a shingle bar. The surrounding landscape is rugged, situated on the edge of the Atlantic Ocean and at the foot of the mountains. It is largely the aesthetic quality of the surroundings that entices visitors, as it is not on any main road.

This coastal site is situated on the seaward side of a number of lakes and interconnecting wetlands. It has been proposed for designation as a candidate Special Area of Conservation (cSAC 001529) owing to the presence of Lagoons (a priority Annex I habitat), Perennial vegetation of stony banks and Shifting dunes along the shoreline with *Ammophila arenaria*. Although machair (another priority Annex I habitat) has been noted from Lough Cahasy, its negligible extent and the condition of the remaining habitat did not qualify it for inclusion as a designated habitat within this cSAC.

One of the coastal lakes (Roonah Lough) has been recognised as true sedimentary lagoon, whilst Lough Cahasy and Lough Baun are classified as freshwater lakes that may on occasion become brackish (Healy *et al*., 1997). A number of notable or rare plants species are also known from the Loughs. The presence of two charaphytes *Chara globularis* var. *virgata* and *C. globularis* var. *annulata* in Roonah Lough was considered noteworthy (Healy *et al*., 1997). In addition, the rare lagoonal species *Ruppia maritima* (beaked tasselweed) is also known from the site, but was not searched for during this survey.

Another rare plant species previously recorded from shingle substrate is *Mertensia maritima* (oysterplant). It was not relocated during the current survey, although given its relative national scarcity and the timing of the survey, this does not constitute proof of its disappearance from Lough Cahasy.

The approximate areas of sand dune habitats recorded from Lough Cahasy are shown in Table 109A. There are no reliable previous estimates as to the extent of each habitat, as some of the earlier reports have had conflicting information e.g. the occurrence and distribution of machair. Thus, it should be noted that some areas may have complied with the parameters of the machair stop, but are clearly relatively species-rich dune grassland over shingle bar. Thus, it is recorded on the map as fixed dunes.

Table 109A Areas of EU Annex I habitats mapped at Lough Cahasy

EU Code	EU Habitat	Area (ha)
H1210	Annual vegetation of drift lines	0.066
H2110	Embryonic shifting dunes	1.034
H2120	Shifting dunes along the shoreline with *Ammophila arenaria*	0.898
H2130	Fixed coastal dunes with herbaceous vegetation	40.276
H21A0	Machair	15.757
	Total Sand dune habitat	**58.031**

Machair (H21A0)

While the occurrence of machair in and around Lough Cahasy has previously been noted, its distribution is poorly understood. Indeed, the management plan indicated the need for further work to characterise and delineate the habitat. The machair is not very extensive at Lough Cahasy and is largely concentrated along the southern end of the site around Lough Cahasy itself. A smaller area of intensively grazed machair grassland occurs at the foot of the fixed dunes.

Along with the ubiquitous *Festuca rubra* (red fescue) typical species included *Plantago lanceolata* (ribwort plantain), *Luzula campestris* (field wood-rush), *Galium verum* (lady's bedstraw), *Bellis perennis* (daisy), *Hypochaeris radicata* (cat's ear), *Carex flacca* (carnation sedge), *Trifolium repens* (white clover), *Ranunculus repens* (creeping buttercup) and *Achillea millefolium* (yarrow). Less abundant species included *Thymus polytrichus* (thyme), *Glaux maritima* (sea milkwort) and *Plantago coronopus* (buck's-horn plantain).

Areas of the machair grassland were disturbed and occasionally inundated by rising groundwater. The increase in the soil saturation is mirrored by the occurrence of species such as *Agrostis stolonifera* (creeping bent), *Carex nigra* (common sedge), *Hydrocotyle vulgaris* (marsh pennywort) and the moss *Calliergonella cuspidata*.

Other bryophytes such as *Brachythecium* spp., *Plagiomnium undulatum* and *Thuidium tamariscinum* were noted throughout the remnant machair grassland and typically accounted for between 10% and 30% of ground cover.

The presence of negative indicator species reflected the agricultural influence within the habitat. Species such as *Senecio jacobaea* (common ragwort) and *Cirsium arvense* (creeping thistle) were common. Indeed, two of the four monitoring stops failed on this target due to the abundance of S*enecio jacobaea* (common ragwort). The agricultural improvement is characterised by the relative abundance of species such as *Cynosurus cristatus* (crested dog's-tail), *Lolium perenne* (perennial ryegrass), *Holcus lanatus* (Yorkshire fog) and *Dactylis glomerata* (cock's-foot).

There is an added complexity in delineating the machair grassland owing to a transition to fixed dunes. The site is of ecological importance owing in part to the extent and volume of the shingle/cobble that has built up along then ridge. In places it is relatively low-lying and flattened on top. In other places however, the pebble extends some distance inland. Although an area of 15.757ha has been mapped (Map 107), there is a gradation from machair grassland to *Festuca*-rich dune grassland as the sand-rich strata over the shingle bar disappears. Thus, the extent of the machair may be over-estimated.

Fixed Dunes (H2130)

The occurrence of large accumulations of sandy substrates at Lough Cahasy is characterised by fixed dune grassland. Most of the fixed dunes are fenced off and display the impacts of agricultural management. Sward height ranged from 2–80 centimetres. While small patches of short sward were recorded, the vegetation is predominantly rank in nature and is characterised by *Ammophila arenaria* (marram). Large areas of the fixed dunes are grazed by cattle, while sheep and horses to a lesser extent were noted in damp grassland at the northern end of the site.

Other typical species included *Festuca rubra* (red fescue), *Galium verum* (lady's bedstraw), *Lotus corniculatus* (common bird's-foot-trefoil), *Plantago lanceolata* (ribwort plantain), *Cerastium fontanum* (common mouse-ear) and *Taraxacum* agg. (dandelion). Common species, less frequently recorded, included *Trifolium pratense* (red clover), *Holcus lanatus* (Yorkshire fog) and *Bellis perennis* (daisy).

Typically, lichens were not common, nor were bryophytes. The most commonly noted species included *Rhytidiadelphus squarrosus* and *Pseudoscleropodium purum*, which were both recorded in monitoring stop 2.

One stop failed owing to the presence of *Senecio jacobaea* (common ragwort), although its presence was noted as occasional throughout the system. On higher ground, towards the back of the fixed dunes, *Pteridium aquilinum* (bracken) is spreading, seemingly unchecked. The condition and quality of the herbage is such that supplemental feeding takes place and a large area of agriculturally improved land is shown on the map.

Although fixed dunes are estimated to occupy 40.276 ha (Table 109A), vegetation assemblages comparable with both machair and fixed dune habitats were recorded from this low-lying pebble plain, where small pockets of sand have built up in hollows within the cobble. Some of the dune grassland may be more analogous to species-rich coastal grassland, commonly referred to as a *Festuca-Galium* grassland. Confidently defining the grassland vegetation is complicated by the grazing regime, which has resulted in the spread of agricultural species such as *Lolium perenne* (perennial ryegrass), *Holcus lanatus* (Yorkshire fog) and *Dactylis glomerata* (cock's-foot). One monitoring stop satisfied all of the criteria that are applicable to machair, including the occurrence of nine typical dune grassland species. It was evident, however that the grazed species-rich grassland was not strictly machair or fixed dune, as there was little sand present over the largely shingle/cobble substrate.

Mobile Dunes (H2120)
Four separate areas of mobile dunes were mapped, mostly confined to the northern end of the site and are largely occurring on recycled sand from the eroding dune face. Windblown sand however does accumulate as was the case to the seaward side of Lough Cahasy itself. In total, they covered an area measuring approximately 0.898 ha (Table 109A).

The mobile dunes are characterised by the presence of *Ammophila arenaria* (marram grass) which ranged in abundance from 75% to 90%. Other species include *Elytrigia juncea* (sand couch) and *Taraxacum* agg. (dandelion). It was noticeable that the marram tussocks were common where sand had built up in patches within the cobble bank.

Overall, the vegetation was comparatively healthy and bare ground ranges accounted for between 10% and 25% of the habitat. The occurrence of the negative indicator species, *Senecio jacobaea* (common ragwort) was negligible.

Embryonic Dunes (H1220)
Foredunes are not extensive along the front of Lough Cahasy and occupied an area estimated at 1.034 ha. (Table 109A). This is not uncommon along the western seaboard, where the coastal dynamics of the Atlantic prevents the establishment of foredune communities.

Characterised by the presence of *Elytrigia juncea* (sand couch), the habitat also had a number of other species such as the typical strandline species *Cakile maritima* (sea rocket) and *Atriplex prostrata* (frosted orache). Although not widespread in its distribution, its occurrence reflects the limited supply of fine-grained sediment that arrives and its persistence in the face of tidal conditions.

Perennial Shingle (H1220)
Although much of the frontline is a shingle bar and cobble bank, the strandline is largely unvegetated owing to its exposure. While this is not uncommon in storm beaches, no Annex I habitat is shown for the site in keeping with all other unvegetated shingle/pebble sites in this survey. The approximate area of the boulder/shingle ridge, however, was mapped, to facilitate a greater understanding of the dynamics of the habitat at this site.

Typical species of perennial vegetation of stony banks that were recorded from the site include *Tripleurospermum maritimum* (sea mayweed), *Honckenya peploides* (sea sandwort), *Potentilla anserina* (silverweed), *Rumex crispus* (curled dock) and *Eryngium maritimum* (sea holly). Invariably these species occurred as individual plants rather than as an easily characterised habitat. Although it was not relocated during the current survey, *Mertensia maritima* (oysterplant), a species listed on the Flora (Protection) Order was previously recorded from the site.

Annual Strandline (H1210)
While much of the frontline is composed of pebble and shingle, longshore drift has deposited the coarse-grained sand at the northern end of the site, along with tidal debris, which is trapped by the projecting rocky headland. A small patch of annual strandline was recorded, measuring approximately

0.066 ha (Table 109A). The habitat was dominated by *Honckenya peploides* (sea sandwort), *Atriplex* spp. (orache) and *Cakile maritima* (sea rocket).

IMPACTS

The exposed beach is subject to considerable deposition of tidal debris, along with negligible amounts left by beach users. Bins are located at the two main carparks (code 490), alongside the other facilities like the 'temporary' toilets and shower facilities. The beach had recently been cleaned, with several piles of bagged debris awaiting collection. It is not known whether a voluntary group or the County Council were involved in collecting the rubbish.

While the underlying geological conditions, both hard rock and glacial, affect the occurrence of the coastal habitats, their distribution and condition is greatly influenced by environmental conditions and the erosion (code 900) brought about by the Atlantic Ocean. There is evidence of natural erosion at the seaward edge of the habitats. Although there is a build-up of sediment in places, the mobile dunes occur on recycled sand from the eroding fixed dunes face. This is more pronounced in the foredunes, which are greatly reduced in extent. Erosion of the fixed dunes is most noticeable where that habitat occurs on low, undulating clay/sand cliffs along the southern half of the site.

Recreational pressures are confined to the beach itself, as much of the coastal grassland is private land and fenced off preventing access. While there are a number of access points to the beach, the majority of beach users make use of the two main car parks. The beach is locally popular in the summer months for swimming. Other activities include walking and water sports (code 621). At least one surf school operates from the main carpark during the summer months, although depending on the conditions surfers are attracted to the beach all year round.

Table 109B Intensity and impact of various activities on sand dune habitats at Lough Cahasy

EU Habitat Code[1]	Activity Code[2]	Intensity[3]	Impact[4]	Area affected/ha	Location of Activity[5]
H2130	140	A	+1	8.5	Inside
H21A0	140	A	+1	11	Inside
H2130	143	A	-1	1.0	Inside
H2130	149	A	-1	14	Inside
H2130	150	B	-1	0.5	Inside
21BB	302	C	0	<1.0	Inside
H21A0	490	A	-2	0.061	Inside
H2130	490	A	-2	0.324	Inside
21BB	621	B	0	Unknown	Outside
H2130	871	C	0	<0.05	Inside
H2110	900	A	0	Unknown	Inside
H2120	900	A	0	Unknown	Inside
H2130	900	B	0	Unknown	Inside
H21A0	900	C	0	Unknown	Inside
H2130	954	A	-1	7.0	Inside

[1] EU Codes as per Interpretation Manual. Code 21BB is an additional code used to signify the entire dune habitat.
[2] Description of activity codes are found in Appendix 3
[3] Intensity of the influence of an activity is rated as: A= high, B = medium, C = low influence and D = unknown.
[4] Impact is rated as: -2 = irreparable negative influence, -1 = repairable negative influence, 0 = neutral, +1 = natural positive influence and +2 = strongly managed positive influence
[5] Location of activity: Inside = activities recorded within and directly impacting the sand dune habitat. Outside = activities recorded outside but adjacent to sand dune habitat that are impacting the sand dune habitat

Local information recalls that this isolated area once supported a far greater agricultural population that were dependant on the land for its survival. Testament to this is the number of derelict cultivation ridges (lazybeds) that are still evident on the surrounding landscape. The agrarian lifestyle has changed, with little or no cultivation carried out. Much of the land is used as pasture, although large tracts of land are wet and of poor quality. As some of the land is wet or sporadically under water, the agricultural regime is locally intensive, where the conditions allow. A considerable area of sand dune habitats has been fenced off (code 150), and some of the fences are well maintained and considerably sturdier than the quality or condition of the land might suggest. Towards the northern end of the site, the fences were continued into Lough Baun, indicating the fluctuating nature of the coastal lake. The restructuring of the agricultural land has impacted on the site and concentrated livestock in areas. Livestock, primarily cattle, but sheep also are concentrated for much of the year on 'drier' ground. Supplemental feeding is carried out in a number of places and poaching is not uncommon.

Other management practices have negatively impacted upon the fixed dune system. Overstocking, in places has had in influence and seen the spread of negative indicator species such as *Senecio jacobaea* (common ragwort), and agricultural grasses such as *Lolium perenne* (perennial ryegrass) and *Dactylis glomerata* (cock's-foot) in places. Poaching was not uncommon, particularly in the fixed dunes around the lakes. Supplemental feeding is carried out in at least one location and has greatly altered the vegetative composition of the habitat. Another loss of condition includes the spread of bracken (code 954). Although concentrated in places, trails are often created by the cattle, which can be beneficial in maintaining some variation within the dune sward. However, this does not appear to be curtailing the spread of bracken in places towards the back of the fixed dune grassland.

Grazing (code 140) can also be positive in some situations and this is certainly the case of the machair grassland and some of the dune grassland found over cobble where species diversity is relatively high where stocking levels are low or the areas are less easily accessed by cattle.

It was previously noted in the NPWS documents that sand and cobble were being excavated from the beach (code 302). Indeed, the County Council erected a number of signs advising against the removal of beach materials. While this is known to have negative effects on the dynamics of coastal systems, there was little obvious evidence that it was occurring at the site at the time of survey. Some coastal protection works (code 871) have been carried out but are largely inconsequential and are associated with access points.

Other impacts that are noted but not quantified are associated with management of hydrographic functioning and the importance of the fish hatcheries managed by the Western Fisheries Board. The management plan indicates that owing to the build-up of sand and shingle at the mouth of the Carrownisky river, the fisheries board have in the past removed any impediments to spawning salmon and trout. As this is not a large-scale operation and is carried out for the benefit of salmon in their freshwater habitat (an Annex II species), this is regarded as a positive management step in their conservation.

CONSERVATION STATUS

The overall EU conservation assessment is based on a combination of factors – Extent, Structure and Functions, and Future Prospects (Table 109C). Although the vegetation structure and functions was assessed by means of monitoring stops, the final determination of conservation status assessment relies in part on baseline information held in the NATURA 2000 dataform and management plan. Much of the previous information is not directly comparable with the present data, indeed there the site is not designated for machair a priority Annex I habitat, and information about its distribution and condition are at best limited.

Machair (H21A0)

The site has not been designated for machair, a fact that is reiterated in the draft management plan which states that "the size and quality of the habitat found is not of sufficient quality to merit its listing". No comment can be made as to a serious change in the quality or extent of the machair, as previous reports suggest that further work is required to understand the structure and dynamics of the machair.

The remnant machair grassland at Lough Cahasy is not widespread and has certainly been influenced by a number of impacting activities in the past. In view of the fact that there is no reliable data as to the previous distribution or condition of the machair at Lough Cahasy, other than to recognise its presence, habitat extent is therefore rated as *favourable* (Table 109C).

In terms of its structure and functions, all four monitoring stops passed (Table 109D). Therefore, the habitat is rated as *favourable*. It is apparent that there is great variation within the habitat, particularly in terms of species diversity, which reflected the agricultural management of the area and the impact of ever-changing shingle/sand bar and rising waters of the lagoons/coastal lakes.

The future prospects are uncertain for the machair. It would appear to be a remnant piece of coastal grassland trapped behind a shingle/cobble bar. Given the remoteness of the site and the lack of good-quality agricultural land in the surrounding area, it may be uneconomical to alter the current land management regime. For this reason, the future prospects are rated as *unfavourable-inadequate* (Table 109C).

As two elements of the conservation status are rated *unfavourable-inadequate*, the overall EU conservation assessment for the machair is *unfavourable-inadequate*. In light of the paucity of comparable information as to its historical distribution and condition, this warrants a rating under the Irish conservation assessment scheme as *unfavourable-declining* (Table 109C).

Table 109C Conservation status of Annex I sand dune habitats of the sub-sites at Lough Cahasy

Habitat[1]	EU Conservation Status Assessment			Overall EU conservation status assessment	Proposed Irish conservation status system[2]
	Favourable	Unfavourable – Inadequate	Unfavourable - Bad		
Machair (H21A0)	Extent / Structure & Functions	Future Prospects		**Unfavourable-Inadequate**	**Unfavourable - Declining**
Fixed Dunes (H2130)	Extent	Structure & Functions / Future Prospects		**Unfavourable-Inadequate**	**Unfavourable - Declining**
Mobile Dunes (H2120)	Extent / Structure & Functions / Future Prospects			**Favourable**	**Favourable - Maintained**
Embryonic Dunes (H2110)	Extent / Structure & Functions / Future Prospects			**Favourable**	**Favourable - Maintained**
Annual Strandline (H1210)	Extent / Structure & Functions* / Future Prospects			**Favourable**	**Favourable - Maintained**

[1] EU Codes as per Interpretation Manual
[2] Ratings are Favourable (Enhanced, Maintained, Recovered, Declining), Unfavourable (Recovering, Unchanged, Declining) and Destroyed (Partially destroyed, Completely destroyed and Unknown)
* Structure and Functions are based on Best Scientific Judgement as monitoring stops were not carried out

Fixed Dunes (H2130)

The fixed dunes have not been described in any great detail, previously, other than to document that large areas of Marram grassland occur. Patches of sandy grassland extend over a considerable distance (Map 107). Some remnant patches are far removed from main distribution of the fixed dunes, located around Gortnagarryan strand and the two main carparks. Notwithstanding the fact that agricultural intensification has occurred in places and resulted in the modification of the sward composition through the grazing regime or other management such as drainage or fertilisation of the land, the habitat extent is considered as *favourable.*

Table 109D Pass/Fail results of monitoring stops for Annex I sand dune habitats at Lough Cahasy

	Monitoring stops		
Habitat	**Pass**	**Fail**	**Conservation status**
Machair (H21A0)	4	0	**Favourable**
Fixed Dunes (H2130)	3*	0	**Unfavourable-inadequate**
Mobile Dunes (H2120)	2	0	**Favourable**
Embryonic Dunes (H2110)	2	0	**Favourable**

* Modified to *Unfavourable-inadequate* owing to the fact that it was not permissible to access large areas of the fixed dunes

The three monitoring stops (Table 109D) located in the northern half of the site, passed on the majority of the criteria indicating *favourable* habitat structure and functions. These are not

representative of the habitat however and the assessment is modified however to *unfavourable-inadequate* given the largely rank and agriculturally disturbed nature of the dune grassland. One stop had passed on all six of the assessment criteria the other two stop passed on five attributes, failing on the presence of negative indicator species namely *Senecio jacobaea* (common ragwort) being present in excess of the 5% cover target.

The future prospects for the fixed dunes are considered as *unfavourable-inadequate*. A considerable area of the fixed dunes has declined in condition over recent years following the restructuring of the field boundaries (particularly to the northern end of the site). Although there has been an intensification of agricultural activities, this is locally concentrated. In other areas, there has been a reduction in grazing pressure, which has encouraged the persistence of the rank-marram dominated sward. In areas, the spread of invasive species such as of marram and other agricultural weeds continues.

The overall EU conservation assessment for the fixed dunes at Lough Cahasy is *unfavourable-inadequate*, as the individual parameters of the conservation assessment include an *unfavourable-inadequate* rating. The most appropriate Irish conservation status assessment is *unfavourable-declining*, owing to the condition and management of the site and the subsequent deterioration of the habitat (Table 109C).

Mobile Dunes (H2120)

The mobile dunes are not extensive and are mainly confined to a narrow band along Gortnagarryan strand. Their presence was previously highlighted as early as 1979 (An Foras Forbartha, 1979). The rugged nature of the coastline coupled with the highly mobile nature of the system would suggest that there has not been a significant loss of habitat. In light of this, their extent is rated as *favourable* (Table 109C).

Though not extensive, the vegetation is representative of low-lying and shifting habitat and both monitoring stops passed on all criteria (Table 109D). Therefore, the structure and functions element for the habitat is rated as *favourable*.

Although there is little useful quantitative evidence with which to gauge the future prospects, they are rated as *favourable* (Table 109C). It is considered that this highly mobile system they will persist owing to the continuous input of fresh sand from longshore drift.

Therefore, the overall EU conservation assessment for the mobile dunes at Lough Cahasy is *favourable* and under the proposed Irish conservation scheme this is *favourable-maintained* (Table 109C).

Embryonic Dunes (H2110)

There is little previous information with regards the occurrence and distribution of foredunes at Lough Cahasy. Although small in area and discontinuous, the foredunes are located in less exposed situations. This is typical of many dune systems along the western seaboard. Therefore, the extent of the foredunes is considered *favourable* (Table 109C).

Both monitoring stops passed on structure and functions (Table 109D). The condition of the habitat and the vigorous growth warrants a *favourable* rating for structure and functions (Table 109C).

Despite on-going impacts of erosion and some disturbance from recreational pressures, the future prospects of the habitat are *favourable*, as it would appear that sediment is continuously reworked after the winter storm events, allowing for the continuity of the embryonic dunes.

Overall, the EU conservation status assessment for the embryonic dunes at Lough Cahasy is considered to be *favourable* (Table 109C). This corresponds to a rating of *favourable-maintained* under the Irish system.

Perennial Shingle (H1220)

An extensive and high boulder/shingle ridge occurs along much of the shoreline at this site, much of it largely unvegetated. The occurrence of typical species was infrequent, all of them occurring as scattered individuals. Unlike the NATURA 2000 dataform and the subsequent draft management plan, perennial vegetation of stony banks is not mapped as a sand dune habitat (Map 109), in keeping with similar sites in this report. The distribution, however, of the cobble and shingle is illustrated so as to enable future comparison of its distribution and trends. For this reason, no conservation assessment is given for the shingle vegetation in the current survey, although previous conservation status synthesis in both the NATURA 2000 and draft management plan rates the habitat as B – good conservation.

Annual Strandline (H1210)

Given the rugged nature for the coastline and composition of the strandline substrate, it is not surprising that annual strandline community is not extensive. Coarse, gritty sand only accumulates at the southern end of Gortnagarryan strand. As there is no previous information, the extent of the annual strandline is rated as *favourable* (Table 109C).

Monitoring stops were not carried out owing to the relative paucity of the habitat. However, the species composition and habitat dynamic indicate that the structure and functions warrant a *favourable* rating.

The future prospects are also *favourable*, as there are no known threatening impacts other than the on-going cycle of natural erosion and re-deposition of sediment.

The conservation assessment for the annual strandline is *favourable* (Table 109C), and its equivalent Irish rating is *favourable-maintained*.

Coastal Monitoring Project 2004-2006

Lough Cahasy

Lough Cahasy / Lough Baun and Roonah Complex (SAC 1529)

CMP code: 109

This habitat map was created with a combination of fieldwork, GPS and interpretation of aerial photos. Boundaries of designated areas are subject to revision. Produced from Ordnance Survey material by permission of the Government (Permit number 5953)

0 400 800 1200 1600 2000 Meters

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