

Oh, dear! What can the Machair be?

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ABSTRACT

Machair is a mosaic of different habitats – beach, sand dunes, dune slacks, pasture, marshes, ditches and lochs. Indeed to explain their relationship to one another and to the wildlife that inhabits them it is more convenient to think of ‘machair’ as a system, one that conspires to create and maintain the landscape that we celebrate today. Geography, geology, geomorphological processes, climate, plants (in the form of seaweed, marram etc) and animals (molluscs and other calcium-rich marine creatures) all contributed to a habitat mosaic that was to prove so attractive to wildlife. A few thousand years ago humans arrived to populate and work this land . The unique husbandry they came to develop was not only sympathetic to and driven by the local environmental conditions but also, as it happened, served to enrich the biodiversity of the machair. It is only in recent decades that conservationists have come to appreciate this resource and how they must work with the local crofters to retain this biodiversity. But the older generation admit that the wildlife is not as good as it once was. Global climate change, agricultural innovation, and the demands of modern living are now all conspiring to accelerate the erosion of this beautiful, low-intensity land use system, and indeed towards the erosion of the very machair itself.

INTRODUCTION

In recent decades crofters and conservationists alike have come to celebrate the biodiversity of machair but why it all came to be at all goes back millions even billions of years geologically, thousands of years geomorphologically and many generations of human occupation and traditional land use. But there is still debate over what exactly is machair or rather how we should describe it, which is one reason why I have chosen the title for this talk. The other reason, and implied in the title pun, is that all may not be well with machair and its biodiversity. Any crofter will tell you that it is not at all as good for wildlife as it once was.

WHAT IS MACHAIR?

Generations of Gaelic bards have been celebrating the beauty of machair in their poetry. John MacCodrum who lived and worked in North Uist around 1750 composed a poem entitled ‘Smeorach Chlann Domhnaill’:

‘S I `n tìr sgiamhach tìr a`machair,
Tìr nan dìthean miogach daithe,
An tìr laireach aigeach mhartach,
Tìr an aigh gu brath nach gaisear

‘Tis a beautiful land, the land of the machair,
the land of the smiling coloured flowers,
the land of mares and stallions and kine,
the land of good fortune which shall never be blighted.

Since ‘machair’ is a Gaelic word we should of course ask the Gaels themselves. It is a curious irony that the definitive dictionary of the Gaelic language – well over a thousand pages all typeset, illustrated, printed, bound and marketed by the compiler himself – should have been produced by an Englishman, Edward Dwelly (1864-1939). First appearing in 1911 it has remained the classic work of reference to this day - although its author was to die in obscurity in the south of England.

Dwelly had learnt Gaelic so that he could glean as much as possible from native speakers. He gives several meanings of the word ‘machair’ including ‘a low-lying country’ - with, curiously enough given his own roots, ‘machaireach’ being someone who came from the low country in the south! But he adds to this first brief reference ‘an extensive, low-lying fertile plain’. He then expands on this with: ‘a long range of sandy plains fringing the Atlantic side of the Outer Hebrides. They are closely covered with short green grass, thickly studded with herbs of fragrant odours and plants of lovely hues.’ That is very much what the word conjures up in the popular mind, and it is what today we tend to think of as machair.

WHERE IS MACHAIR?

Machair is not restricted to the Outer Hebrides however, as Dwelly implied. It also exists on the Atlantic coasts of mainland Scotland, Orkney, Shetland and Ireland. Gaelic is not indigenous to Orkney and Shetland but ‘machair’ does appear in placenames elsewhere - such as Machrihanish in Kintyre, Machair Bay in Islay, Magheramore and Maghera Strand in Ireland. In Scotland machair grassland (in its strictest sense) covers some 15,000 hectares, almost half of it in the Outer Hebrides. The best and most extensive is in the Uists and Barra, Coll and Tiree.

On the east coast of Scotland we would refer to such dune systems as ‘links’ but the sands there have a

higher mineral content, rich in silica. There is on the other hand a convincing reference to machair existing in southern New Zealand (Wilson *et al* 1993), one of the areas where Scots and indeed Hebrideans, went to settle after the Highland Clearances. Were they attracted to a landscape which seemed so familiar and which they knew would prove amenable to them? I would also like to add, that I encountered what I thought to be machair on several of the Falkland Islands (another honeypot destination for Hebridean settlers). All that these two exotic locations seem to lack is heavy rain and the human element – cultivation.

DEFINING MACHAIR

Experts differ in where machair begins and where it ends. Frank Fraser Darling (1947) noted how: ‘the machair starts with the florally sterile tidal zone of shell sand, then there is the bank of unstable dunes, on the seaward edge of which the marram grass begins to grow thinly.’ Professor Bill Ritchie (1979) takes a stricter view that machair is only the non-dune element of a sandy coast, usually only a few metres above sea level yet ultimately dependent for development upon the beach and the dunes. Dr Derek Ranwell (1974) is more expansive considering it: ‘a local landscape term applied to dune pasture (often calcareous) subject to local cultivation and developed in humid and windy condition in north and west Scotland.’

Nowadays it is often said that machair is the only natural habitat to bear a Gaelic name. Having lived on a machair in South Uist for sixteen years I have come to see machair as not so much a single habitat but a mosaic of *different* habitats – beach, sand dunes, dune slacks, pasture, marshes, ditches and lochs. Indeed to explain their relationship to one another and to the wildlife that inhabits them it might be more convenient to think of ‘machair’ as a system, one that conspires to create and maintain the landscape that we celebrate today.

Perhaps G. Dickinson (1977) gives the most useful description: ‘Machair... merits the use of the term landscape... acknowledging that its existence depends on the physical environment, the habitats provided by this, the vegetation and animal life of the area, man’s activities and all the manifestations of human culture in an interacting ‘socio-ecosystem’.’ Introducing a botanical element Stewart Angus further developed the idea of a ‘machair system’ but perhaps the use of good old-fashioned term ‘ecosystem’ or even ‘socio-ecosystem’ rather than ‘habitat’ encompasses all that is necessary. The machair landscape includes beach, dunes, machair plain, rock knolls, marshes, ditches and lochs that are all habitats in their own right, until finally grading into peaty moorland and hills. We shall see how geology, geomorphological processes, climate, geography, plants and animals, even humans, have all contributed to machair - the habitat mosaic or ecosystem that proves so attractive to wildlife.

THE GEOLOGY OF MACHAIR

Machair lies directly upon an unforgiving platform of ancient, acidic rocks, attractively-streaked grey and black and known as gneiss. Samples from Ardivachar in South Uist have been dated at 2,900 million years making them one of the oldest rocks known. Other strata may have formed on top but by 1,500 million years ago it had all been eroded away to expose a bare rock surface of gentle ridges and basins sloping gradually out to the west. Then, as recently as 65 million years ago when dinosaurs still roamed the earth, the rocks began to split apart forming the North Atlantic Ocean. Thus the northwest of Scotland share gneisses with Greenland and parts of eastern Canada.

GEOMORPHOLOGY AND CLIMATE

Two and half million years ago, and not for the only time in its geological history, the earth was gripped in a series of Ice Ages and warm Interglacials between. The last cold episode began 115,000 years ago and ice eventually covered much of northern Britain. Land subsided under its weight, while the ice had locked away so much water that the sea level also dropped. But even at this time the deep trench of the Minch remained flooded. Some 18,000 years ago the ice began to melt, releasing its vast store of water and revealing the Outer Hebrides as one island some 200 km long. Relieved of its weight of ice the land rose, but sea level was rising faster. It is likely that Uist split apart into separate islands about 4000 years ago. It extended much further west however and over the next 8000 years remained lightly wooded with a patchwork of freshwater lochs but, as yet, little sand. The trees would doubtless have been somewhat stunted and bent over by the prevailing oceanic winds.

Under the sea to the west, the ice sheet had dumped glacial debris where, some 6000 years ago, it was mixing with prodigious quantities of crushed shells from animals living in deeper waters. This calcareous sand was gradually swept ashore and blown inland to form beaches, dunes - and the machair plain. Having been brought up at Northton, the superb machair in Harris, Professor William MacGillivray deduced how the system worked as long ago as 1830:

‘The generally received theory of the formation of drift sands and hillocks or downs is this: the fragments of the shells of molluscous animals inhabiting the sea near the coasts, are rolled by the waves towards the shore, where they are further broken and comminuted. The wind then blows them beyond the water mark, where, in progress of time, hillocks are formed. These hillocks are occasionally broken up by the winds, and blown inland covering the fields and pasture. . .’

TREES?

Archaeology and soil profiles have revealed how machair developed. It seems that sand and debris deposition offshore progressed apace for another few millenium as sea level continued to rise.

By 6000 BC the climate would have been warmer and drier than today. Pollen analysis and more usefully,

beetle remains, indicate that the open birch *Betula* and hazel *Corylus avellana* sp scrub was largely cleared for cultivation, although it would be some time before woodland disappeared altogether. There are remains of trees preserved in peat along the shore, at Stoneybridge in South Uist for instance. But what we would identify as machair nowadays was probably at that time much more stable, with thicker soils able to sustain well-advanced plant communities. Dean Monro could still describe some woodland along the east coast of South Uist as late as 1549.

THE ARRIVAL OF HUMANS.

Although there are no artifacts to suggest that Mesolithic hunter-gatherers were present on Uist, charcoal deposits might suggest that, if not living there, they were at least visiting and setting fire to the woodland. After all, Mesolithic peoples were well established in the Isle of Rum only 50 km to the east, also on Oransay, and on others of the Inner Hebrides further south. Within the next two thousand years prehistoric peoples changed from being hunter-gatherers to farmers. We know of some 200 archaeological sites on the machairs of South Uist alone and who knows how many more remain to be discovered?

While there are numerous burial cairns of Neolithic age (4000-6000 years ago) surviving, in Uist and Benbecula for instance (some even below high water mark), these tend to be further inland. Evidence of houses, on the other hand, are scarce - but erosion has doubtless removed many traces.

It seems that by the Bronze Age, some 1500 or more years ago, sea level had reached a peak and the machair plain had stabilised, with farming now well established. Through the Iron Age machair then went through phases of erosion and deposition. There seems to have been stormy periods eroding the machair between 3800 and 2300 BC for instance, again from 1800 to 1300 BC, AD 200 to 300 and between AD 600 and 700.

Historic sources tell of further major sand blows in recent centuries. In 1756 the houses of Baleshare in North Uist were buried in sand up to their roofs. Indeed the name 'Baile sear' means the eastern town, which implies that there would have been a western town 'Baile siar'. The village of Hussabost is mentioned in a document dated 1389 and was said to have been washed away in the 15th century. It is remembered locally in a reef offshore called Sgeir Husabost, just west of Baleshare, while local tradition maintains how it was once possible to journey across to Heisgeir (the Monach Isles) by horse and cart.

ECOLOGICAL CHARACTERISTICS OF MACHAIR

Dickinson and Randall (1979) summarised the key features of machair.

- 1) the highly **calcareous substrate**, with anything from 20% to 80% calcium carbonate

on the beaches and declining inland. Thus machair soils, though shallow, have a high pH.

- 2) the influence of the **oceanic climate**, mild winters with little frost and snow but cool summers. The soil may have dried out by May but there is little plant growth until warmer summer temperatures finally kick in.
- 3) a **rainfall** of around some 1500mm annually, which encourages, then traps and compacts the sand to facilitate soil formation. Although some machairs may flood to several inches in winter, they dry out quickly in spring.
- 4) **wind** is of course an essential element, driving sand up the beaches, over the dunes and inland. By such means machair may creep 30 or 40 metres up hill slopes, such as at Eoligarry in Barra. Although south-westerlies prevail, wind and storms can come from any direction, even at the height of summer.
- 5) Gales off the sea carry **salt spray**, a factor which greatly affects plant growth. Even in June or July the vegetation can burn brown after an unseasonal westerly storm.
- 6) A final ecological characteristic is **human activity** through stock husbandry and cultivation.

SEAWEED

Having considered physical features such as geology, geomorphology, archaeology and climate, it is now appropriate to assess the botanical contribution to machair development.

William MacGillivray recognised the importance of marram *Ammophila arenaria* but while this is undoubtedly a key plant in the formation and perpetuation of dune habitats and machair, another crucial plant is usually overlooked. This is seaweed, mainly kelp or tangle *Laminaria*, which lies offshore in dense beds that shelter rich communities of marine life, including fish. But these kelp beds also serve to absorb wave energy and thus reduce erosion along the soft, sandy Atlantic shores of Uist, Coll, Tiree etc.

In winter storms kelp is ripped off the seabed, to be carried ashore and dumped on the beach in piles sometimes several metres high. Here crofters have been able to harvest and dry the stipes, later to be processed for valuable alginates etc. – though never again on the scale achieved two hundred years back. These heaps of stranded seaweed continue to reduce the impact of wind and wave and thus protect beaches and dune fronts from erosion. Rotting seaweed abounding in sand flies and other invertebrates provides rich feeding for flocks of starlings *Sturnus vulgaris* and other passerines, wintering waders, gulls and a host of others.

If the cast tangle does not get swept away again on the next spring tides it soon gets covered with sand, to create beds of damp compost where seeds of coastal

annual flowers, and of course marram grass, can germinate and thrive.

THE IMPORTANCE OF LAND PLANTS

Only the hardiest and most salt-tolerant of plants such as sea sandwort *Honkenya peploides*, sea rocket *Cakile maritime* and mayweed *Tripleurospermum maritimum* can withstand rigorous coastal conditions. A salinity in excess of 0.5% is harmful to most plants, salt not only being toxic in itself but it disrupts osmotic processes that make it difficult for roots to take up moisture. To cope with this the plants that can survive near the coast tend to have sap with a higher than normal salt concentration.

One of the most celebrated flowers of Hebridean beaches is the sea bindweed or convolvulus *Calystegia soldanella*. Growing along the dune edge on Eriskay for instance, at the very spot where Bonnie Prince Charlie first set foot on British soil in 1745, it is known as the Prince's flower. Island tradition maintains how the seeds fell out of his pocket as he stepped ashore. Although not wishing to spoil a good story, botanists have to admit that it is also found on Vatersay further south, on some of the Inner Hebrides, at the Giant's Causeway in Antrim, even on South Ronaldsay in Orkney, all places Charlie never ventured! The ability of seeds from such pioneering beach plants to withstand saltwater was first investigated by the celebrated naturalist Charles Darwin, who as a medical student at Edinburgh University had met William MacGillivray, then curator of the natural history museum. Darwin successfully germinated 64 of 87 plant species whose seeds he had immersed in seawater for periods of up to 28 days, enough to travel distances in excess of a thousand miles.

Plants have the facility to react when more sand is dumped on top; the vegetation grows taller and thicker, thus encouraging fore dunes to develop and stabilise. Marram plays a particularly significant role maintaining a protective rampart of dunes between the sea and the machair plain. As MacGillivray astutely observed: 'It is the natural inmate of a sandy soil, to which, in fact, it is peculiar. It is therefore obviously the best that could be selected for the purpose of fixing loose sands.' Its deep roots and thick tussocks trap and bind blowing sand and grow vigorously to keep pace with its accumulation. Furthermore, marram's spiky, in-rolled leaves have a remarkable ability to withstand the desiccating effects of stong winds, which in turn serves to break open and disperse the seed heads.

Behind these dunes of marram, sometimes reaching 10 metres or more in height, the impact of wind and salt spray is reduced sufficiently for a variety of other plants to establish. The first are annuals that perpetuate afresh each year from abundant blown seed Marram finally gives way to red fescue *Festuca rubra* and some other grasses, buttercups *Ranunculus* spp, ragwort *Senecio jacobaea*, storks-bill *Erodium cicutarium*, scarlet pimpernel *Anagallis arvensis*, speedwells *Veronica* spp and rue-leaved saxifrage *Saxifraga*

tridactylites, all of which can still tolerate a thin covering of wind-blown sand in winter. Perennial plants do not thrive until the sand is less mobile, allowing white clover *Trifolium repens*, bird's foot trefoil *Lotus corniculatus*, silverweed *Potentilla anserina* and ladies bedstraw *Galium verum* to now take hold. Now decaying plant matter can accumulate that helps retain moisture and renders the soil a little more acid. The plants of the stable machair plain are too numerous to list here but it is worth mentioning Ben Eoligarry in Barra, where sand blown 100 metres up the rocky slopes inland supports an unusually profusion of primroses *Primula vulgaris*- alongside other species such as thyme *Thymus praecox*, frog orchids *Coeloglossum viride*, and adder's tongue fern *Ophioglossum vulgatum*.

In June yellow is the dominant colour, from buttercups, vetches *Vicium* spp and bird's foot trefoil; meadow rue *Thalictrum minus* is unusually abundant on machair. On damper ground cottongrass *Eriophorum angustifolium*, silverweed, yellow rattle *Rhinanthus minor*, and marsh marigolds *Caltha palustris* thrive. Red and purple become the prevalent colours later in the summer from red clover *Trifolium pratense*, ragged robin *Lychnis flos-cuculi*, with self heal *Prunella vulgaris* in damp grassland. Baltic rush *Juncus balticus* and curved sedge *Carex maritime* are unusually abundant along the machair from North Uist to Lewis, but some orchids are particular Hebridean highlights.

Botanical interest is reduced where machair meets moorland. It is on this so-called 'blackland' that the croft buildings tend to be located, amidst enriched pasture and hay meadows. In Coll and Barra however small patches of damp, peaty pasture or marsh grazed by cattle are home to one of the rarest orchids in Europe - Irish lady's tresses *Spiranthes Romanzoffiana*. It is principally a North American species, though how it came to colonise the remote western seaboard of Scotland and Ireland is still being debated. One theory is that the tiny seeds were transported on the muddy feet of migrant wildfowl such as white-fronted geese *Branta leucopsis*, something that Charles Darwin demonstrated on woodcock *Scolopax rusticola* and ducks.

ISLAND EFFECTS ON FLORA AND FAUNA

One might expect machair to be rich in species, but in fact can muster no more than 150 species. When the mosaic of associated habitats is included, some islands such as the Monach Isles (Heisgeir) can support some 200 species while Tiree has a list of over 500. But what machair lacks in species is of course compensated for by sheer abundance and spectacle. In contrast, dune pasture on the east coast of Scotland, can support 400-500 species. The paucity of species may well result from the fact that the best machairs are to be found on islands.

To colonise an island, plants and animals have to overcome the barrier presented by the sea. If they cannot survive the voyage, as seeds or in rafts of

vegetation, then there are only two other alternatives available to them – as wind-blown seeds or spores, or by hitching a lift on other animals, be they birds or humans. Many plants have developed sticky seeds, or with hooks that can attach to plumage or fur. Others fruits and seeds may arrive in the crop, gut or droppings of birds or domestic animals yet – as Darwin again demonstrated – can still germinate. Furthermore humans may bring in other plants in fodder crops.

Such principles also apply to invertebrates but the trend for islands to possess fewer species than the mainland still holds. Some 937 beetles are listed for the Inner Hebrides, about 600 for the Outer Hebrides, with only 350 or so for Orkney and for Shetland. Beetles also reflect habitat differences; only 22 species being found on the shore and foredunes, but 155 species on the machair. Similarly 16 earthworm species occur in machair but only 7 on open moorland.

While snails, grasshoppers, flies, spiders and harvestmen might appear numerous enough on machair they are less diverse than on the mainland. There is a group of spiders whose tiny young can disperse over large distances using long threads of gossamer. They are termed balloonists and being able to travel on winds or air currents it is not surprising that they make up a significant proportion of the Uist spider fauna. Bumble bees, on the other hand are strong fliers, and one or two Hebridean specialities are resident on machair grassland. Machair possesses relatively few lepidoptera, meadow brown *Maniola jurtina*, common blues *Polyommatus icarus* and small tortoiseshell *Aglais urticae* being the commonest butterflies with dark arches *Apamea monoglypha* and common rustic *Mesapamea secalis* as the most widespread moths. The belted beauty *Lycia zonaria* is an interesting machair moth, the females being flightless; one theory is that they might have reached offshore islands on rafts of dead wood.

THE IMPACT OF HUMANS

When humans arrived to populate and work this land some six thousand years ago they quickly developed a unique husbandry that was guided by, and ideally suited to, the local environmental conditions. Early farmers were quick to appreciate the bounty from the sea and liberally applied seaweed over their machair cultivations. Seaweed provides a protective cover to the thin sandy soils thus minimising wind erosion, while the alginate content helps bind the soils, facilitates moisture retention and of course, introduces organic material and vital nutrients.

It is significant that at the height of the kelp industry two hundred years ago when crofters were deterred from adding tangle to their fields erosion became a serious problem. In 1811 for example James Macdonald could only observe how ‘in winter, and even until the middle of May. . . machair is almost a desolate waste of sand’.

By 1830 however, after the collapse of kelping, William Macgillivray wrote: ‘It must not be imagined that this Hebridean sand is on a barren soil, it being destitute of vegetation only when drifting loose. When in some degree fixed by moisture, or the interspersing of pebbles and shells, it affords excellent crops of barley, when manured with sea-weeds, and its natural pastures are by far the best.’

TRADITIONAL LAND USE AND BIODIVERSITY

The real spectacle of machair flowers is greatly enhanced in Uist by another agricultural activity - cultivation. Traditionally the area was cultivated on a two- or three-year rotation so that no more than half the arable machair will come under the plough at any one time. Tيرة machair on the other hand, which constitutes nearly half of the island’s area, is not normally cropped - perhaps because the interior is less rocky so can be easily ploughed instead. Cultivation has all but ceased in Barra, Harris and Lewis.

In the first year of fallow, wild pansy *Viola tricolor*, poppies *Papaver rhoeas*, creeping buttercup *Ranunculus repens*, forget-me-not, mouse-ear *Cerastium fontanum* and storksbill are added to the flora, with clover and red fescue establishing in the second year as creeping buttercup is gradually replaced by meadow buttercup *R. acris*. Here and there the tiny, scarlet pimpernel adds a further dash of colour.

SOIL DEFICIENCIES

Although lime-rich machair soils would be expected to be relatively productive. However they can be rather low in some essential nutrients and trace elements such as copper, cobalt and manganese. Livestock used to be able to make up some of this dietary deficiency when they were moved from the machair to summer pastures out on the hill grazings. The animals tend to be kept in fenced areas around the croft nowadays so mineral supplements are often necessary.

Sandy soils are open and free-draining so nutrients wash out easily and artificial fertilisers might prove ineffective. Deficiencies in machair soils limit the crops that can be grown. Only the older strains of small oats and rye will thrive, along with the old, six-rowed bere barley. Rye is particularly tolerant of the dry conditions and has strong stalks that resist the wind and allow mechanical binders still to be used. Small oats grow quite well in competition with wild flowers which - if the crop was intended as anything other than cattle fodder - would be condemned as weeds. It is therefore not normally practical to consider expensive herbicide treatment. Early in the season cereal crops are dominated by corn marigold *Chrysanthemum segetum* or charlock *Sinapsis arvensis*, with bugloss *Lycopsis arvensis*, field pansy, cornsalad *Valerianella locusta*, red dead-nettle *Lamium purpureum* and sun spurge *Euphorbia helioscopia*.

BIRDS OF THE MACHAIR

Much has already been published about the rich birdlife of the machairs of Coll, Tiree and Uist. These islands have become the last British stronghold of the corncrake *Crex crex* for example, and are fast becoming so for other farmland birds such as corn bunting *Emberiza calendra*, twite *Acanthis flavirostris* and skylark *Alauda arvensis*. In Uist even the rare little tern *Sterna albirfrons* might forsake the foreshore to nest amongst the cultivations.

It is almost certainly the absence of mammalian predators on these islands that make them safe havens for such ground-nesting birds. None benefit more however, than the waders. During the 1980s over 25,000 pairs bred on machair each year, some 6,000 in Tiree alone, with another 17,000 in Uist and Barra.

The most numerous wader is the peewit or lapwing *Vanellus vanellus*, a bird now increasingly rare on intensive farmland on the mainland. In Uist, lapwing breed in the highest densities amongst the dune slacks and on drier grasslands (up to 85 pairs per km²) with fewer numbers (40 per km²) in damp machair and fewest (30 per km²) on dry cultivated machair and croftland; in Tiree densities are lower. Dunlin *Calidris alpine* are more specific, preferring the tufted vegetation of wet machair to conceal their nests. A record density of some 300 pairs per km² has been recorded in one area of South Uist, with some 40% of the British Dunlin population being found on the machairs of the Uists and Tiree alone. Redshank *Tringa tetanus* and snipe *Gallinago gallinago* prefer the taller vegetation of marshes and wetlands.

It is the oystercatcher *Haematopus ostragalus* and ringed plover *Charadrius hiaticula* that are most dependent upon arable practices. Normally they nest on shingle beaches or bare ground, where their cryptically coloured eggs are well concealed; they also like the broken runways on The Reef in Tiree. But both species also nest on dry cultivated machair. Up to 400 pairs of ringed plover have been recorded per km² on ploughed land or recent fallow in Uist. This constitutes nearly one third of the total British breeding population of ringed plover.

Storm-cast, rotting seaweed offers important feeding grounds for flocks of wintering waders. Saltspray and wind-blown shell sand add nutrients to machair lochs, resulting in an interesting profusion of freshwater plants associated with prodigious invertebrate populations, all of which provide rich feeding for waterfowl both in winter and summer. Several hundred pairs of mute swans *Cygnus olor* breed. Whooper swans *Cygnus Cygnus* from Iceland overwinter and, although odd birds summered and even laid eggs, for the first time, in 2008, a pair successfully fledged six cygnets in North Uist. Later in October, barnacle and white-fronted geese *Anser albifrons* arrive from Greenland. These wildfowl, along with the resident greylag geese *Anser anser*, like to feed on the stubble.

GREYLAG GEESE

There has always been a relict population of greylag geese resident in Uist, reckoned to be of pure, original native stock.

As long ago as 1764 the Rev. John Walker recognised the damage they could inflict:

‘The crops in North Uist and Benbecula, but especially South Uist, are exposed to a very singular misfortune; being sometimes entirely destroyed by the vast flocks of wild geese, which haunt these islands. This bird is never seen in the south of Scotland except in winter but in these islands it hatches and resides all the year round. . .’

Recent counts indicate several hundred greylags in Colonsay, Coll, Lewis and Harris, with several thousand in Tiree and in Uist. Although wildfowling are permitted to shoot greylags in winter, numbers are increasing each year. These flocks are not of course comparable with the huge numbers wintering on the mainland and in Islay but, in a crofting context, the damage they might do is highly significant. In some parts of Uist geese can compete with sheep for the first spring flush of grass on reseeded pastures in spring, and then flatten or graze ripening corn just prior to harvest in the autumn.

In 1992 Uist pioneered a Goose Management Committee of crofters, estates, the local council, agricultural agencies and conservationists, paving the way for other more formal, funded schemes. Not only do they undertake regular counts but the Schemes also collate complaints, lend out goose scarers and organise shooting parties. On machair their particular remit is to minimise goose pressure on crofting, thus maintaining biodiversity, yet still retaining a viable breeding population of pure-bred Scottish greylags.

KEEPING THE BALANCE

Machair is cultivated to provide winter feed for livestock. Cattle do not graze as closely as sheep, taking the less palatable species as well as the less attractive portions - stems, seed heads, dead plant material, rushes, cotton grass and other less tasty plants. Cattle thus improve the quality of sward for other grazers as well as for wildlife. In addition, trampling creates texture in the sward, tussocks for example providing good invertebrate habitat and thus food for birds. Breaking up coarse vegetation (such as iris *Iris pseudacorus* root systems) further opens up and improves the pasture. Poached ground creates bare patches which are good for invertebrates and as seed beds for annual plants. Dung contains seeds and grain to help the ground regenerate, while adding useful nutrients and humus to the soil.

The mosaic of extra habitats created by low intensity land use enhances biodiversity. But crofting is at the same time implicit in the survival of Gaelic culture in these crofting communities. In turn such a distinctive mix of culture, landscape and wildlife generates

tourism. Thus good crofting, alongside nature conservation, is a highly successful combination that proves vital to the economy of the islands.

Many good examples of machair have been protected first as SSSIs or nature reserves, and more recently under the European Directives. Such designations can attract funding for continuing wise and productive management of the land. Such practises are however labour-intensive so environmental support needs to be both appropriate and generous.

In 1993 Iain MacIver, then President of the Scottish Crofters' Union (now the Scottish Crofting Federation), highlighted the problems.

'As crofters we have always been aware of our responsibility for the unique environment of the crofting areas, and we realise that crofting and conservation can and should go hand in hand. Crofting is integrally linked with the distinctive cultures and languages associated with the Highlands and Islands, and with equally distinctive plant and animal communities. . . We believe that any rural policy should contain social and environmental, as well as agricultural objectives. Crofters should be rewarded for sound management of the countryside, not just for food production.'

ALIEN INTRODUCTIONS

Only otters *Lutra lutra* and seals can be considered truly native to the Hebrides. Subsequently pygmy shrews *Sorex minutus*, field voles *Microtus agrestis*, Orkney vole *Microtus arvalis*, mice *Muss pp* and rats *Rattus* spp, feral cats *Felis domesticus*, rabbits *Oryctolagus cuniculus* and red deer *Cervus elaphus* arrived with man, along with a host of plants. The dangers of introduced species has long been recognised as a worldwide risk for native flora and fauna.

Two or three centuries ago rabbits were brought to the islands as a source of food. Tiree and Berneray (off North Uist) are exceptions, although the latter with its new causeway is now at risk of invasion. Since myxomatosis, people are less inclined to eat rabbits. Numbers fluctuate, and while rabbits will damage crops and pasture their warrens can initiate serious soil erosion, as well as providing bare sand for ragwort and other noxious weeds to set seed and to spread.

Ferrets *Mustela putorius furo* are a recent introduction to Uist, ostensibly to control rabbits but in this they have singularly failed. Together with feral cats ferrets will also prey upon birds. Fortunately though, feral cats are now extinct on the Monach Isles National Nature Reserve.

Mink *Mustela vison* escaped from Lewis fur farms in the 1960s, and have now increased to wipe out many shorebird colonies throughout the Hebrides and the west coast mainland. A strategic trapping campaign has recently removed mink from Uist, and is now concentrating efforts on Lewis and Harris ultimately to

remove mink altogether from the Outer Isles. Hedgehogs *Erinaceus europaeus* were introduced to the Uists in the 1970s but instead of munching garden slugs they found wader eggs more appealing. Recent studies by SNH and the RSPB have demonstrated such serious declines in wader numbers in South Uist and Benbecula that strategic control measures were instigated. This has prevented any further spread into North Uist and ultimately seeks to remove them altogether from Benbecula and South Uist.

EROSION

All such problems seem to fade in significance, compared with global climate change. The gradual rise in sea level and an increase in Atlantic storms has intensified erosion. With increasing frequency any natural capacity for sand dunes to recover is hopelessly ineffective. Erosion has long been a threat to machair, and concerns were expressed in Uist in February 1982, only to be repeated in January 1993 (when hurricane force westerlies also drove the oil tanker *Braer* aground in Shetland). Three metres of machair were lost that night along the entire length of Uist and Barra. During an even worse storm on the 11/12th January 2005, southerly winds well in excess of hurricane force 12 blew all night without respite, peaking at about 225 km per hour in Benbecula. Hectares more machair were washed away, huge areas were flooded and one family of five, representing three generations, tragically died.

There are few beaches more lovely and unspoilt than those of the Northern and Western Isles, all a considerable asset for the local tourist trade (though perhaps midges, cool winds and cold seas conspire to prevent over-exploitation!) With care, recreation need not be damaging. Offshore kelp beds, shingle beaches and marram are all vital natural buffers against storms, while it is crucial that cast tangle continues to be applied to machair soils .

CONCLUSION

Machair is both a dynamic and a unique, rare ecosystem. It is one of the best demonstrations of a distinctive and finely-tuned land use and culture successfully supporting an extremely rich wildlife resource. Generations of local folk have understood enough of the system to use it to their advantage, to cherish it for their very survival and to pass on this knowledge to their children. But pressures of modern living threaten to undermine that ancient balance. We now require a better understanding of changes to the machair and its wildlife in order that the continuing needs of local people living and working there can be provided for. After all, machair without people would be a very much poorer place.

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