

TIRE MACHAIR SPECIAL AREA OF CONSERVATION (SAC)

CONSERVATION ADVICE PACKAGE



John Bowler, RSPB Scotland

Site Details

Site name:	Tiree Machair
Map:	https://sitelink.nature.scot/site/8396
Location:	Highlands and Islands
Site code:	UK0014744
Area (ha):	789.37
Date designated:	17 March 2005

Qualifying features

Qualifying feature	Assessed condition	SCM visit date	UK overall Conservation Status
Shifting dunes	Favourable Maintained	17 July 2013	Unfavourable - Bad
Shifting dunes with marram	Favourable Maintained	17 July 2013	Unfavourable - Bad
Dune grassland*	Favourable Maintained	12 July 2012	Unfavourable - Bad
Humid dune slacks	Favourable Maintained	16 September 2008	Unfavourable - Bad
Machair	Favourable Declining	19 July 2012	Favourable
Naturally nutrient-rich lakes or lochs which are often dominated by pondweed	Favourable Maintained	26 June 2009	Unfavourable - Bad

Notes:

Assessed Condition refers to the condition of the SAC feature assessed at a site level as part of NatureScot's [Site Condition Monitoring \(SCM\)](#) programme.

Conservation status is the overall condition of the feature throughout its range within the UK as reported to the European Commission under Article 17 of the Habitats Directive in 2019.

*Habitats Directive priority habitat

Overlapping Protected Areas:

Hough Bay and Balevullin Machair SSSI, Sleibhtean agus Cladach Thiriodh (Tiree Wetlands and Coast) SSSI, SPA & RAMSAR

Further information on these sites can be found on [SiteLink](#).

Key factors affecting the qualifying features

Shifting dunes

This habitat exists in a highly dynamic state and is dependent on the continued operation of physical processes at the dune/beach interface. It is the first type of vegetation to colonise areas of incipient dune formation at the top of a beach. In most cases Embryonic shifting dunes are transient and will either be displaced by marram-dominated vegetation as the dunes develop or will be washed away by storms.

The continued supply of new sand from the beach plain into the dune system is vital to the continued existence of this habitat, even if this sand is derived from within the same system. The habitat type is of exceptional importance as an indicator of the general structural and functional 'health' of a dune system. Creation of new dune habitat, and indeed the long-term survival of the dune system at which it occurs, is often dependent upon the survival of this habitat type.

At the Hough Bay and Balevullin SSSI section of the SAC the habitat forms a 10-20 m wide area along Traigh Bailamhuilinn and Traigh Chornaig in the northern sector but elsewhere it is only patchily developed, suggesting severe exposure on beaches with a westerly aspect. In many places maximum sand deposition is to the rear of foredune, though wider extents are present in the centre of Traigh Bailamhuilinn and at the south end of Traigh Thodhrasdail.

At the Sleibhtean Agus Cladach SSSI component of the SAC the bulk of sand dune habitat is present behind the beach at Traigh Bhagh. In terms of the feature as found, mobile dunes were present at Traigh Bagh. There is *Elytrigia juncea* embryo dune present at either end of the beach and a narrow band of *Ammophila arenaria* foredune along the width of the bay.

Key management issues for this site are primarily concerned with ensuring no development disrupts the system of sediment movement to and from these areas. Minimising disturbance from humans, livestock and vehicles is also important in preventing damage to this habitat.

Shifting dunes with marram

This habitat encompasses most of the vegetation of unstable dunes where there is active sand movement. Under these conditions sand-binding marram *Ammophila arenaria* is always a prominent feature of the vegetation and is usually dominant. This is a dynamic vegetation type maintained only by change. It can occur on both accreting and eroding dunes, but will rapidly change and disappear if stability is imposed.

This habitat rarely occurs in isolation because of its dynamic nature and because it is successional related to other dune habitats. This habitat type excludes the low, embryonic dunes where occasional exposure to saltwater flooding constrains the growth of marram.

Mobile dune is scarce on Tiree except on west Tiree, which has the largest dune system in the Inner Hebrides. The dune front morphology and vegetation closely

resemble Crossapol and Feall Bay on Coll Machair but blowouts are less frequent and there is a more rapid transition to semi-fixed dune. As at Coll Machair, the mobile sands contribute to the maintenance of dynamic hindshore machair.

Key management issues for this site are primarily concerned with ensuring no development disrupts the system of sediment movement to and from these areas. Minimising disturbance from humans, livestock and vehicles is also important in preventing damage to this habitat. Preventing the introduction and spread of invasive non-native species, and human activities (e.g., trampling, material extraction, path or track creation) are also important. Currently none of these pressures are of concern at Tiree Machair SAC.

Dune grassland

This habitat occurs mainly on the largest dune systems, being those that have the width to allow it to develop. It typically occurs inland of the zone dominated by marram *Ammophila arenaria* on coastal dunes, and represents the vegetation that replaces marram as the dune stabilises and the organic content of the sand increases.

The herbaceous vegetation of fixed dunes in the UK exhibits considerable variation. The most widespread type is Atlantic dune grassland, consisting of a short sward characterised by red fescue *Festuca rubra* and lady's bedstraw *Galium verum* and typically rich in species of calcareous substrates but also includes acidic substrates.

The dune grassland habitat, also known as grey dunes, on Tiree features similar vegetation to Coll, but the sand is more stable, and rabbits are absent. Calcareous fixed dunes are extensive, with a wide range of these represented, including large areas of lightly grazed fixed dune, relatively uncommon in northern Scotland.

Key management issues for this site are primarily concerned with ensuring no development disrupts the system of sediment movement to and from these areas. Minimising disturbance from humans, livestock and vehicles is also important in preventing damage to this habitat.

Humid dune slacks

Dune slacks are low-lying areas within dune systems that are seasonally flooded and where nutrient levels are low. They occur primarily on the larger dune systems. The range of communities found is considerable and depends on the structure of the dune system, the successional stage of the dune slack, the chemical composition of the dune sand, and the prevailing climatic conditions

The area of humid dune slack within Tiree Machair SAC is the wetter parts (often flooded in winter) of an extensive plain known as The Reef, particularly along the margins of An Fhaodhail. Unusually, on The Reef the slack occurs along the wetter margin of the machair plain in a fairly balanced system of sand erosion and deposition and little movement of features. The vegetation communities within the slack areas are also thought to be very specialised.

Dune slacks are characterised by a pattern of pronounced seasonal fluctuation of the water table, related to the landform of the dune system as well as climate and the

nature of the underlying sediment – whether porous shingle or impervious clay. Variations in the extent and duration of flooding of the dune surface are very important in determining the vegetation.

Key management issues for this site are primarily concerned with ensuring no development disrupts the system of sediment movement to and from these areas. Minimising disturbance from humans, livestock and vehicles is also important in preventing damage to this habitat. Alterations to hydrology either through direct human activities and interventions or, as a result of climate change is also a key issue.

Machairs

Machair is an extreme form of dune grassland restricted to northern Scotland in the UK, and to NW Ireland (Galway to Donegal). It tends to occur on low-lying, exposed coasts, on sandy soils with a high shell sand content, and within a wider machair complex comprising beach, dunes, marshes, lochs, saltmarsh and saline lagoons. It often has a high water table in winter, and a long history of management.

Machair has developed in tandem with human settlement and there has never been such a thing as truly natural machair. The human role in machair land use and conservation should thus always be recognised.

Tiree has the most extensive and diverse area of machair outside the Outer Hebrides with 24% of the total area of the island covered by machair. The machair complex on Tiree is uncultivated and has a long history of seasonal grazing. There is a diverse series of physical machair formations. The Tiree complex is also noteworthy as one of the few examples of rabbit-free machair in Scotland. An Fhaodhail and the Reef is an extensive area of wet machair grading into an extensive marsh and wetland (An Fhaodhail), and is the only site in the Inner Hebrides that is influenced by saline water, although this has recently been restricted by the insertion of a tidal flood-gate. The site is unusual in that it is grazed only by cattle, a traditional management practice that has maintained an extremely rich and varied flora. In contrast, Hough Bay – Balevullin is a complex of dry machair and hummocky dunes forming an intricate mosaic with wet machair and dune slack vegetation.

Although this feature is at favourable condition key management issues for this habitat can include grazing/trampling levels (by sheep, cattle and horses/ponies), development (tourism), sand extraction and damage from vehicles.

Naturally nutrient-rich lakes or lochs which are often dominated by pondweed

Natural eutrophic lochs have nutrient levels that are higher than those of oligotrophic (nutrient-poor), dystrophic (rich in organic substances) or mesotrophic (intermediate nutrient level) lakes, resulting in higher natural productivity, and are typically species-rich. This type of loch is relatively widespread however it is hard to distinguish from more naturally nutrient poor lochs which have been subject to enrichment and some examples have themselves been over-enriched.

Tiree Machair SAC comprises some of the finest examples of calcareous sand dunes grading into machair plain and machair loch (Loch Bhasapol). Loch Bhasapol

and other lochs on the machair plain represent high quality naturally eutrophic waterbodies that reflect a strong maritime influence. The eutrophic condition of the waterbodies is derived from the sand deposits and dunes that are prevalent throughout the site. The lochs support a diverse aquatic plant flora with several species indicative of the maritime influence, including brackish water-crowfoot *Ranunculus baudotii* that has a restricted UK and European distribution, and eight species of pondweed.

The key management issues include surface water pollution, nutrient input leading to over-enrichment, non-native species and changes to the hydrology.

Further information about this SAC's protected habitats can be found on the [JNCC website](#).

Feature Priorities

None of the qualifying habitats of this SAC are priority habitats and so in managing the site no clear preference should be given to one habitat over another. In practice, there is unlikely to be any conflict between management of the qualifying features of the SAC. Habitat distribution is mainly determined by environmental conditions and all habitats benefit from a similar low level of grazing.

Any management for this site or assessment of plans or projects subject to a Habitats Regulations Appraisal will also need to take account of the features of the overlapping SPAs. These are dunlin, Greenland barnacle goose, Greenland white-fronted goose, oystercatcher, redshank, ringed plover and turnstone.

Conservation Objectives

Overarching Conservation Objectives for all habitats

1. To ensure that the qualifying features of Tiree Machair SAC are in favourable condition and make an appropriate contribution to achieving favourable conservation status
--

Favourable Conservation Status (FCS) is considered at a European biogeographic level. When determining whether management measures may be required to ensure that the conservation objectives for this site are achieved, the focus should be on maintaining or restoring the contribution that this site makes to FCS.

When carrying out appraisals of plans and projects against these conservation objectives, it is not necessary to understand the status of the feature in other SACs in this biogeographic region. The purpose of the appraisal should be to understand whether the integrity of the site (see objective 2) would be maintained. If this is the case, then its contribution to FCS across the Atlantic Biogeographic Region will continue to be met. Further details on how these appraisals should be carried out in relation to maintaining site integrity is provided by objective 2 (including parts a, b and c). If broader information on the feature is available then it should be used to provide context to the site-based appraisal.

Note that "appropriate" within this part of the conservation objectives is included to indicate that the contribution to FCS varies from site to site and feature to feature.

2. To ensure that the integrity of Tiree Machair SAC is maintained by meeting objectives 2a, 2b and 2c for each qualifying feature.

The aim at this SAC is to maintain, or where appropriate restore, the protected habitats in a favourable condition as a contribution to their wider conservation status. Therefore any impacts on the objectives shown in 2a, 2b, or 2c below must not persist so that they prevent the achievement of this overall aim.

When carrying out appraisals of plans or projects the focus should be on restoring site integrity, specifically by meeting the objectives outlined in 2a, 2b and 2c. If these are met then site integrity will be restored. Note that not all of these will be relevant for every activity being considered. Any impacts on the objectives shown in 2a, 2b or 2c below must not persist so that they prevent the restoration of site integrity. Temporary impacts on these objectives resulting from plans or projects can only be permitted where they do not prevent the ability of a feature to recover and there is certainty that the features will be able to quickly recover.

This objective recognises that the qualifying habitats are exposed to a wide range of drivers of change. Some of these are natural and are not a direct result of human influences. Such changes in the habitats' extent, distribution or condition within the site which are brought about by natural processes, directly or indirectly, are normally considered compatible with the site's conservation objectives. An exception to this is when the favourable condition of a habitat is dependent on halting or managing natural succession. An assessment of whether a change is natural or anthropogenic, or a combination of both, will need to be looked at on a case by case basis.

Conservation Objectives for Embryonic shifting dunes [H2110] (Shifting dunes)

2a. Maintain the extent and distribution of the habitat within the site

This habitat, by its very nature, is restricted in the area it can occupy and as dune systems are dynamic its extent will be subject to natural change.

The extent of the embryonic shifting dune feature has been estimated at 1.03ha. This should be maintained within a reasonable range taking into account natural changes.

However, this habitat is ephemeral with extent dependent on continued supply of new sand from the beach plain into the dune system. Therefore restoration of extent should only be applied where changes can be attributed to human intervention.

2b. Maintain the structure, function and supporting processes of the habitat

This habitat type rarely occurs in isolation, because it may initiate dune succession. Ridges of sand accumulate as dunes above beaches where onshore winds have blown loose beach sand inland, so that there must be a supply of sand and a strong wind for dune formation, as well as low-lying land. The ridges either re-align themselves to changes in wind direction or become partially or completely stabilised by vegetation.

An important attribute of this habitat is that some change is an essential part of the system. Many characteristic plants of dune systems are reliant on some sand movement, and dunes form a natural buffer against coastal erosion, performing best when they are allowed to adjust themselves to changing natural forces. The sand supply from the beach and from offshore can fluctuate, and the dunes react to this by advancing or retreating, so that any attempt to interfere with this process will have consequences for sediment movement over a wider area. An appreciation of the behaviour of sediment is thus essential to the

understanding of the dune habitat. Dune dynamism should not be confused with coastal erosion.

The natural mobility and transition of the embryonic shifting dunes and continuity with adjacent associated habitats should be maintained and not disrupted by coastal defences, artificial (man-made) linear constraints, or extraction of sand.

This habitat is particularly vulnerable to trampling by beach users and to mechanical cleaning of beaches, as this can cause erosion and loss of structure and extent.

SCM of the dune habitats in 2012 (Hough Bay And Balevullin Machair SSSI) and 2014 (Traigh Bhaigh - Sleibhtean agus Cladach Thiriodh SSSI) found the dunes to be in excellent condition with all targets for the vegetation composition and flowering being met.

Negative attributes noted included low levels of invasion by native species associated with areas used for feeding livestock. Light tracking/expansion of existing tracks and, abandonment of vehicles possibly used for the extraction of gravel in the past. None of these were at such a level so as to negatively impact the assessment of the feature but all are indicative of the types of pressures this habitat can be vulnerable to and so should continue to be monitored to ensure management maintains the feature.

2c. Maintain the distribution and viability of typical species of the habitat

This habitat is inherently species-poor and has a limited range of floristic variation. The predominant plants are strandline species such as sea rocket *Cakile maritima* and the two salt-tolerant, sand-binding grasses: lyme-grass *Leymus arenarius* and Marram *Ammophila arenaria*. These grasses generally occur slightly higher up the beach profile than the true strandline species.

Other typical species that colonise embryonic shifting dunes on this site are: Sea sandwort *Honckenyia peploides*; orache sp. *Atriplex* sp; ray's knotgrass *Polygonum oxyspermum*; cleavers *Galium aparine*; sea mayweed *Tripleurospermum maritimum*; silverweed *Potentilla anserine*; whorl grass *Catabrosa aquatic*; common couch *Elytrigia repens*.

Excessive tracking/trampling by visitors / vehicles should be avoided as this can lead to erosion of the embryonic shifting dune and therefore a reduction or loss in the typical/indicator species and a deterioration in the habitat structure.

Birds recorded from the sand dunes at Tiree Machair include oystercatcher (*Haematopus ostralegus*), ringed plover (*Charadrius hiaticula*), lapwing (*Vanellus vanellus*), dunlin (*Calidris alpina schinzii*), snipe (*Gallinago gallinago*), redshank (*Tringa tetanus*), arctic tern (*Sterna paradisaea*) and little tern (*Sternula albifrons*).

Conservation Objectives for Shifting dunes along the shoreline with marram *Ammophila arenaria* (white dunes) [H2120] (Shifting dunes with marram)

2a. Maintain the extent and distribution of the habitat within the site

This habitat, by its very nature, is restricted in the area it can occupy and as dune systems are dynamic. Its extent will be subject to natural change.

The extent of the shifting dune along shoreline with marram feature has been estimated at 32.52ha. This should be maintained within a reasonable range taking into natural changes.

However, this habitat is ephemeral with extent dependent on continued supply of new sand

from the beach plain into the dune system. Therefore restoration of extent should only be applied where changes can be attributed to human intervention.

2b. Maintain the structure, function and supporting processes of the habitat

This habitat can occur on both accreting and eroding dunes, but will rapidly change. Cycles of erosion followed by stability are part of the natural development of shifting dunes with marram and are essential to the maintenance of diversity. It rarely occurs in isolation because of its dynamic nature and because it is successional related to other dune habitats.

A supply of new sand is vital for the continued existence of the shifting dune community and the long-term survival of the dune ecosystem. Dunes form a natural buffer against coastal erosion, performing best when they are allowed to adjust themselves to changing natural forces. The sand supply from the beach and from offshore can fluctuate, and the dunes react to this by advancing or retreating, so that any attempt to interfere with this process will have consequences for sediment movement over a wider area. An appreciation of the behaviour of sediment is thus essential to the understanding of the dune habitat. Dune dynamism should not be confused with coastal erosion.

The natural mobility and transition of the shifting dunes along shoreline with marram and continuity with associated habitats should be maintained and not disrupted by coastal defences, artificial (man-made) linear constraints, or extraction of sand.

This habitat is particularly vulnerable to trampling by beach users and vehicles, as this can cause erosion and loss of structure and extent.

SCM of the dune habitats in 2012 (Hough Bay And Balevullin Machair SSSI) and 2014 (Traigh Bhaigh - Sleibhtean agus Cladach Thiriodh SSSI) found the dunes to be in excellent condition with all targets for the vegetation composition and flowering being met.

Negative attributes noted included low levels of invasion by native species associated with areas used for feeding livestock. Light tracking/expansion of existing tracks and abandonment of vehicles possibly used for the extraction of gravel in the past. None of these were at such a level so as to negatively impact the assessment of the feature but all are indicative of the types of pressures this habitat can be vulnerable to and so should continue to be monitored to ensure management maintains the feature.

2c. Maintain the distribution and viability of typical species of the habitat

The species composition of shifting dunes is constrained by the harsh conditions, but the vegetation is by no means uniform. The most marked floristic variation relates to the degree of instability. Where sand accretion is extremely rapid it is possible to find vegetation that consists only of marram *Ammophila*, *Arenaria* and/or lyme-grass *Leymus arenarius*.

Zonation is a fundamental attribute of a dynamic sand-dune ecosystem. The range of vegetation zones and the transitions between them should be maintained. In most cases there will be several distinct sand dune zones, typically strandline (with sea rocket *Cakile maritima*, sea sandwort *Honckenya peploides*, orache sp. *Atriplex* spp.), embryonic dune (sparse cover of common couch *Elytrigia juncea*, lyme-grass *Leymus arenarius*), mobile dune (more stable dune dominated by marram *Ammophila arenaria*) and fixed dune grassland (with grasses such as red fescue *Festuca rubra*, sheep's fescue *Festuca ovina* and herbs such as cleavers *Galium aparine*, yellow-rattle *Rhinanthus minor*, lady's bedstraw *Galium verum*).

Excessive tracking/trampling by visitors/vehicles should be avoided as this can lead to erosion of the shifting dune and therefore a reduction or loss in the typical/indicator species

and a deterioration in the habitat structure.

Tiree Machair SAC supports over-wintering populations of turnstone (*Arenaria interpres*), purple sandpiper (*Calidris maritima*) and sanderling (*Calidris alba*). There are internationally-important populations of breeding ringed plover (*Charadrius hiaticula*), dunlin (*Calidris alpina schinzii*) and redshank (*Tringa tetanus*) and exceptionally high densities of oystercatcher (*Haematopus ostralegus*). Internationally important wintering non-breeding populations of Greenland white-fronted goose (*Anser albifrons flavirostris*) and Greenland barnacle goose (*Branta leucopsis*) are also found using sand dune habitats.

Conservation Objectives for Fixed coastal dunes with herbaceous vegetation (“grey dunes”) [H2130] (Dune grassland)

2a. Maintain the extent and distribution of the habitat within the site

This habitat occurs when the dunes become more stabilised, or ‘fixed’ and represents a zone inland where sand deposition decreases. However, this does not preclude an element of mobility, but such mobility should be minor.

The extent of the dune grassland feature has been estimated at 137.67ha. This should be maintained within a reasonable range taking into natural changes.

Some systems may have fixed landward boundaries where adjacent land use has encroached on former dunes, and this provides a clear constraining inland boundary and/or loss of habitat. On other systems, the transition can be gradual, with no fixed limit to the system. Aside from the presence of the Tiree Aerodrome, there are no fixed landward boundaries at Tiree Machair SAC.

2b. Maintain the structure, function and supporting processes of the habitat

This habitat occurs inland of the zone dominated by marram *Ammophila arenaria* on coastal dunes. It represents the vegetation that replaces marram where accretion is no longer significant and the dune stabilises, or becomes ‘fixed’, and the organic content of the sand increases. The largely closed swards that are formed generally are, or have been, maintained by grazing, by domestic stock and brown hare.

Although dune grassland is classed as ‘fixed’ this does not preclude an element of mobility, but such mobility should be minor.

Trampling by beach users, use by livestock in concentrated areas and vehicles can cause localised destabilisation through loss of surface vegetation. However, where left unchecked it can lead to large-scale destabilisation via blowouts. This can result in loss of structure and extent within the system, followed by fragmentation of the habitat and loss of continuity with adjacent associated habitats.

SCM of the dune habitats in 2012 (Hough Bay And Balevullin Machair SSSI) and 2014 (Traigh Bhaigh - Sleibhtean agus Cladach Thiriodh SSSI) found the dunes to be in excellent condition with all targets for the vegetation composition and flowering being met.

Negative attributes noted included low levels of invasion by native species associated with areas used for feeding livestock. Light tracking/expansion of existing tracks and, abandonment of vehicles possibly used for the extraction of gravel in the past. None of these were at such a level so as to negatively impact the assessment of the feature but all are indicative of the types of pressures this habitat can be vulnerable to and so should continue to be monitored to ensure management maintains the feature.

2c. Maintain the distribution and viability of typical species of the habitat

The vegetation of dune grassland will vary dependent on the substrate from calcareous to more acidic. The dune grassland found at Tiree Machair SAC is calcareous.

Typical species of the calcareous dune grasslands (SD7, SD8, SD9, SD19), of which at least eight of the following should be present:

Lady's bedstraw *Galium verum*; sand sedge *Carex arenaria*; glaucous sedge *Carex flacca*; ribwort plantain *Plantago lanceolata*; white clover *Trifolium repens*; birdsfoot trefoil *Lotus corniculatus*; common mouse-ear *Cerastium fontanum*; self-heal *Prunella vulgaris*; red fescue *Festuca rubra*; common storksbill *Erodium cicutarium*; springy turf-moss *Rhytidiadelphus squarrosus*; Fairy flax *Linum catharticum*

Appropriate low levels of grazing can maintain the closed swards of this habitat. However, removal of grazing can lead to the development of taller, coarser, species-poor vegetation of lower botanical interest, such as coarse grassland, and loss of sensitive species.

Excessive tracking/trampling by visitors/livestock/vehicles can contribute to deterioration in the habitat structure, and a consequent reduction or loss in the typical/indicator species for this habitat, and could lead to conversion to other habitats.

Colonisation of this habitat by vigorous native species, such as common ragwort *Senecio jacobaea*; creeping thistle *Cirsium arvense* and stinging nettle *Urtica dioica* can cause irreversible habitat loss in the longer term, through loss of typical/indicator species and conversion to other open-ground habitats or woodland. Such species were located at Tiree Machair SAC in 2012, although at low frequency however this should continue to be monitored.

Tiree Machair SAC supports over-wintering populations of turnstone (*Arenaria interpres*), purple sandpiper (*Calidris maritima*) and sanderling (*Calidris alba*). There are internationally-important populations of breeding ringed plover (*Charadrius hiaticula*), dunlin (*Calidris alpina schinzii*) and redshank (*Tringa tetanus*) and exceptionally high densities of oystercatcher (*Haematopus ostralegus*). Internationally important wintering non-breeding populations of Greenland white-fronted goose (*Anser albifrons flavirostris*) and Greenland barnacle goose (*Branta leucopsis*) are also found using sand dune habitats. Non-plant typical species of this habitat include wild herbivores such as brown hare *Lepus europaeus*.

Conservation Objectives for Humid dune slacks [H2190]

2a. Maintain the extent and distribution of the habitat within the site

This habitat occurs primarily on the larger dune systems and in low-lying areas within dune systems that are seasonally flooded and where nutrient levels are low. The extent of the humid dune slack feature has been estimated at 67.1ha. This should be maintained within a reasonable range taking into natural changes.

Some systems may have fixed landward boundaries where adjacent land use has encroached on former dune habitat, and this provides a clear inland boundary. On other systems, the transition can be gradual, with no fixed limit to the system. Aside from the presence of the Tiree Aerodrome, there are no fixed landward boundaries at Tiree Machair SAC.

2b. Maintain the structure, function and supporting processes of the habitat

This habitat represents the later, more mature, stages of the well-marked successional sequence characteristic of sand dunes and generally forms a mosaic with other dune habitats. Humid dune slacks are characterised by a pattern of seasonal fluctuation of the water table, related to the landform of the dune system as well as climate and the nature of the underlying sediment – whether porous shingle or impervious clay.

Transition and interchange between mobile dune, dune grassland, dune slacks and dune heathland will occur through natural processes. In addition, successional and hydrological processes are crucial to the maintenance of the structure and function of humid dune slacks. Where feasible all dune slack communities should be present – from embryonic dune slacks with a high percentage of bare ground to those with more closed vegetation, or existing established slacks should be maintained.

The humid dune slack feature at Tiree Machair SAC is located in the wetter parts (often flooded in winter) of an extensive plain known as The Reef, particularly along the margins of An Fhaodhail. On The Reef the slack occurs along the wetter margin of the machair plain in a fairly balanced system of sand erosion and deposition and little movement of features; the feature is relatively static and lacks successional stages and diversity of habitat structure such as bare earth. The vegetation communities within the slack areas are also thought to be very specialised; the continued presence and nature of these communities is an important quality of the slack. Following detailed discussions with the coastal and wetlands advisors a site specific methodology for monitoring this feature was agreed.

Trampling by recreation users, including horse riders, use by livestock in concentrated areas and vehicles can result in the establishment of a path around the edge of slacks that breaks the habitat transition between the slack and fixed dune. This can lead to fragmentation of the habitat. Monitoring of Tiree Machair SAC in 2008 found no evidence of any fragmentation of the habitat with all associated targets met.

2c. Maintain the distribution and viability of typical species of the habitat

The vegetation of humid dune slacks varies depending on the underlying sediment and in the extent and duration of flooding that occurs on the dune surface. Where the habitat occurs on calcareous sand, the slack vegetation is similar to that of small sedge mires (mires with low-growing sedges), or on acidic dunes where the vegetation may have affinities to wet heath.

At Tiree Machair SAC, the vegetation communities within the slack areas are thought to be very specialised. During the NVC of the island in 1993 Dargie proposed a number of new mire communities as the vegetation failed to fit with the standard types. The continued presence and nature of these communities is an important quality of the slack. Following detailed discussions with the coastal and wetlands advisors a methodology for monitoring this feature has been agreed.

The following communities are now used to assess the humid dune slacks at Tiree Machair SAC: Mx *Carex nigra* poor-fen community, S19 *Eleocharis palustris* swamp, S27 *Potentilla palustris* - *Carex rostrata* fen, S14 *Sparganium erectum* swamp, as per the 1993 Dargie report.

Typical species found at Tiree Machair include water mint *Mentha aquatica*; glaucous sedge *Carex flacca*; sand sedge *Carex arenaria*; birdsfoot trefoil *Lotus corniculatus*; lesser spearwort *Ranunculus flammula*; silverweed *Potentilla anserina*; marsh pennywort *Hydrocotyle vulgaris*; marsh bedstraw *Galium palustre*; yellow starry feather-moss

Campylium stellatum; self-heal *Prunella vulgaris*; bog pimpernel *Anagallis tenella*.

Low levels of grazing with timing sufficient to allow flowering and fruiting of humid dune slack species and maintain the typical species of this habitat. However, removal of grazing or over grazing can lead to loss of sensitive species and conversion to other habitats.

Excessive tracking/trampling by visitors /livestock/vehicles can contribute to a deterioration in the habitat structure, leading to a reduction or loss in the typical/indicator species for this habitat and could lead to conversion to other habitats.

All targets were met for the humid dune slacks at Tiree Machair SAC in 2005, and the feature was reported to be in a favourable maintained condition. This was the first time this feature was reported on for SCM but comparison with the NVC report indicated that the feature had been in an excellent condition for some time.

Colonisation of this habitat by vigorous native species, such as common ragwort *Senecio jacobaea*, creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, stinging nettle *Urtica dioica* could lead to irreversible habitat loss in the longer term, through loss of typical/indicator species and conversion to other open-ground habitats or woodland.

Tiree Machair SAC supports over-wintering populations of turnstone (*Arenaria interpres*), purple sandpiper (*Calidris maritima*) and sanderling (*Calidris alba*). There are internationally-important populations of breeding ringed plover (*Charadrius hiaticula*), dunlin (*Calidris alpina schinzii*) and redshank (*Tringa tetanus*) and exceptionally high densities of oystercatcher (*Haematopus ostralegus*). Internationally important wintering non-breeding populations of Greenland white-fronted goose (*Anser albifrons flavirostris*) and Greenland barnacle goose (*Branta leucopsis*) are also found using sand dune habitats. Non-plant typical species of this habitat include wild herbivores such as brown hare *Lepus europaeus*.

Conservation Objectives for Machair [H21A0]

2a. Maintain the extent and distribution of the habitat within the site

This habitat occurs primarily on the larger dune systems and in low-lying areas within dune systems that are seasonally flooded and where nutrient levels are low. The extent of the machair feature on this SAC has been estimated at 486.25ha. This should be maintained within a reasonable range taking into natural changes due to a high level of dynamism, but also taking into account the inherent difficulties of defining this habitat on the ground.

Natural dynamism is most easily identified in winter, when sand often lies on the surface denoting recent sand movement. As a minimum, the system should not be over-stabilised: the dune system (which is not part of the Annex I habitat in terms of definition, but is in terms of function) should show evidence of sand movement (dominance of *Ammophila* or *Leymus arenarius*), bare sand should be visible, and ideally bare sand should be clearly visible within the dune vegetation and coastal defences should have only minimal influence on inward sand movement. The landward transition is usually marked by a loch, marsh, or transitional blackland. The wetter areas should demonstrate natural transitions, and the blackland transition should be either natural or reflect traditional land use rather than (say) industrial impact.

2b. Maintain the structure, function and supporting processes of the habitat

Habitat structure and function are reliant on maintenance of sediment dynamism and maintenance of existing hydrological processes, which can include artificial drainage. Indeed, some machair habitat was created by drainage of lochs and marshes. Supporting

processes include land use which can be complex.

Generally the preference is very much for low levels of cattle grazing over sheep grazing, with some grazing required to prevent the grassland becoming rank and species-poor. Cattle grazing is widely used on Tiree. The timing and level of grazing should allow plants to set seed and should avoid poaching and on-site feeding, both of which promote ruderals.

SCM of Tiree Machair in 2012 assessed the machair as being in favourable declining condition due to the short grazed sward at Hough Bay. Here the machair was found to be very short in sward height in places and the flowering and seeding although present was not as profuse as hoped. The area appeared to be overgrazed by sheep and cattle. The sward diversity was still high indicating that the site has not had a long history of overgrazing. If this is allowed to continue species diversity may fall.

The short sward height may have been linked to the reported poor grass growth in 2012 due to the extended summer drought experienced on the west coast of Scotland in 2012. It was therefore agreed that the feature should not be failed but the management should be reviewed so that overgrazing in poor grass crop years does not reoccur.

A review of management was also recommended for the two smaller areas to the south of Traigh Chornaig and west of Traigh Baile a Mhuilinn, as some shorter more heavily grazed areas were also noted near the school. There are currently two AECS contracts covering the south of the site that have reduced grazing pressure, which cover 20% and 15% of these areas respectively.

Reseeding should not be carried out on machair used for grazing; restoration of areas already reseeded is not currently regarded as viable, but the problem is rarely very serious. Overgrazing tends to lead to a reduction in biodiversity and should be managed accordingly.

2c. Maintain the distribution and viability of typical species of the habitat

A wide range of plant communities is present on machair, and there is considerable variation within these. With seasonal land inter-annual variations in land use and climate, considerable changes may be recorded between observations. This should not be regarded as a negative attribute but as the result of natural variation within a very dynamic habitat, unless there are grounds for suspecting that land use changes are involved. In particular wet areas should not be subject to new (additional) drainage.

Uncultivated 'natural' machair may have a wide range of species. These will vary according to land use and the degree of wetness. The range is so wide that listing typical species is not possible within this document. However the following species can be found at Tiree Machair SAC:

Galium verum
Centaurea nigra
Cynosurus cristatus
Plantago lanceolata
Trifolium repens
Lotus corniculatus
Cerastium fontanum
Linum catharticum
Ranunculus acris
Trifolium repens
Potentilla anserina
Festuca rubra

Machair that has never been cultivated, such as that at Tiree Machair SAC, can be identified by the presence of

Ophioglossum sp.
Selaginella selaginoides

This habitat should have a low level of grazing to maintain the closed sward whilst allowing typical species can flower and set seed. Grazing should not be removed altogether as this can lead to the development of taller, coarser, species-poor vegetation of lower botanical interest, such as coarse grassland, and loss of sensitive species.

Excessive colonisation of this habitat by vigorous native species, common ragwort *Senecio jacobaea*; timothy grass *Phleum pratense* or perennial ryegrass *Lolium perenne* should be avoided as this can lead to loss of typical species or to habitat loss in the longer term. *Senecio jacobaea* was found to be present at Tiree Machair in 2012 but very rare. *Phleum pratense* or *Lolium sp* frequent in one transect at one point in Hough Bay; however the overall target was met.

Non-plant typical species of this habitat include brown hare *Lepus europaeus* as well as bird species including high densities of breeding waders such as lapwing *Vanellus vanellus*, oystercatcher *Haematopus ostralegus*, ringed plover *Charadrius hiaticula*, redshank *Tringa totanus* and snipe *Gallinago gallinago*

Conservation Objectives for Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation [H3150] (Naturally nutrient-rich lakes or lochs which are often dominated by pondweed)

2a. Maintain the extent and distribution of the habitat within the site

The extent of the Naturally nutrient-rich lakes or lochs which are often dominated by pondweed habitat has been estimated at 40.18ha. This should be maintained.

The area figure has been taken from the Standard Data Form. Fundamentally there should be no measurable net reduction the extent of the habitat and, most importantly, its distribution throughout the site and the number of sites should be maintained.

This should include the total surface area, depth of water and type and distribution of loch substrate sediments.

This conservation objective is considered to be met if the conditions to ensure the habitat's long-term existence are in place.

2b. Maintain the structure, function and supporting processes of the habitat

The structure and function of lochs are strongly influenced by activities within their catchment. Changes in land management or development can affect the integrity of the feature which will manifest itself in changes to the loch.

Physical Attributes

-Surface Area

Changes to surface area can indicate pressures on the structure and function of lochs. The surface area of a loch may fluctuate slightly naturally. However changes to surface area and the associated change to depth can adversely affect the character of the loch, particularly the edge vegetation. Artificial fluctuations to depth found in controlled water bodies such as reservoirs can adversely affect the vegetation.

Changes to the surface area may also indicate a number of pressures such as abstraction, regulation, construction, excessive sediment deposition and natural succession which may be caused by issues in the catchment.

Loch Bhasapoll at Tìree Machair SAC appears to have the same surface area as at the time of designation.

-Hydrological regime

The hydrology of the loch affects both water level fluctuations and annual and within year flushing patterns. Flushing is important as it is strongly related to dilution and removal of nutrients and plankton. Changes to the flushing pattern can be caused by factors similar to those affecting area; abstraction, regulation, construction, excessive sediment deposition and natural succession which may occur in the catchment.

SCM performed in 2009 stated the loch appeared to have a natural hydrological regime; water levels were estimated to be 0.50 to 0.80 m lower than normal in June, although there was no evidence of any recent water level management.

-Loch substrate character

The type and distribution of sediment particles within a loch will affect the biology of the loch and the availability of habitats. Changes to the substrate character may also be indicative of changes to the area and hydrological regime. Reduction in area or flushing may affect the substrate character as finer sediments become trapped and there is increased input of leaf-litter from scrub encroachment.

-Natural sediment load

Accumulation of nutrient-rich sediment may have a strong effect on the water quality and biology of the loch. Release of nutrients bound to silt can increase enrichment. Increases in sediment loading may result from both changes in land management practice in the catchment or on the shoreline and short term events such as construction. Evidence is growing that an increase in storm events associated with climate change may increase the amount of sediment deposited in lochs.

Loch Bhasapoll is predominantly sandy but there are pebble areas and a rocky shore in the south and east.

-Connectivity between the loch and the surrounding area

While a loch is often perceived as a discrete entity the connections between it and the surrounding area are vital to its functioning as part of a natural system. These natural connections can be reduced or changed by, for example, hard engineering works on the shoreline or loch bed and anything that impedes the exchange of water either on the surface or with the underlying water table.

SCM in 2009 found the shoreline of Loch Bhasapoll to be unmodified and natural although some margins are trampled particularly in vicinity of windsurfing school at northern end of loch.

Water Quality

-Dissolved Oxygen

Oxygen is vital to respiration. An artificially high biomass caused by increased loadings of organic matter or algal blooms can create a heavy demand which causes low levels of dissolved oxygen. Dissolved oxygen is likely to be lowest in July and August. The target is dissolved oxygen >6.0mg/l for lochs classified as at Good Ecological Status (GES) under the Water framework Directive (WFD) or >8.0 Mg/l for lochs classified as High Ecological Status

(HES) during July and August.

-pH

This influences many of the chemical processes in lochs such as the binding of phosphorus. Artificial changes through eutrophication or acidification can therefore have a significant effect. Eutrophic lochs should have pH of 7 to 9.

A medium alkalinity value of 66.9 mg l⁻¹ was recorded at Loch Bhasapoll for SCM in 2009. However, data should be interpreted with caution as based only on a single sampling.

-Nutrients

In general issues with nutrient levels are inferred from effects upon the vegetation. Phosphorus is one of the main nutrients required for plant growth and there is strong correlation between Total Phosphorus (TP) concentration and phytoplankton biomass. The target for TP is based on an annual mean; for deeper lochs (mean depth >3m) 35ugP/l maximum annual mean TP, very shallow (Mean depth <3m) 50ugP/l.

In terms of water quality, Total Dissolved Phosphorus (TDP) levels were 15 µg l⁻¹ at Loch Bhasapoll in 2009, well below the upper limit of the expected range for a natural eutrophic loch. However, data should be interpreted with caution as based only on a single sampling.

Nitrogen is the other main nutrient important in loch ecosystems. It is generally less likely to be limiting than phosphorus because of the ability of some organisms to fix Nitrogen from the atmosphere. The target for all lochs is that Annual Mean Total Nitrogen should not exceed 1.5mg/l. with no deterioration from baseline. For Nitrogen limited lochs consideration may be given to setting site based targets.

Chlorophyll a is used as a proxy for algal growth. Phytoplankton is an important part of the processes of a lake ecosystem affecting light penetration and oxygen demand. Excessive chlorophyll a is usually associated with nutrient enrichment. Filamentous algae is also a negative indicator associated with high nutrient levels. Some species can form dense floating rafts or coat macrophytes.

There were no cyanobacterial or algal blooms recorded in Loch Bhasapoll in 2009. Water clarity was clear.

2c. Maintain, or where appropriate restore, the distribution and viability of typical species of the habitat

The indicator species for Naturally nutrient-rich lakes or lochs, which are often dominated by pondweed are:

Potamogeton coloratus

Potamogeton filiformis

Potamogeton gramineus

Potamogeton pectinatus

Potamogeton perfoliatus

Potamogeton polygonifolius

Potamogeton x nitens

Any hybrid with one of the above as parent

Other species:

Apium inundatum

Chara (each species counts)

Eleogiton fluitans

Elatine hexandra

Isoetes echinospora
Isoetes lacustris
Littorella uniflora
Lobelia dortmanna
Pilularia globulifera
Myriophyllum alterniflorum
Myriophyllum spicatum
Ranunculus baudotii

There should be no loss or significant decline and good cover of notable species.

The lochs at Tiree Machair SAC are important for nesting waterfowl, waders and gulls. These include mute swan (*Cygnus olor*), shelduck (*Tadorna tadorna*), teal (*Anas crecca*), pintail (*Anas acuta*), shoveler (*Anas clypeata*), tufted duck (*Aythya fuligula*), red-breasted merganser, water rail (*Rallus aquaticus*) snipe (*Gallinago gallinago*), sedge warbler (*Acrocephalus schoenobaenus*) and reed bunting (*Emberiza schoeniclus*).

Conservation Measures

Tiree Machair is notified as a Site of Special Scientific Interest and management changes described on the list of Operations Requiring Consent must have prior consent from NatureScot (operating name of Scottish Natural Heritage).

Current and recommended management for Embryonic shifting dunes and Shifting dunes along the shoreline with marram *Ammophila arenaria*.

Issue	Measure	Responsible party
Coastal defences	<p>Ensure that coastal defences and/or linear features do not disrupt the natural mobility and supply of new sand of the embryonic shifting dunes or continuity with adjacent associated habitats.</p> <p>There are currently no coastal defences present at Tiree Machair.</p>	Land managers, NatureScot
Excessive tracking/trampling by visitors / vehicles	<p>Ensure tracking/trampling is minimal to prevent erosion of the shifting dunes and loss of typical species.</p> <p>Some light tracking in the dunes and the widening of the existing gravel surfaced track were noted at Hough Bay in 2012.</p>	Land managers NatureScot
Colonisation by vigorous native and/or non-native species [e.g. creeping thistle]	<p>Ensure colonisation of this habitat by vigorous native and/or non-native species, such as creeping thistle, is minimal to prevent loss of indicator species and conversion to other open ground habitats.</p>	Land managers NatureScot
Research and monitoring	<p>To identify emerging impacts on the habitat and their causes, in order to understand the long term issues, and to inform future management of the habitat across Scotland.</p>	NatureScot

Current and recommended management for Fixed dunes with herbaceous vegetation and humid dune slacks

Issue	Measure	Responsible party
Grazing	Ensure low levels of grazing to maintain the closed swards of the dune grassland and humid dune slacks.	Land managers, NatureScot
Habitat continuity	Ensure localised destabilisation through loss of surface vegetation does not lead to large-scale destabilisation via blowouts. To prevent loss of structure and extent within the system and any fragmentation of the habitat and loss of continuity with adjacent associated habitats.	Land managers, NatureScot
Adjacent land uses and Development	Ensure that adjacent land uses and/or development do not limit the inland extent of the dune grassland/humid dune slacks	Land managers, NatureScot
Excessive tracking/trampling by livestock / visitors / vehicles	Excessive areas of bare sand caused by vehicular traffic, parked cars and livestock disturbance should be avoided to prevent a progressive instability and erosion of the sand dunes. The use by crofters of sand from the dunes and for local needs must be carefully limited to prevent damage to the dunes and erosion.	Land managers NatureScot
Colonisation by vigorous native and/or non-native species [e.g. ragwort, creeping thistle, spear thistle, stinging nettle]	Ensure colonisation of this habitat by vigorous native and/or non-native species, such as ragwort, creeping thistle, spear thistle and stinging nettle is minimal to prevent loss of indicator species and conversion to other open ground habitats or woodland.	Land managers, NatureScot
Research and monitoring	To identify emerging impacts on the habitat and their causes, in order to understand the long term issues, and to inform future management of the habitat across Scotland.	NatureScot

Current and recommended management for Machair

Issue	Measure	Responsible party
Herbivore impacts	Ensure low levels of grazing to maintain the typical species.	Land Manager NatureScot
Excessive tracking/trampling by livestock/visitors/vehicles	Excessive areas of bare sand caused by vehicular traffic, parked cars and livestock disturbance should be avoided to prevent a progressive instability and erosion of the sand dunes. The use by crofters of sand from the dunes and for	Land manager NatureScot

	local needs must be carefully limited to prevent damage to the dunes and erosion.	
Habitat management	Maintain plans as required, for example the RSPB Tieve Management Plan.	RSPB NatureScot
Research and monitoring	To identify emerging impacts on the habitat and their causes, in order to understand the long term issues, and to inform future management of the habitat across Scotland.	NatureScot

Conservation Measures for Naturally nutrient-rich lakes or lochs which are often dominated by pondweed

Issue	Measure	Responsible party
Abstraction	Ensure timing and volume of abstraction is not damaging through discussions with regulator. Ensure that drought plans adequately address the interests of the site.	SEPA Scottish Water
Enrichment	Ensure no adverse impacts from diffuse or point sources	Land Manager SEPA
Sediment	Avoid activities such that can lead to bare soils close to watercourses at sensitive times	Land Manager SEPA
Grazing	Ensure grazing avoids poaching of edges and soil erosion. Avoid related activities such as supplementary feeding close to lochs	Land Manager
Development	Ensure any development proposals do not adversely affect the site.	Land Manager Local Authority NatureScot
Invasive species	Maintain surveillance for invasive species and agree action with regulator	SEPA NatureScot
Recreation	Access for recreational activities must consider the habitat and species destruction caused by windsurfing, trampling and car parking around Loch Bhasapoll.	Land manager NatureScot

Contact details:

NatureScot
1 Kilmory Industrial Estate
Kilmory
Lochgilphead
PA31 8RR

Telephone: 0131 316 2690

Approved on 24 November 2020 by:

Greg Mudge
Principal Advisor
International Designations

David MacIennan
Area Manager
Argyll and Outer Hebrides