Scotland's National Nature Reserves

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The Story of Moine Mhor National Nature Reserve

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Scottish Natural Heritage
All of nature for all of Scotland

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Foreword

Moine Mhor National Nature Reserve (NNR) is a bog showpiece. Covering over 500 hectares (ha) this 'Great Moss' forms the wild heartland of Kilmartin Glen, 10 kilometres (km) north of Lochgilphead on the west coast of Scotland.

Raised bogs are one of Europe's rarest and most threatened natural wildlife habitats, home to plants and animals specially adapted to survive in the water-logged conditions. At Moine Mhor, glistening dragonflies and graceful hen harriers hunt over the colourful patchwork carpet of bog moss, cotton grass and heather. Fringed by tidal flats, saltmarsh, brackish grassland, fen, alder carr and ancient oak woodland, this intact transition of habitats adds to the Reserve's rich diversity of wildlife. Coastal birds, otters and the rare marsh fritillary butterfly all make their home here.

The 'Great Moss' started its life over 5000 years ago and once covered a vast area from the Crinan Estuary in the west, to the ancient hill fort at Dunadd in the east and north to Kilmartin. In recent times, tree planting and land reclaimed for farming have eaten into it but what remains is a remarkable remnant of one of our most ancient landscapes, older than the Neolithic cairns and standing stones that surround it.

Moine Mhor is one of 58 NNRs in Scotland. Scotland's NNRs are special places for nature, where some of the best examples of Scotland's wildlife are managed. Whilst nature comes first on NNRs, they also offer special opportunities for visitors to enjoy and find out about the richness of our natural heritage. Visitors to Moine Mhor can enjoy a short all-ability self-guided trail, climb Dunadd Hill for outstanding views and stroll or cycle along the Crinan canal bank.

The Story of Moine Mhor National Nature Reserve contains background information about the Reserve, describing the wildlife interest, its land use history and management since it became a Reserve. How we intend to manage the Reserve in future years is outlined in the Reserve Proposals. We invite your comments on these Proposals and your feedback informs the production of the final Reserve Plan, which is the blueprint for management of the Reserve for the next few years.

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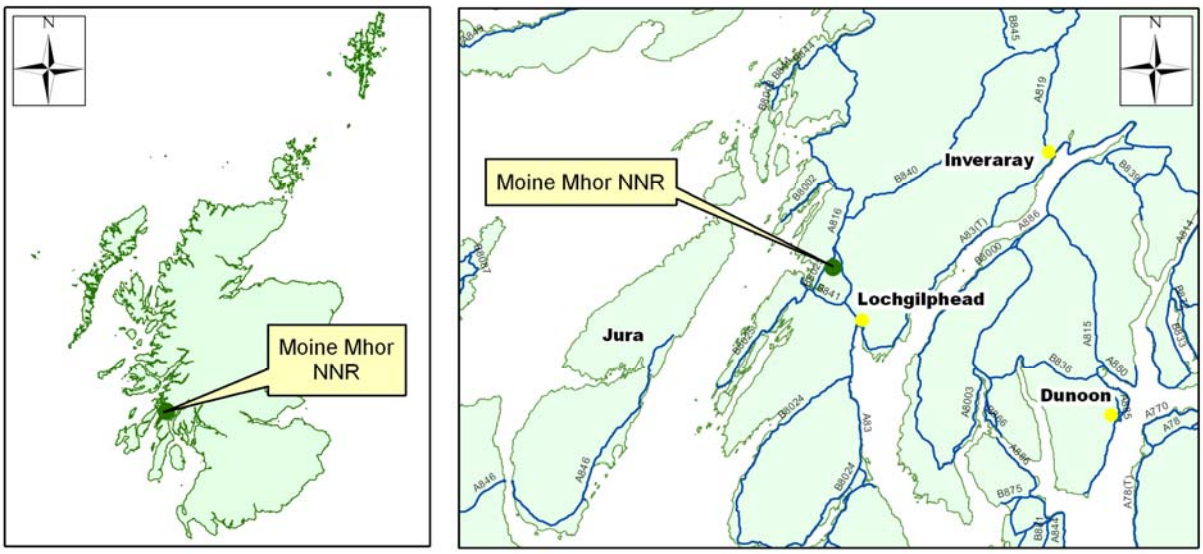
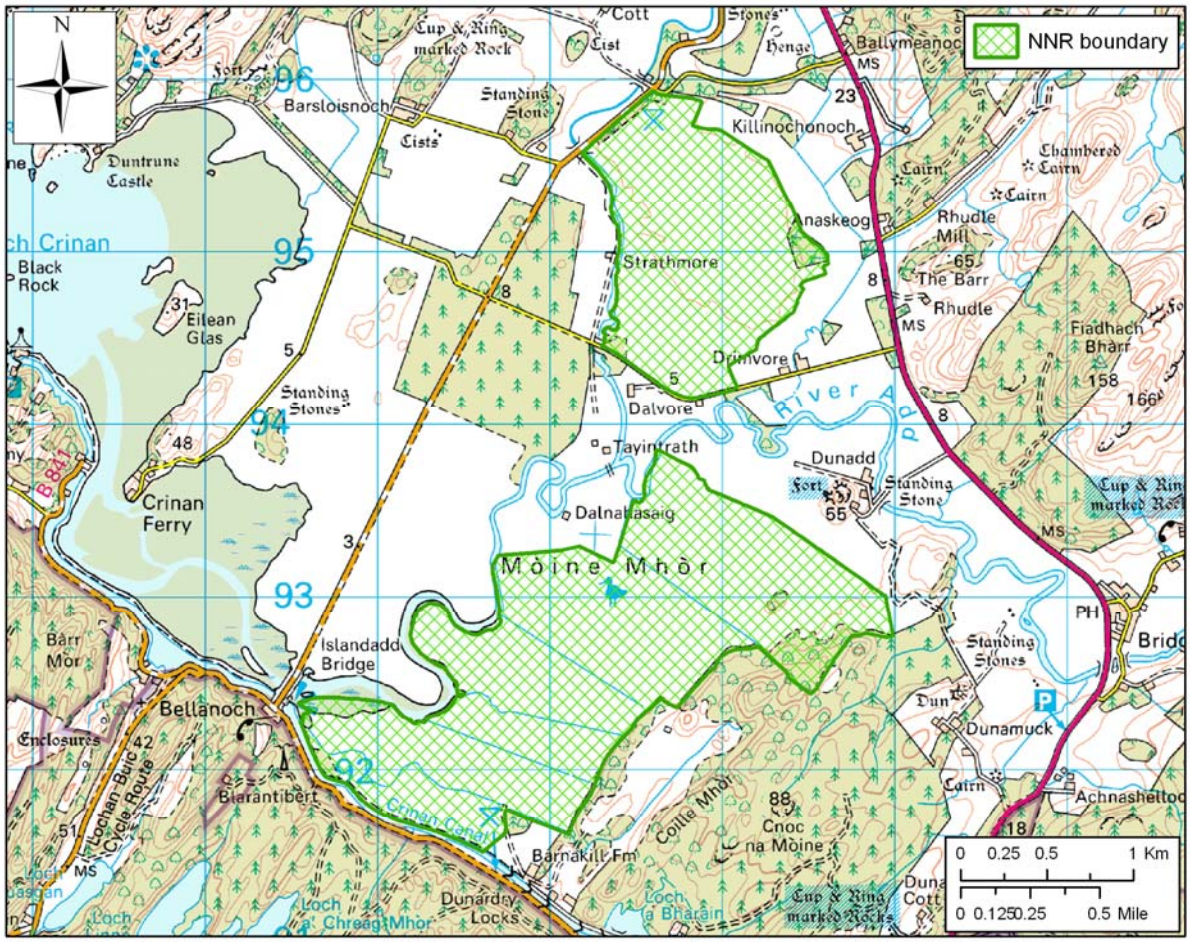
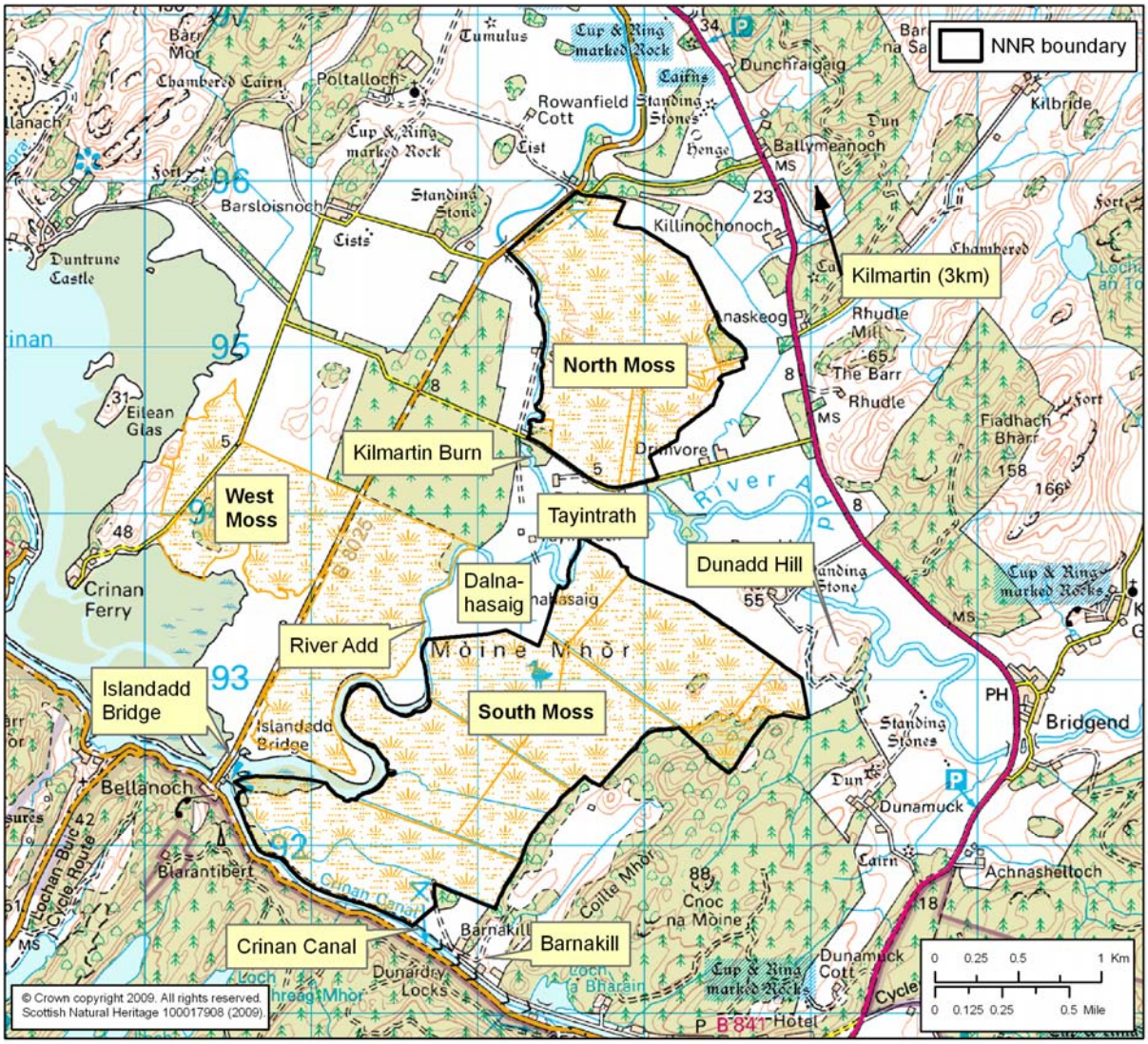


Boundary of Moine Mhor NNR



Map showing key locations of Moine Mhor NNR



1 Introduction

Moine Mhor ('Great Moss') NNR lies 10 km north of Lochgilphead and 3km south of Kilmartin in Argyll. The Reserve is one of Britain's best examples of a virtually intact lowland estuarine raised bog. Dissected by the River Add and Kilmartin Burn, the Reserve includes the two main mosses north and east of the river (North Moss and South Moss).

The Moine Mhor started life as a shallow freshwater loch edged at the coast by saltmarsh. As lush plant life died it built up in layers and eventually filled the loch with what is now peat. This process has been going on for some 5000 years and the bog continues to rise about 1millimetre (mm) each year - still growing and forming what's called a 'raised bog'.

Moine Mhor NNR

The highest point on the bog is only 13 metres (m) above sea level with peat depths increasing gradually from the coast to the centre of the North Moss where it is about 4m deep. The North Moss is entirely rain fed and comprises a pronounced raised dome with drainage ditches radiating out from the centre of the dome. On the South Moss, the drainage ditches generally run east to west reflecting the gently sloping topography from the wooded hills to the east down towards the River Add. Here the hydrology is influenced by ground water which seeps out at the eastern boundary where the hills provide a source of drainage water to the ditch network. A fen-type marshland habitat (known as 'lagg fen') would have formed an extensive transition between the moss and the surrounding land during early bog development. Remnants of the lagg fen still exist along this eastern margin of the South Moss.

The Gulf Stream is responsible for Moine Mhor's mild and moist oceanic climate. A rain gauge on the North Moss has recorded an average of 1594mm annual rainfall (1999 -2008), similar to the Knapdale average of 1532mm recorded from 1969 to 1978. The autumn and winter months are usually the wettest with 349mm of rainfall recorded in December 1999. Spring is driest with only 20mm of rainfall recorded in

May 2008 and the summer months are unpredictable with 224 mm recorded in August 2004! Being so low lying and close to the sea, the Reserve is very exposed to the prevailing westerly winds.

The hydrology of raised bogs is complex, influenced by topography, precipitation, evaporation and drainage. The high rainfall keeps the water levels on the bog high but this can still drop significantly during periods of low rainfall and high evaporation especially close to drainage ditches, where rainwater rapidly runs off. Water tables usually recover quickly from these drought events and can remain relatively high even during the summer months as they did during the summer of 2008. Precipitation in the west of Scotland has increased by 10-15% over the past 150 years. This increased rainfall has helped to mitigate against the damaging impacts of past ditch construction on the bog. Our management at Moine Mhor aims to restore and maintain a natural hydrological regime with water levels at or near the surface throughout the year.

The waterlogged infertile conditions of the bog and the wet climate are ideal for the growth of bog mosses (sphagnum). These multi-coloured mosses form a carpet over the moss surface which traps and stores rainwater like a huge living sponge. They keep the ground waterlogged and are the powerhouse of the bog. Layers of dead sphagnum beneath the living surface accumulate to form peat. This damp and squelchy habitat is ideal for insects and on a summer's day dragonflies and butterflies flit across the ground.

To the west, the Reserve is fringed by estuarine habitats such as saltmarsh. Beyond the Reserve these estuarine habitats become more dominant and the whole area forms what is probably the UK's most intact natural transition from bog to coastal communities such as mudflat and sandflats. These fringe habitats are important for the rare marsh fritillary butterfly.

The eastern edge of the Reserve is cloaked by extensive areas of oak woodland and smaller remnant areas of alder carr and fenland which add to the tremendous diversity that this 'Great Moss' offers. Otters are ubiquitous on the Reserve which is also important for breeding and roosting hen harriers.

Situated in the heart of Kilmartin Glen below the ramparts of the Dunadd hill fort, the historic and cultural interest of this ancient landscape adds a further dimension to the Reserve. Viewed from Dunadd Hill, a very important historic site with many visitors, the unique landscape features of the Moine Mhor and River Add are of outstanding

Moine Mhor from Dunadd Hill

intrinsic appeal. Wandering or cycling along the Crinan Canal near Bellanoch also offers outstanding views over the estuary and southern part of the Reserve.

A car park, picnic area and short self-guided trail, suitable for wheelchair access have been constructed adjacent to the B8025, 3 km south of Kilmartin. Now, an average of 7500 visitors a year enjoy a close encounter with the bog as they wander round the 'Tileworks Trail' and venture out on the boardwalk. Benches and interpretation points are provided to facilitate visitor's enjoyment and understanding of this special place.

Moine Mhor NNR was declared in 1987 and is owned by Scottish Natural Heritage (SNH). The natural heritage interests at Moine Mhor have been designated at UK, and European level. The Reserve forms part of the larger Moine Mhor Special Area of Conservation (SAC) and is internationally important for its raised bog, Atlantic salt meadows, intertidal mudflat and sandflats and western acidic oak woodland habitats, as well as its population of marsh fritillary butterfly and otter. The recognition of Moine Mhor as a European site of international importance (SAC) means that it is part of a Europe wide network of protected sites known as 'Natura'. This extremely important suite of sites includes other high profile raised bogs in Ireland and Sweden.

At a national level, the Reserve is part of the Moine Mhor Site of Special Scientific Interest (SSSI) and also lies within the Knapdale National Scenic Area (NSA).

Table 1 Designations and qualifying features for Moine Mhor NNR

Designation	Special Area of Conservation	Site of Special Scientific Interest	Species	
	European Union	UK	UKBAP	LBAP
Active raised bog* (Estuarine raised bog)	✓	✓		
Degraded raised bog	✓			
Atlantic salt meadows (saltmarsh)	✓	✓		
Intertidal mudflats and sandflats[1]	✓			
Western acidic oak woodland (Upland oak woodland)	✓	✓		
Marsh fritillary butterfly	✓	✓	✓	✓
Large heath butterfly			✓	
Otter[2]	✓		✓	✓
Breeding bird assemblage		✓		
Hen harrier				✓

* Priority habitat of the SAC.
[1] All of the mudflat and sandflats lie off the Reserve.
[2] otters are also a European protected species (EPS)
UKBAP – UK Biodiversity Action Plan
LBAP – Local Biodiversity Action Plan

2 The Natural Heritage of Moine Mhor NNR

Moine Mhor NNR is predominantly raised bog, but its fringes include a gradation of habitats with saltmarsh, brackish grassland, fen, alder carr and woodland. This tremendous diversity of habitats, associated animal and plant communities and important species populations contribute to the wealth of Moine Mhor's rich natural heritage.

Earth Science

After the last Ice Age about 10,000 years ago, rising sea levels flooded Kilmartin Glen and covered it in impermeable marine clay. Then the land, released from the weight of glaciers, began to rise faster than the sea and a shallow estuary formed at the mouth of the River Add. Saltmarsh formed near the sea and a freshwater loch developed inland where the Moine Mhor now lies. This area is one of the largest sediment-filled embayments of the west Highland coast extending to approximately 1750ha and not more than 15m above sea level.

The peat body itself is also of considerable interest. Records of geological events that have happened during the life of the bog are stored below the peat surface. The extensive peat deposits overlying the marine estuarine deposits make the Moine Mhor one of the best localities in western Scotland for dating sea-level change. We know from peat cores that sea levels fell approximately 5,500 years ago and this allowed peat to start to build up, accumulating year on year to form the 'Great Moss'.

The domes of peat are also a time capsule of historical information. Flowering plant pollen, moss spores and unicellular creatures preserved in the peat, all provide us with clues to local environmental changes that have taken place in the area over the life of the bog.

Habitats

Lowland raised bog

Lowland raised bogs such as Moine Mhor are one of Europe's rarest and most threatened natural wildlife habitats. Most of the bogs in the UK (about 95%) have been destroyed or damaged as a result of reclamation for farmland, removal of peat for the horticultural industry or planted with conifers.

At its peak, the Moine Mhor extended approximately 1600 ha. covering most of the marine embayment and comprising of three separate mosses (South Moss, North Moss and West Moss). Past land reclamation for farming and conifer planting has caused a significant loss of area to the original 'Great Moss' with virtually all of the West Moss lost. Despite this over 800 ha. of the original bog survives relatively intact

and nearly 500 ha. of this is within the Reserve. The North Moss (east of Kilmartin Burn) is one of the largest examples in Britain of a raised bog with an original domed surface. Here the peat depth reaches up to 4.1m.

North Moss from the boardwalk

In healthy raised bogs, the water table is always maintained close to the surface of the bog. This creates the right environment for sphagnum mosses (bog mosses) to thrive and for peat to form. We use the term 'active' to describe these bogs where peat is continuing to build-up. Peat is able to retain huge quantities of water – like the sphagnum moss growing on it – and this slows down the rate at which the stored rainwater is released. Such conditions exist over most of the North Moss. Here the vegetation is dominated by heather, cross-leaved heath and cotton-grass with a thick under storey of sphagnum mosses.

On the South Moss the peat is not so thick. Research by McMullen (2003) indicates that sphagnum-dominated communities only became established in the seventeenth century. The vegetation on the South Moss is also more modified. Purple moor grass for example is present across the site and dominant in localised areas suggesting that water is still flowing through the peat dome.

Around the eastern margin of the South Moss there are remnants of natural fen (lagg fen). Lagg fen is a classic feature of a raised bog and forms where undisturbed seepage from the peat body meets mineral soils. Unfortunately, being close to the edge of the bog it is usually one of the first features to be lost.

Part of the Reserve including much of the South Moss can be described as 'degraded raised bog', which means that at one time the bog has been damaged in some way, for example by peat-cutting or drainage. Even though this habitat has been damaged, with the right management, these areas are still capable of natural regeneration and longer-term restoration.

The thick mass of vegetation on a raised bog also absorbs large amounts of carbon dioxide and stores it as peat. Disturb the bog and the locked-up carbon would be released. So, in its own way, the Moine Mhor is helping the fight against global warming.

Saltmarsh

Small areas of estuarine habitats such as saltmarsh (less than 5 ha) are found on the fringes of the Reserve, along the margins of the River Add immediately east of Islandadd Bridge. West of the bridge and beyond the Reserve boundary, these estuarine habitats become extensive (about 300 ha) and form what is probably the UK's most intact example of a transition from bog through to brackish areas and saltmarsh to coastal communities such as mudflats and sandflats.

Scrub and woodland

Trees and scrub are largely confined to the drier margins of the bog. Woodland is particularly extensive on the eastern margin of the South Moss near Barnakill where it has developed on epidiorite rock outcrops. Here there is a large area (just over 100 ha) of western acidic oak woodland; a small part (about 10 ha) of which is included within the Reserve near Dunadd. It contains a number of areas rich in mosses and liverworts and is of interest for woodland bird and invertebrate communities.

There are smaller areas of birch wood around the fringes of the North Moss and some wet alder carr on the southern edge of the South Moss. These sheltered areas add diversity to the Reserve and include a wealth of interesting plant communities including impressive clumps of greater tussock-sedge in the carr woodland.

The birch woods act as a seed source, and young scrub is lightly scattered over the bog surface. Peat coring has shown that birch occurred infrequently on the bog surface in the past. Although a few trees probably form a natural part of most bogs it is a delicate balance ensuring that they do not cause drying out problems.

Flora and Fauna

Lower plants

Sphagnum mosses are the key plants of a raised bog and 9 species have been recorded on the Reserve. Their presence is an indication of the excellent quality of the bog habitat.

Sphagnum moss

The sphagnum mosses can be considered as the powerhouse of the bog. They create the wet, acidic conditions found on raised bogs by trapping and storing rainwater like a huge living sponge and keeping the bog waterlogged. This in turn helps to seal buried

dead sphagnum material from the air, so that rather than rotting, it is preserved to accumulate as peat. These peat forming species are the active component of an active raised bog.

Different sphagnum species have different requirements. Subtle variations in conditions across the bog control the distribution of species and create the distinctively undulating and often colourful carpet characteristic of the bog surface. A closer look will be rewarded by reds, oranges and various shades of greens and yellows all forming mosaics and patterns. At Moine Mhor only a few different kinds of sphagnum predominate while the others such as *Sphagnum papillosum* and *Sphagnum magellanicum* are relatively scarce and localised. This indicates past disturbance, particularly by burning and drainage.

A total of 242 species of lichens have been recorded on the Reserve including 23 species of 'reindeer moss' (*Cladonia*), the main interest being in the woodland areas and rocky knolls. Bogs are not generally noted for their lichen flora. The waterlogged areas dominated by sphagnum rarely support many lichen species apart from clumps of *Cladonia* on the less disturbed areas. They are however particularly abundant on the North Moss. As water levels change through active management and the bog becomes wetter, we would expect to see different mosses and lichens come in, better adapted to the wet conditions, particularly sphagnum species.

Higher plants

The Moine Mhor has an exceptionally rich flowering plant community thanks to the range of marginal habitats associated with the bog. The relatively harsh conditions of a raised bog often limit the variety of plants to heathers, sedges and cotton-grasses, which are all specially adapted to live in water-logged, nutrient poor conditions. On Moine Mhor we have thriving populations of a whole range of bog specialists such as the insectivorous round-leaved sundew, cranberry, bog myrtle and bog asphodel. During the late spring months beautiful displays of heath spotted orchids form discrete swathes of purple on the fringes of the North Moss. There are few bog rarities though small cranberry is notable while bog rosemary is notable by its absence.

Purple heath orchid

The lagg fen and alder carr also support interesting plant communities including tussock-sedges, parsley water-dropwort and large bitter-cress. Nodding bur-marigold also occurs in a vegetated ox-bow lake.

Invertebrates

The wider area of the Moine Mhor is a stronghold for the marsh fritillary butterfly, one of Europe's most threatened butterfly species. The Scottish population is now largely confined to the Argyll mainland and islands, and it is a UKBAP priority species. The Moine Mhor is one of the key sites in mid Argyll, the core of the population being on the marginal bog areas of the Reserve with smaller satellite colonies on the edge of the Reserve at Barnakill, Dunadd and Dalnahasaig. It depends on devil's-bit scabious, its food plant, which grows on the drier fringes of the bog.

The large heath butterfly, also a UKBAP priority species, is a bog specialist, the larval food plant being cotton-grass. It is widely distributed though scarce on the Reserve.

Marsh fritillary butterfly

The dragonflies are probably the most conspicuous group of insects at Moine Mhor and 11 of these colourful species have now been recorded, including the beautiful demoiselle. They hunt over the bog for smaller insects and lay their eggs in the pools and flooded drains.

Generally the invertebrates at Moine Mhor have received very little attention and more survey work is needed. Our spider records, some of local interest, date from 1978 and over 100 species of moths were recorded in 1991.

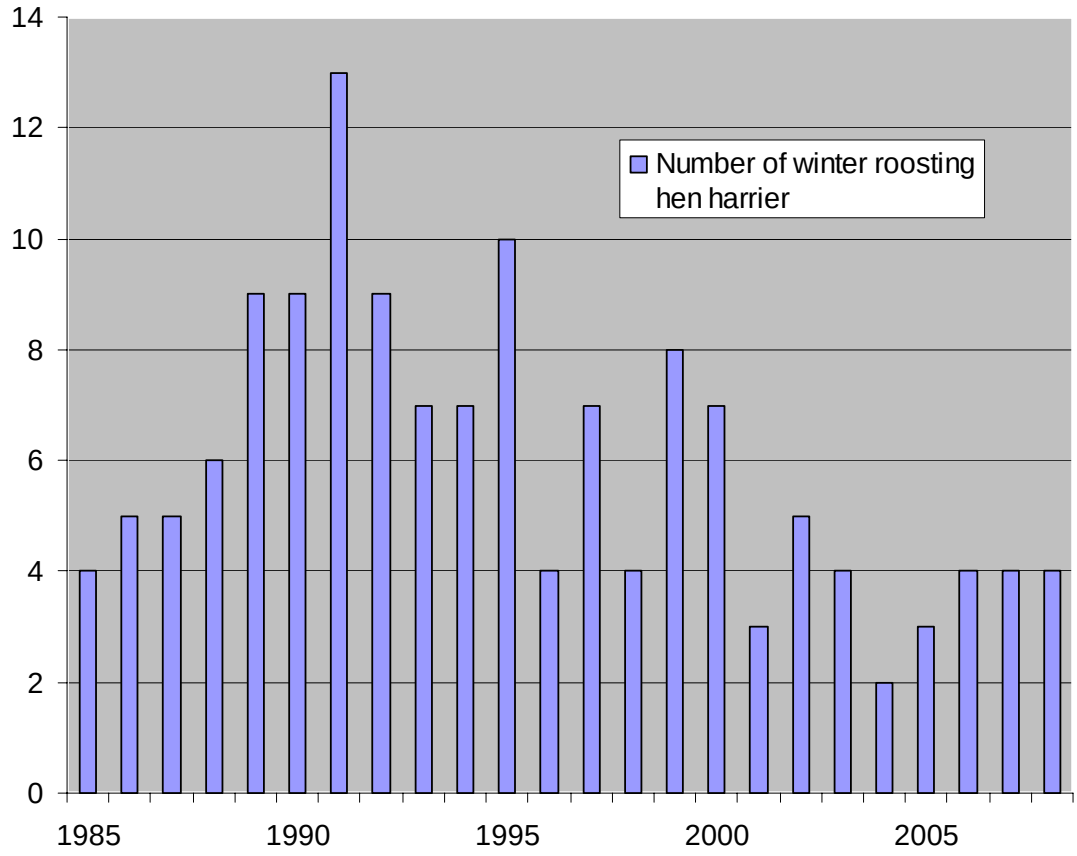
Birds

A total of 235 species of bird have been recorded on the Reserve and this includes most of the species that make up the nationally important breeding bird assemblage for the Moine Mhor as a whole. The range of habitats on the fringes of the bog provides added scope for a wide variety of birds. Woodland birds such as chaffinch and willow warbler are common, with curlew and meadow pipit on the bog, lapwing on the marginal fields and redshank, snipe and oystercatcher breeding on the saltmarsh in the vicinity of the River Add. Surveys carried out in 2008 confirm that breeding bird diversity remains high at Moine Mhor though there has been a recent decline in curlew and lapwing.

Hen harrier

The Moine Mhor has a locally important population of breeding and roosting hen harriers. Regular observations have indicated that there has been a significant decline in hen harrier numbers over the last 10 years reflecting regional trends on the Argyll mainland. Now only a few use the Reserve as a winter roost, usually on the South Moss and West Moss and only one pair occasionally attempts to breed. The North Moss, which was a popular roost in the late 80s and 90s, is now more or less abandoned, possibly due to the loss of heather caused by heather beetle attacks and rising water levels. Every spring however, hen harriers can be seen providing spectacular aerial displays over the bog. Short-eared owls also breed on the Reserve occasionally and ospreys are a common sight in summer fishing along the river and on the estuary.

Graph showing numbers of winter roosting hen harrier on Moine Mhor NNR



In winter, just off the Reserve, large numbers of wildfowl congregate on the estuary and surrounding fields including whooper swans, Greenland white-fronted geese and wigeon.

Mammals

The Reserve forms part of an internationally important area for otter. There are signs that otters regularly use the River Add and Kilmartin Burn catchment and pass through the network of ditches on the Reserve.

Roe and sika deer both use the Reserve and tracks criss-cross their way across the bog. Both are likely to have an important impact on the vegetation structure through browsing and help to keep the birch scrub in check.

3 Management of Moine Mhor before it became a NNR

History of Moine Mhor

About 10,000 BP	Rising sea levels following the end of Ice Age flood the Moine Mhor embayment
About 5,500 BP	Sea retreats to leave brackish areas of estuary and loch where peat starts to accumulate.
Pre 1750	Small scale summer grazing, peat cutting and marginal drainage take place.
1750-1850	Large scale land reclamation takes place. Drains are cut through the centre of the bog, farmsteads and roads are constructed, peat cutting increases and there is further summer grazing. The bog's water table drops as a result of these activities.
1850-1985	Cattle and sheep graze the bog and the edges are mowed for bog hay. Burning takes place to improve grouse numbers for shooting.
1901	The British Charcoal Company produce peat-coke at Barnakill.
1946	Accidental fire burns the whole of the North Moss.
1959	Moine Mhor is surveyed as part of the Scottish Peat Survey.
1980	About 100ha of conifers are planted west of the Kilmartin Burn and as shelterbelts on North Moss.
1980-1987	501 ha of Moine Mhor, part of which was proposed for conifer planting, is purchased by Nature Conservancy Council (NCC)[1] in 7 lots from 6 owners.

Land use history

Throughout Kilmartin Glen, now recognised as one of the most important prehistoric sites on the Scottish mainland, there is evidence of standing stones, burial chambers and rock carvings. Prehistoric people couldn't live and farm on the boggy Moine Mhor but it is likely they would have used the bog in other ways. Bogs traditionally provided peat for fuel, dyes for clothing, berries for food, potions for medicine and heather for honey and ales.

Up to about 1750, the extent of the Moine Mhor would have changed little. There were no roads or any cultivation and Tayintrath (near the confluence of Kilmartin Burn and River Add) was one of few settlements. The only activities would have been domestic peat cutting around the edges and summer grazing. The regular occurrence of charcoal within peat cores also suggests that the bog would have been

[1] The Nature Conservancy Council (NCC) were the predecessors of Scottish Natural Heritage.

burnt regularly to maintain the grazing. The grazing and burning would have helped to keep the bog free of trees.

Reclaimed land on the edge of the bog

In 1794, construction work on the Crinan Canal started. Once the canal was opened in 1801 this allowed for the import of coal from Glasgow reducing the local population's reliance on peat cutting and enabled them to improve land. Poltalloch Estate, owners of about 1200 ha of the bog, recognised that the clay base layer underneath the Moine Mhor was potentially good agricultural land. In 1795 they started reclaiming the bog by drainage and peat removal, and by 1801 they had enough reclaimed land to establish a new farm called "Experiment", now Barsloisnoch.

The expanding Estate needed food for the laird's household and for the new village of Kilmartin, built to house Estate workers. The Estate set up a tile works and used local clay to make bricks for buildings and pipes that were used to drain the bog. Parts of the bog were cut to fuel the tile works and the remains of the peat drying sheds can still be seen near the northern boundary of the Reserve. Our nature trail on the North Moss (near the former Tileworks Cottage) is appropriately named 'Tileworks' - as a very interesting link to the cultural heritage of the Moine Mhor.

The first Ordinance Survey map (1865) of the area shows the farms, roads, drains and fences in position, much as they are today. Agricultural improvement was notable during this period and led to the removal of much of the peat from the West Moss (probably over 400ha). About a third of the bog had been reclaimed during a period of as little as 50 years. Over the rest of the bog internal drains were cut through in an effort to improve the grazing. Grazing by both cattle and sheep would have been a regular occurrence until the Reserve was established. We have no detailed records of the grazing regime but we know from local farmers that cattle and sheep grazed both the North and South mosses and losses of cattle were regular. We also know that bog hay was cut at the edges of the bog for instance at Barnakill Farm.

Between 1850 and 1950 controlled burning took place regularly on the bog to encourage red grouse for shooting parties. There is a record of an accidental fire in 1946 that burnt the whole of the North Moss, the last fire recorded here. At this time the vegetation on the bog would have looked quite different, the regular burning and

grazing management practices keeping the bog free of trees and heather and bog myrtle in check. It is uncertain how the key component of the bog, the sphagnum moss community, would have responded to these activities, but there is evidence from the peat cores that sphagnum growth was retarded during fire events and recovered between these events.

There is further evidence of peat cutting and extraction at Barnakill where the British Charcoal Company, commercially extracted peat in 1901 to produce peat-coke for the iron and steel industry. In 1959, the Moine Mhor was surveyed as part of the Scottish Peat Survey to explore the possibility of using the peat for industrial, agricultural and horticultural use. Fortunately for the Moine Mhor it was decided that this was not viable. Domestic peat cutting by local farmers continued around the fringes of the bog at Dunadd, Drimvore and Dalvore until the Reserve was established – only Dalvore Croft retains its peat cutting rights on the North Moss now.

Around 1980, approximately 100ha of conifers were planted on the Moine Mhor, including shelter belts on what is now the Reserve. It was the further threat of conifer planting that prompted NCC to purchase 500 ha of the bog from the local farmers and establish the Moine Mhor NNR.

4 Management of Moine Mhor NNR

Key events in the history of Moine Mhor since it became a NNR are as follows:

1987	Moine Mhor is declared a National Nature Reserve.
1987	A Reserve warden, Dave Batty, is appointed and the first management plan is produced (1987-1997).
1987 - present	Major bog restoration works including damming of ditches and control and removal of birch starts.
1988	Programme for removing rhododendron starts.
1989	The owners of Dunadd Farm gift a further 1ha of bog to NCC. The conifer shelterbelts are removed from the North Moss.
1990	Moine Mhor SSSI (parts of which were notified in 1974 and 1981) is extended and renotified in 1990, to include the coastal, estuarine and bog communities west of River Add, the Barnakill Woods and the Reserve area of the bog and some woodland.
1993	The pine trees are removed.
1995	We provide the first visitor facilities for the Reserve - includes a car park, picnic area and all-ability nature trail ('Tileworks'). Numbers of visitors increase to about 7500 visitors a year. The rhododendron removal programme is complete with all major bushes cleared.
1997	The second management plan (1997-2007) is produced.
2005	The Reserve's European importance is recognised by its inclusion within the Moine Mhor SAC.
2002-2008	John MacRae is appointed as Site Management Officer – John pioneered the construction of large-scale dams on the major drains on South Moss.

Management of the Natural Heritage

Moine Mhor NNR has been managed primarily for nature conservation since 1987. Our whole focus for management has been to reverse the trends of drying out caused by past drainage as well as the spread of trees and scrub. Ultimately we would like to restore the water table over the whole of the peat body to a stable position as close to the surface as possible. It is only when the water table is consistently close to the bog surface that sphagnum communities can fully recover and start the process of laying down peat.

Ditch damming

Damming techniques have evolved greatly on the Reserve over the last 20 years. During the first ten years, oak and elm boards were used, but these heavy planks proved cumbersome to transport on the bog and sometimes were not as durable as expected. Since 1998 we have used recycled plastic piling as this is a longer lasting, more flexible and lighter material to use.

Damming at Moine Mhor has proved a considerable challenge, mainly due to the relatively shallow peat layer and the large-scale drains involved; the bases of the drains often being near the level of the mineral soil below the peat. Inserting the piling is therefore extremely difficult by hand so in recent years, thanks to the skills and pioneering techniques devised by Reserve staff, we have used an excavator with specially adapted pile driving attachments to insert the piling and this has proved both efficient and effective. Despite this it can still take several man-days to install a dam, 10 m wide and 1.5 m deep - so progress is relatively slow.

Excavator driving in dams

Over 150 dams have now been constructed, blocking all internal drains on the North and South mosses. We quickly see the rewards of all this effort. Our monitoring of the water table levels over the last 10 years shows a higher water table in the vicinity of all blocked drains. Away from the drains, water levels remain relatively stable over much of the Reserve, particularly on the North Moss and central parts of the South Moss. Sphagnum is also regenerating well in the flooded drains and hollows with some dams are now disappearing under the sphagnum carpet as the drains infill with bog vegetation.

Re-vegetating dammed ditch

There is also evidence of heather die-back on the North Moss as the water-table has risen especially in the vicinity of the main drain, though heather-beetle attack has also been prevalent. The loss of mature heather could potentially have implications for breeding and roosting hen harriers but extensive monitoring (roost counts) over 20 years indicates that harriers use the entire Moine Mhor and roost in any rank vegetation including grasses and rushes.

Prior to damming works, there was very little standing water habitat, which may be surprising given the extent of the bog. Now there has been a significant increase in the surface area of standing water, which is clearly beneficial to dragonfly populations, otters, breeding ducks and amphibians.

Some of the Reserve boundary is bordered by improved agricultural land. This limits our opportunities to restore the degraded areas of bog on the margins of the Reserve and to expand the area of raised bog off the Reserve or/and create buffer areas. At Barnakill, where we own two of the fields we have managed to restore boggy conditions in parts of these fields by blocking internal and boundary drains. This part of Reserve now provides us with a good demonstration of rehabilitation work on the fringes of the bog.

Tree and scrub management

Historical maps and studies of peat cores show that for most of its life Moine Mhor had few trees. The cessation of grazing and burning since the Reserve was established has contributed to the establishment of birch scrub, which is lightly scattered over much of the Reserve. The recovery of birch at 70 centimetres (cm) depth from a peat core suggests that birch was present on the bog prior to drainage operations 150 years ago. We would expect that, as the water table has risen and is maintained at the surface, this would inhibit tree and shrub colonisation and kill off existing tree and scrub growth on the bog surface. Remarkably, as yet, there is still little evidence of this so we continue to clear and poison trees and scrub over the bog. Natural regeneration of birch is likely to remain a long-term problem especially on the woodland edge. Given that the marginal woodlands contribute to the diverse interest of the Reserve, we have no intention of clearing these to control the seed source. The woodlands also offer shelter to deer that are regularly seen browsing out on the bog, helping to keep the scrub in check.

The bog surface is now largely devoid of mature trees and shrubs thanks to our concerted efforts to remove these over the years. In 1989, we removed the conifer shelterbelts that were planted on the North Moss just prior to the Reserve being established. We have also had a long programme of pine, birch and rhododendron clearance from the North Moss and some isolated stands of birch on the South Moss. It took us 7 years to eradicate the dense rhododendron from the north-west wood which now prevents the threat of further spread onto the North Moss.

The drainage and subsequent planting of conifer shelterbelts was particularly damaging to the ground vegetation, causing drying out and shading resulting in the loss of sphagnum by local drying and shading cover. The plough lines are still evident but water is now spilling into these from the main flooded drains close by. A water level recorder in the former shelterbelt area suggests that the water table is now fairly close to the surface most of the time.

Rhododendron clearance on North Moss

Grazing

When NCC took over the management of the Reserve the decision to stop grazing on the bog was made. There were a number of reasons for this. Bogs are nutrient poor systems and heavy stocking by grazing animals can produce localised nutrient enrichment altering the vegetation and also causing damage by poaching. This combined with the risks involved with the treacherous terrain, especially as flooding was increasingly more prevalent through our damming operations, made grazing inappropriate and impractical on the Reserve.

This has resulted in vegetation changes on the margins of the bog for example at Barnakill where there are important populations of marsh fritillary butterfly. We recognised that with the lack of grazing the marsh fritillaries food plant (devil's bit scabious) was being suppressed by vigorous grasses (such as purple moor grass). Grazing by sheep and cattle has continued on the western section of the Moine Mhor, just off the Reserve, which is privately owned. Management agreements have been established here with our neighbours to maintain the core marsh fritillary habitats. Grazing has also recently been extended in this western section to allow grazing of part of the bog that has not been grazed for 20 years or more. We hope that this will open up the rank vegetation providing more open conditions for sphagnum mosses. Experience here on this privately owned part of the bog will help inform future grazing management decisions on the Reserve.

We also continued grazing our fields at Barnakill during the early years of the Reserve with a view to improving the quality of the fields for geese and breeding waders. Restoration of the bog in these fields is now a higher priority as water tables have risen in recent years making the grazing less attractive to the neighbouring farmer.

Research

Throughout the Reserve's history, survey, monitoring and research have been given a high priority, particularly where this will help achieve our natural heritage objectives. Projects have included studies of short and long-term changes in vegetation and hydrology as well as long-term monitoring of hen harriers.

Off the Reserve, the rich archaeology of Kilmartin Glen has received a huge amount of research attention including environmental history studies by Campbell et al (2001). Clarke (2003) followed up Campbell's research using 'Ground Penetrating Radar' on the Reserve in an unsuccessful attempt to locate evidence of archaeological remains buried under the peat.

Haggart (1987) carried out research at the Moine Mhor by taking peat cores down through the sediments to determine the nature and timing of relative sea-level change in the area. He estimated from pollen analysis that peat began to form as the sea retreated about 5,500 years ago. This has contributed greatly to our understanding of the ancient history and formation of the 'Great Moss'. Haggart's work was complemented by a more recent palaeoecological study by McMullen (2003) who investigated vegetation and hydrological changes during the last 1000 years or so from peat cores and pollen analysis.

Further studies have related directly to our recent restoration management of the Reserve. Butcher (1998) produced a hydrological evaluation of the three mosses and made management recommendations. This was followed by Soulsby (2001, 2003) establishing hydrological monitoring on all three mosses and increasing our knowledge of the hydrology of the Reserve and the effectiveness of our ditch blocking. This was complemented by Dayton (1999, 2005) establishing vegetation monitoring to assess short-term changes in the vegetation communities. Both hydrological and vegetation monitoring are ongoing.

Regenerating sphagnum

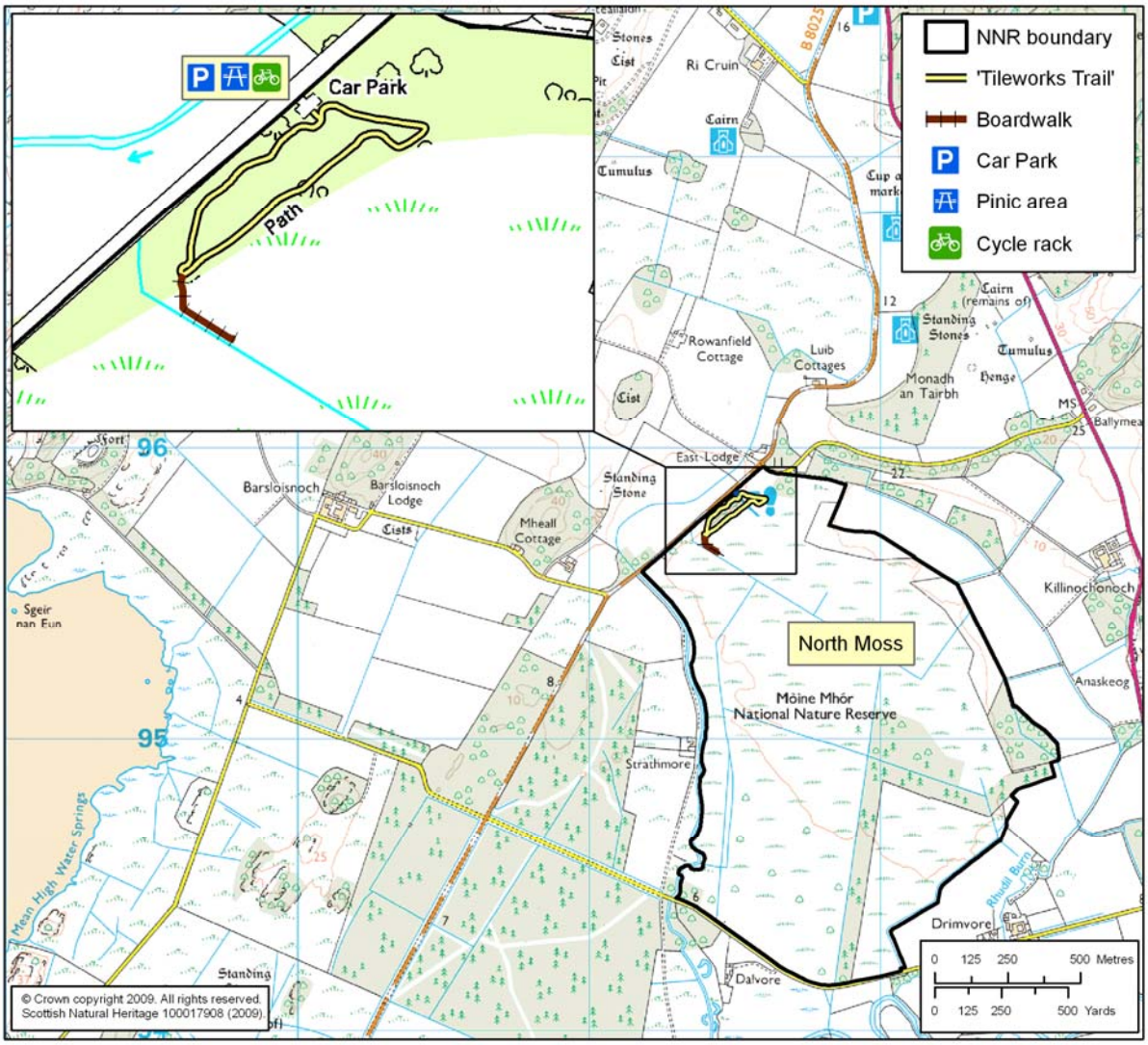
Since the discovery of an important hen harrier roost on the Reserve, by Jeff Watson in the early 1980's, Reserve staff have maintained monthly winter roost counts. We now have over 20 years of data that we contribute to the national database.

Management for People

The nature of the terrain and often hazardous conditions on the bog has made access to the Reserve difficult and of low appeal to the general visitor. In the past, we have not actively encouraged visitors to the Reserve because of these difficulties and the fragility of the bog surface.

Prior to 1995, visitor numbers were small (in the hundreds) and included a few specialist groups and individuals. Since then, Kilmartin Glen has become a popular tourist destination with the museum in Kilmartin and much improved access facilities in the Glen. This includes significant improvements in our visitor provision at Moine Mhor NNR.

Map showing visitor facilities at Moine Mhor NNR



The North Moss adjoins the well used minor road from Kilmartin to Bellanoch on the Crinan Canal, and with the completion of massive rhododendron clearance in the north-west wood, this provided us with an ideal opportunity to facilitate and formalise visitor access to the Reserve. In 1995, we opened a small car park, which can hold up to eight cars, a picnic area and an all-ability nature trail called the 'Tileworks'. The Tileworks trail includes a short section of boardwalk going out onto the bog and ending in a viewing platform.

Recreational use of the Reserve has increased dramatically since the opening of these facilities. The excellent on-site interpretation, including leaflets and information panels, help visitors find out what's special about bogs generally, Moine Mhor in particular, and what we are doing to make it even better. Visitor numbers now average 7500 each year with a peak of 9,500 in 2005, which is even higher than numbers at the popular Taynish NNR just down the road. There has however been a steady decline in visitor numbers from 9,500 in 2005 to only 5,200 in 2008. While the Reserve has clearly benefitted from the increase in tourist numbers in Kilmartin, it is also a very popular walk for local people. Fortunately, few of these visitors venture far beyond the end of the boardwalk and damage to the sensitive vegetation is minimal.

School groups mainly from the nearby Kilmartin Primary School also visit the Reserve regularly. The sheltered woodland, adjoining bog and safe access provide a focus for a range of environmental education activities. We also produced a local School's Education Pack for Moine Mhor in 1996. The pack encourages local school involvement in the Reserve both on site and back in the classroom. Groups of less-able people from the Lochgilphead Resource Centre also regularly use the facilities.

Viewing platform at end of boardwalk

British Waterways also provide information panels about the Moine Mhor in their bird hide overlooking the estuary, and along the Crinan Canal which forms the southern boundary of the Reserve and provides excellent views over the South Moss. The impressive Dunadd Hill Fort provides an outstanding natural vantage point from which this wild and beautiful heartland of Kilmartin Glen can also be viewed.

Property Management

Scottish Natural Heritage (SNH) owns the entire Moine Mhor NNR (502 ha) and endeavours to manage the property responsibly to ensure high safety standards for staff, contractors and our visitors.

There are no buildings on the Reserve. The only facilities are the car park, picnic area, trail, boardwalk and associated infrastructure. Reserve staff carry out regular condition and safety checks to ensure high standards for visitors. Given the treacherous nature of the bog and the proximity to flooded conditions, visitors are warned of the risks and advised to stay on the boardwalk. With high numbers of visitors in summer and the close proximity of the Reserve to public roads, there are potential risks of fire on the North Moss, so a fire plan has been produced.

Various agreements were made with neighbouring landowners when the land was acquired. These include us having a joint responsibility for the maintenance of all boundary fences and drains except the march drain at Drimvore and march fences at Barnakill, which we are responsible for entirely. At Dunadd we are required to maintain a water supply in the march ditch and allow the right of access for stock to water. The owner of Dunadd fields has the first offer of a seasonal grazing licence over the Dunadd Moss if we wish to allow grazing but there are no other grazing or sporting leases on the Reserve. The owner of Dalvore Croft has peat cutting rights on part of the North Moss – these have not been exercised for many years. Scottish Hydro-Electric have power lines crossing parts of the North and South mosses and have normal wayleave rights. We too have access rights across farmland at Killinochonoch, Dunadd, Dalnahasaig and Barnakill, which we use to access the Reserve for management purposes.

Like any other property owner of a designated site, we carry out detailed assessments of plans and projects to ensure that they do not harm the conservation interests of the Reserve. It is heartening that the significant increase in visitor numbers at Moine Mhor in recent years has not impinged on the property nor on the wildlife – long may visitors continue to enjoy the wild experience of the Great Moss!

Summary

Moine Mhor NNR is recognised internationally for its natural heritage importance. Our management has focused on reversing some of the damage inflicted on the bog in the past. We are now starting to see the success of our efforts and would like to share this with as many people as possible. Our aim is to make sure that Moine Mhor retains its natural character and rich biodiversity, whilst also providing visitors with the opportunity to experience and learn all about how special the Reserve is.

The future management of Moine Mhor NNR is outlined in the Reserve Proposals. Management options are presented which, hopefully, will achieve our primary aim to ensure that the raised bog and the diversity of other habitats and important species populations are looked after in the long term.

5 Document properties

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Photography

Photography by John Halliday, Mark Hamblin, Emma Philip and Lorne Gill/SNH

Acknowledgements

The Story of Moine Mhor National Nature Reserve has been written by John Halliday (Reserve Manager), edited by Emma Philip (SNH Managed Sites Unit) and approved by Angus Laing (Area Manager – Arygll & Stirling).

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Links

Scottish Natural Heritage	www.snh.org.uk
SNH Sitelink	www.snh.org.uk/snhi/
Joint Nature Conservation Committee	www.jncc.gov.uk

Appendix 1 - National Nature Reserves (NNR)

Scotland's National Nature Reserves are special places for nature, where many of the best examples of Scotland's natural heritage are protected. Whilst nature always comes first on our NNR's, they also offer special opportunities for people to enjoy and find out about the richness of our natural heritage. NNRs are declared under the National Parks and Access to the Countryside Act 1949 or the Wildlife & Countryside Act 1981.

A policy for NNRs in Scotland was developed in 1996. This policy requires NNRs in Scotland to have four attributes and be managed for one or more of the three purposes.

The attributes are:

- **Primacy of nature** – The needs of nature will be placed at the heart of decisions about land-use and management of our NNRs, and nature conservation will be the overriding land use, although it may not be the sole purpose of management.

- **National importance** – The NNR must be managed for the features of interest, which are of national importance on the NNR i.e. for the protection of geological features, habitats or species found there.

- **Best practice management** – NNRs must be well managed, not only to safeguard the nature conservation interests, but also to provide for people's enjoyment and understanding.

- **Continuity of management** – Both research and management on NNRs require us to take a long-term view, so it is important that management continuity is assured.

The purposes are:

- **National awareness of NNRs -** The NNR is managed so that people can take pride in the natural heritage 'on display' and come to understand it better and enjoy it to the full.

- **Specialised management of NNRs -** The character of one or all of the features of interest on the Reserve requires specialised and pro-active management, which is best, delivered by a Nature Reserve.

- **Research-related NNRs -** These NNRs will offer opportunities for research into the natural heritage and its management. The research specifically requires a Nature Reserve location.

From 2000 - 2003 all of Scotland's NNRs were reviewed against this policy. Because of the review there are now (2009) 58 NNRs in Scotland. There are currently a number of NNRs identified during the review which have still to be taken through the de-declaration process. As a result of this a search on many SNH systems will show more than 58 NNRs until this work is complete.

More information can be found at:

Scotland's National Nature Reserves: A policy statement:
http://www.snh.org.uk/pdfs/polstat/nnrpolcy.pdf

National Nature Reserves – General Information:
http://www.nnr-scotland.org.uk

Appendix 2 - Special Area of Conservation (SAC)

Special Areas of Conservation are areas designated under the European Community Council Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/43/EEC), commonly known as the Habitats Directive. Together with Special Protection Areas (SPA), which are designated under the Wild Birds Directive for wild birds and their habitats, SACs form the Natura 2000 network of sites. The Natura 2000 network is designed to conserve natural habitats and species of animals and plants, which are rare, endangered or vulnerable in the European Community. Annexes I and II to the Habitats Directive list the habitats and (non-bird) species respectively for which SACs are selected. In Great Britain, the Directive was transposed into domestic legislation via the Conservation (Natural Habitats &c.) Regulations 1994. The Regulations cover both SPAs and SACs. Natura sites are generally underpinned by a Site of Special Scientific Interest (SSSI) in the terrestrial environment, although there are a few exceptions where other management measures are employed. The Scottish Executive Rural Affairs Department Circular No. 6/1995 (Revised June 2000) on the Habitats and Birds Directives gives further details of how the Regulations apply in Scotland.

Scottish Natural Heritage (SNH) acts as the advisor to Government in proposing selected sites for ministerial approval as possible SACs. SNH then consults with key parties over the site proposals on behalf of Scottish Ministers. The consultees, who include owners and occupiers of land, local authorities and other interested parties, are sent details of the proposed site boundaries and the habitats and/or species for which they qualify. SNH also negotiates the longer-term management of these sites. Following consultation, SNH forwards all responses to Scottish Ministers who then make a decision about whether to submit the site to the European Commission as a candidate SAC. Once submission of all candidate sites is completed, the Commission, together with Member States, will consider the site series across Europe as a whole. At this stage, sites that are adopted by the Commission become Sites of Community Importance (SCIs), after which they can be finally designated as Special Areas of Conservation by national governments.

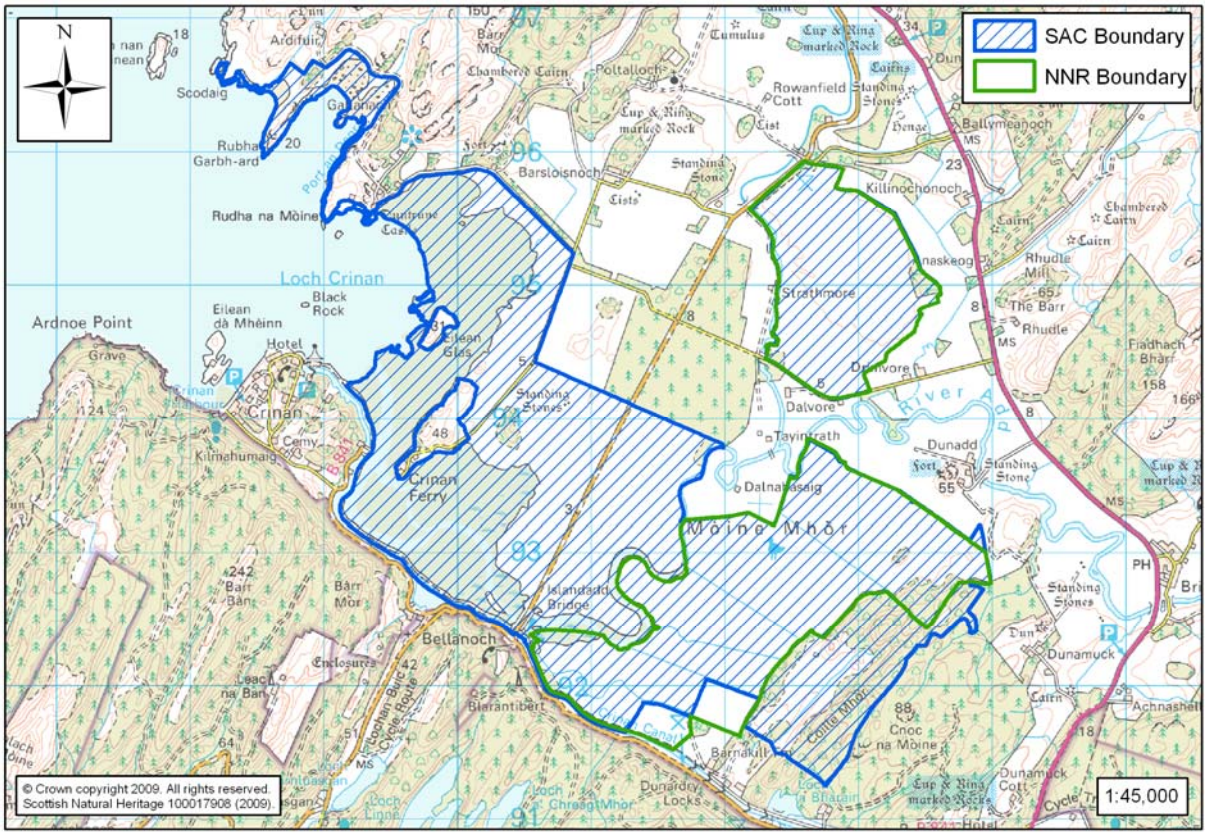
The following websites provide further information:

Special Areas of Conservation:
http://www.jncc.gov.uk/ProtectedSites/SACselection

Moine Mhor SAC

Country	Scotland
Unitary Authority	Argyll & Bute
Grid Ref*	NR 81 29 34
Latitude	56 04 50 N
Longitude	05 31 05 W
SAC EU code	UK 0019839
Status	Designated Special Area of Conservation (SAC)
Area (ha)	1150.41

*This is the approximate central point of the SAC. In the case of large, linear or composite sites, this may not represent the location where a feature occurs within the SAC.



Site details

Annex I habitats that are a primary reason for selection of this site:

Active raised bogs * Priority feature

This extensive raised bog was subjected to considerable damage and peat extraction in the past, but nevertheless a substantial part of it, particularly in the northern section, supports active bog habitat and there is evidence of continuing regeneration of the habitat. The bog is very close to sea level and has maritime affinities, grading into saltmarsh. It is the most extensive westerly raised bog in Scotland. The bog-moss *Sphagnum magellanicum* is abundant around the highest part of the bog and cranberry *Vaccinium oxycoccos* is also common.

Degraded raised bogs still capable of natural regeneration

Most peat on the west coast of Scotland is classified as Blanket bogs. The small amount of raised bog present in this area has suffered significant human impact. Mòine Mhór is the largest area of raised bog in this part of Scotland and represents the hyper-oceanic zone within the raised bog SAC series. It has been subjected to a number of damaging management activities in the past, including extensive drainage, commercial and domestic peat extraction and some afforestation, but now shows strong evidence of regeneration. A transition to saltmarsh is an unusual ecological feature of this site.

Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site:

Mudflats and sandflats not covered by seawater at low tide

Atlantic salt meadows (Glauco-Puccinellietalia maritimae)

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

Annex II species that are a primary reason for selection of this site:

Not applicable.

Annex II species present as a qualifying feature, but not a primary reason for site selection:

Marsh fritillary butterfly Euphydryas (Eurodryas, Hypodryas) aurinia

Otter Lutra lutra

Conservation Objectives for Moine Mhor Special Area of Conservation

Habitats:

To avoid deterioration of the qualifying habitats (listed below) thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and
To ensure for the qualifying habitats that the following are maintained in the long term:

- Extent of the habitat on site
- Distribution of the habitat within site
- Structure and function of the habitat
- Processes supporting the habitat
- Distribution of typical species of the habitat
- Viability of typical species as components of the habitat
- No significant disturbance of typical species of the habitat

Qualifying habitats:

- Active raised bogs*
- Atlantic salt meadows
- Degraded raised bogs
- Intertidal mudflats and sandflats
- Western acidic oak woodland

Species:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and
To ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site
- Distribution of the species within site
- Distribution and extent of habitats supporting the species
- Structure, function and supporting processes of habitats supporting the species
- No significant disturbance of the species

Qualifying species:

- Marsh fritillary butterly
- Otter

Appendix 3 - Sites of Special Scientific Interest (SSSI)

Scottish Natural Heritage is the key statutory agency in Scotland for advising Government and for acting as the Government's agent in the delivery of conservation designations in Scotland. Site of Special Scientific Interest (SSSI) is the main nature conservation designation in Great Britain (GB). These sites are special for their plants or animals or habitats, their rocks or landforms or a combination of these.

The SSSI series has been developed over the last 50 years, and since 1981 as the national suite of sites providing statutory protection for the best examples of GB's flora, fauna, or geological or physiographical features. Originally notified under the National Parks and Access to the Countryside Act 1949, many SSSIs were renotified and others newly notified under the Wildlife and Countryside Act 1981. SSSI continue under the Nature Conservation Act (Scotland) 2004, which further strengthens their protection and makes the system more user friendly.

These sites are also used to underpin other national and international nature conservation designations. Most SSSIs are privately owned or managed; others are owned or managed by public bodies or non-government organisations. There are more than 1400 SSSIs in Scotland.

Web Links:

'The Nature of Scotland – A Policy Statement'
http://www.scotland.gov.uk/library3/environment/nas-00.asp

'People and Nature: A New Approach to SSSI Designations in Scotland'
http://www.scotland.gov.uk/library/documents-w1/pandn-00.htm

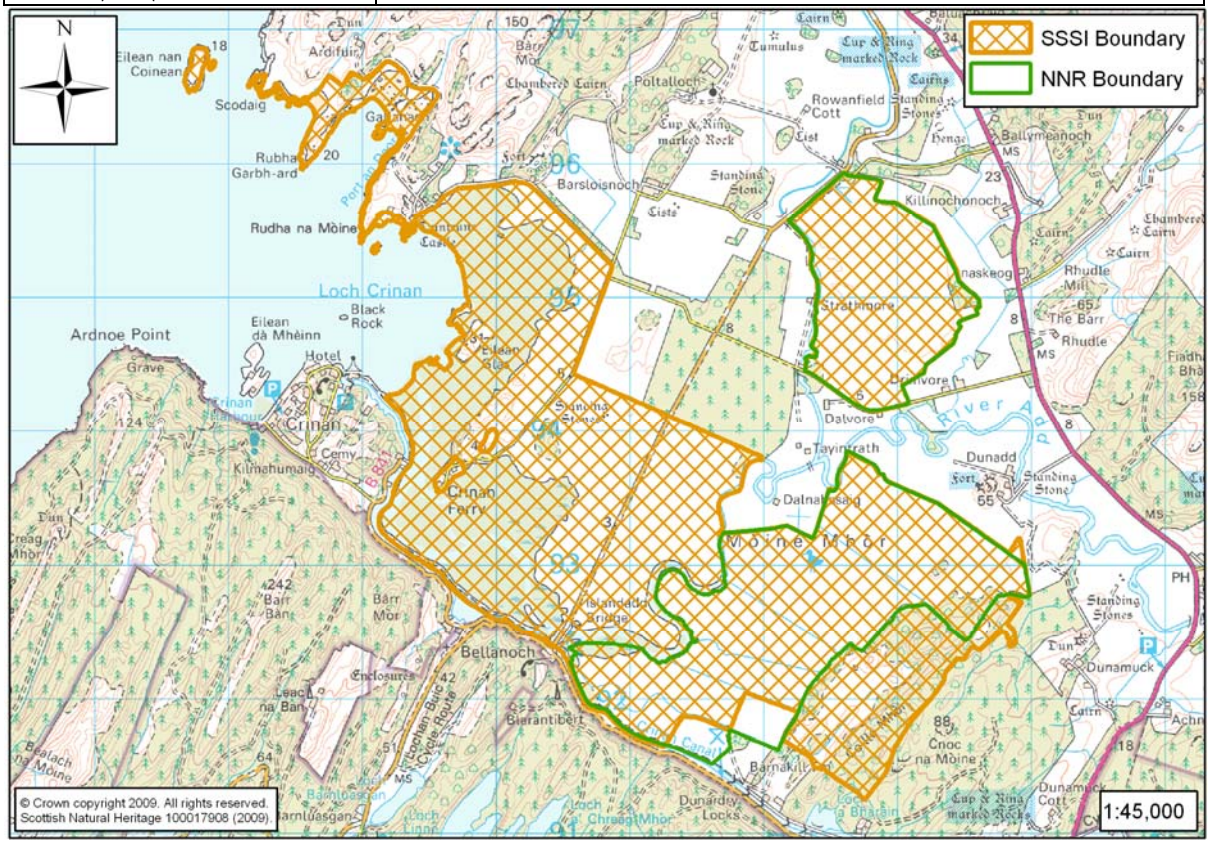
Guidelines for selection of biological SSSIs
http://www.jncc.gov.uk/Publications/sssi/default.htm

Site of Special Scientific Interest (SSSI):
http://www.snh.org.uk/about/ab-pa01.asp

List of Scottish SSSI:
http://www.snh.org.uk/pdfs/protect/SSSI_02.pdf

Moine Mhor SSSI

Country	Scotland
Unitary Authority	Argyll & Bute
Grid Ref	NR 81 59 25, NR 82 99 50
Notified	28 February 1990
Area (ha.)	1194.8



Description

Biological: Habitat: Peatland
Biological: Habitat: Coastland
Biological: Habitat: Woodland
Biological: Species: Birds

The Moine Mhor (Great Moss) lies to the east of the Crinan Estuary and to the north and south of the River Add. This flat expanse of land which is underlain by heavy marine clays was uplifted following glaciation and provided ideal conditions for the development of a lowland estuarine raised bog. Dissection by the Kilmartin Burn and the River Add led to the development of a number of separate raised peat areas but the north western area was lost through agricultural improvement in the 19th century and more recent afforestation has damaged a further central area. The remaining peat masses are however unusually intact and support bog communities which in the case of the northern section appear to have close affinities to surviving eastern Scottish

bogs. The highest point on the bog is only 13 metres O.D. and peat depths range from 0 at the coast to an estimated 5 metres. The higher sections of the peat lens are covered by a community typified by cross-leaved heath and bog mosses *Erica tetralix – Sphagnum* spp, with *Sphagnum magellanicum* the dominant plant over many areas while cranberry *Vaccinium oxycoccos* is also common. The northern section is one of the largest examples in Britain retaining its original surface.

The southern section contains an intact transition of plant communities from the dwarf eel grass *Zostera noltii* beds on the tidal flats, through saltmarsh, brackish areas and on to the bog itself. This is the only known intact example in Britain of this transition.

The loch head saltmarsh is the largest on mainland Argyll and contains a variety of saltmarsh communities, including those characterised by *Juncus gerardii* and *Blysmus rufus*. Beaked tasselweed *Ruppia maritima* occurs in the creeks while acidic and base rich flushes support plants including lesser tussock-sedge *Carex diandra*, slender sedge *Carex lasiocarpa* and parsley water-dropwort *Oenanthe lachenalii*. To the landward side the succession develops into marshy grassland where large bitter-cress *Cardamine amara* and greater tussock-sedge *Carex paniculata* occur, while nodding bur-marigold *Bidens cernua* occurs in a vegetated ox-bow lake.

Woodland has developed on epidiorite rock outcrops enclosing the bog and Barnakill woodland is a large area of ancient seminatural woodland dominated by the oak-birch-wood-sorrel community *Quercus petraea-Betula pubescens-Oxalis acetosella*. It contains a number of areas rich in oceanic bryophytes and in addition to its woodland bird communities supports butterflies including purple hairstreak, dark green fritillary, marsh fritillary and Scotch argus.

The site is an important feeding, roosting and breeding area for a range of birds including several species of international significance. Breeding species include short-eared owl, redshank, curlew and snipe whilst in winter birds of prey, Greenland white-fronted geese and greylag geese roost and feed on the bog and mudflats. In addition the bay provides feeding for one of the largest concentrations of teal, wigeon and mallard in mainland Argyll and also acts as a staging post for migrating birds such as whooper swan.

REMARKS

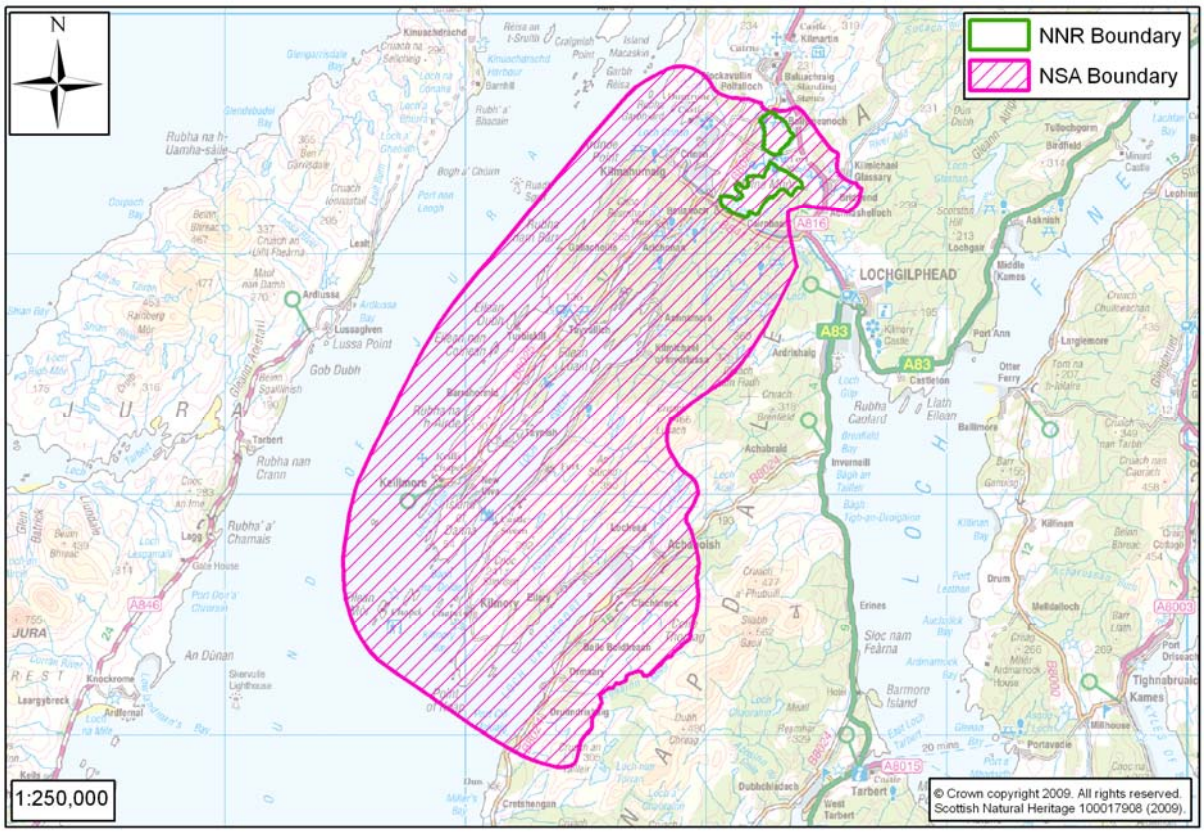
A two part site. Boundary amended with significant net increase to include woodland. A Grade 1 NCR site. In part a National Nature Reserve.

Appendix 4 - National Scenic Area (NSA)

National Scenic Areas are Scotland's only national landscape designation. They are those areas of land considered of national significance on the basis of their outstanding scenic interest, which must be conserved as part of the country's natural heritage. They have been selected for their characteristic features of scenery comprising a mixture of richly diverse landscapes including prominent landforms, coastline, sea and freshwater lochs, rivers, woodlands and moorlands.

There are currently 40 NSAs in Scotland, covering a total area of 1,001,800 ha.

Knapdale NSA



Extent of Area

The area includes Loch Crinan and the Moine Mhor, as well as the tightly folded ridge and glen topography of north western Knapdale, around Lochs Sween and Caolisport.

Description

The strongly grained topography of Knapdale, with long parallel ridges and glens aligned on a north-west south-east axis, presents a miniature 'Appalachian' type

landscape. Heavily wooded now, the glacially overdeepened glens either have narrow ribbon lakes in their bottoms or else have been invaded by the sea. Loch Sween is a complex series of parallel channels intruding long narrow fingers of sea into the coniferous forests of Knapdale. This ever present combination of fresh and sea water with their different plant life, small waterside meadows, and heavily wooded ridges makes up a series of narrow enclosed landscapes gradually opening out to the lower, more open, and mixed land uses of the wider topography at the mouth of Loch Sween, from where there are fine views to the Paps of Jura. By contrast Loch Caolisport is a wide sea loch. It is contained by sufficient amplitude of relief to frame the views of Jura, and in this more open loch basin there is a pleasing mixture of forestry and well kept farmland, with moorland on the high land, and some deciduous woodlands on the hillsides. To the north the flat moss, meadow and arable land of the Moine Mhor, the finely curving meanders of the River Add, and the abruptly upstanding heights of Dunadd and Cnoc na Moine, the former rocky and bare, the latter heavily mantled in oakwoods, provide a sharp contrast to the tightly grained and forested hills of Knapdale. Loch Crinan, with its wide expanse of flats, continues this character seawards, and is enclosed on its north side by a series of miniature glens and hills, echoing the scale of Knapdale to the south, but offering a gentle, open, cultivated contrast to the forest. The historic and cultural interest of this landscape adds a further dimension to the scene.