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KNOCKAN CLIFF
Site of Special Scientific Interest

SITE MANAGEMENT STATEMENT

Site code: 875

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Purpose

This is a public statement prepared by SNH for owners and occupiers of the SSSI. It outlines the reasons it is designated as an SSSI and provides guidance on how its special natural features should be conserved or enhanced. This Statement does not affect or form part of the statutory notification and does not remove the need to apply for consent for operations requiring consent.

We welcome your views on this statement.

This statement is available in Gaelic on request.

Natural features of Knockan Cliff SSSI	**Condition of feature (and date monitored)**
Moine (geology)	Favourable, maintained (May 2002)
Upland assemblage (a mosaic of upland habitats)	Favourable, maintained (July 2005 & December 2006)

Description of the site

Knockan Cliff Site of Special Scientific Interest (SSSI) is located about 1km southwest of Elphin and straddles the border of Wester Ross and Sutherland. The site lies at the western end of the Cromalt Hills, to the east of Cul Mor and to the south of the Inchnadamph and Assynt limestone area. The site has been designated as an SSSI for the nationally important geology and upland habitats. The southwest part of the site includes the Knockan Crag National Nature Reserve (NNR) which has internationally renowned geological exposures.

Moine (geology)

Knockan Cliff SSSI includes historically significant exposures of the Moine Thrust. The rocks here were first studied more than 120 years ago and were the subject of a major geological controversy in the late 19th century. The Moine Thrust is a large, low angled fault, or fracture, in the Earth's crust, which is exposed along a line from Loch Eriboll to the Isle of Skye. When Scotland collided with Scandinavia and then England between about 460 and 425 million years ago, the impact created the Caledonian 'Orogeny', or mountain building episode. A great mountain chain formed extending from Norway to Ireland and the USA. Intensive compression at the time split the crust along gently inclined thrust faults and older rocks were pushed upwards and westwards over younger rocks. The rocks of the Moine Supergroup were pushed westward along the Moine Thrust by up to 100km. Beneath the Moine Thrust are a number of other thrusts that together form the Moine Thrust Belt.

Sedimentary rocks which were laid down during the Cambrian period (around 550 million years ago) can be viewed at the base of Knockan Crag in the south west of the site. These rocks have been relatively undisturbed by earth movements of the mountain building period and can be seen in the sequence in which they were originally laid down as sandy and muddy sediments in a warm shallow sea. These rocks are known as the Foreland group.

The line of the Moine Thrust is visible higher up the crag. Here the thrusting action of earth movements has caused older, dark-coloured Moine rocks to come to rest from their westward journey across the top of lighter coloured, younger Durness limestone of the Foreland group. The Moine rocks have been formed from sandy, or sometimes muddy, sediments deposited in a shallow sea around 1000 million years ago. These sediments were buried and compressed into rock which was then heated and deformed into harder 'metamorphic' rock during the Caledonian Orogeny. Additionally, Moine rock along the Moine Thrust has been fractured, crushed and sheared to form 'mylonite' (literally 'milled rock').

In the northeastern part of the site, north of Cnoc an Sasunnaich, the rocks of the Moine Thrust swing to the east and the Sole Thrust, which developed beneath the Moine Thrust, is exposed. The rocks above the line of the Sole Thrust comprise 'slices' of Cambrian age Durness limestone and Salterella grit separated by small thrust faults. This series of small thrusts is known as an 'imbricate' thrust stack. At the southern end of the SSSI, the Moine Thrust runs along a stream where excellent exposures of the thrust plane can be seen. At this point the dark crags of Moine rocks have been thrust over gently dipping slabs of Durness limestone.

Near Uamh Mhor, the Moine Thrust cuts across a third major thrust fault known as the Uamh Mhor Thrust. The Uamh Mhor Thrust has brought Cambrian quartzite on to the top of the slightly younger Cambrian Durness limestone but has been deformed by faulting in the underlying limestone. The quartzite is well exposed on Cnoc a' Choilich Mor (Figure 1) and is faulted in a similar 'imbricate' way to the Durness limestone. The Uamh Mhor Thrust can be clearly seen at Creag a' Ghlinne on the eastern edge of the SSSI.

Figure 1. White to pale pink quartzite at summit of Cnoc a' Choilich Mor. Vegetation changes between the brown blanket bog and the green lime-rich areas are also visible.	Figure 2. Mountain avens can be found in calcareous grassland habitat. The plant forms a ground hugging mat - this protects it from the desiccating effects of the wind.
	

This site clearly demonstrates the nature of the Moine Thrust in this area and supplies evidence critical to the understanding of the relative ages of movement in the Thrust Belt. Much of the importance of the site lies in the apparent order of thrust development, which shows that movement on thrusts higher in the rock pile occurred first, with the exception of movement on the Moine Trust which occurred last. This observation of late movement on the 'overlying' Moine Thrust, makes the site of great international significance in our understanding of the concept of 'overthrusting', a phenomenon now known to occur worldwide.

The order of fault movements at Knockan differs from elsewhere in the Moine Thrust Belt where movement on the Moine Thrust occurred earlier. This illustrates the complexity of the Thrust Belt. Comparisons of grain-scale deformation, such as fracturing, shearing and crushing to form mylonite shows that here, where the Moine Thrust is late, there was complex, multi-stage deformation. The deformation was less complex where movement on the Moine Thrust occurred earlier. Knockan Cliff SSSI shows the link between grain-scale processes, such as shearing and fracturing, and the larger scale tectonic features.

The Moine feature was assessed as being in favourable condition when monitored in 2002. The visibility of the rock outcrops had been maintained.

Upland assemblage (a mosaic of upland habitats)
Knockan Cliff SSSI includes one of only three limestone areas in Sutherland. The outcrops of limestone that occur on this site enable plant species to grow here that are found in few other places in the northwest Highlands. The assemblage of upland habitats includes tall herbs, calcareous grassland, calcareous scree, blanket bog and flushes.

The cliffs support a rich upland flora associated with limestone which makes up the **tall herb** habitat. Stands are found below Creag Dubh na Glaic-fearna, at the north end of Creag Dubh na Glaic-fearna and on the small section of the SSSI that lies below the road. Great wood-rush, bilberry and water avens dominate these stands. Fern species also thrive here, including black spleenwort.

The herb-rich **calcareous grassland** is widespread throughout the site, particularly below the cliff and rock outcrops. The vegetation is dominated by sheep's fescue, common bent and creeping thyme, mountain avens (Figure 2) and glaucous sedge. An area rich in carnation sedge and dog violet is found below Creag Dubh na Glaic-fearna where the path goes up through the cliff. The base-rich soils support a diverse range of flowering plants including lady's bedstraw, and autumn gentian. Lime-loving ferns like green spleenwort are found here, together with mosses such as lesser club moss.

There are two types of **calcareous screes**. One is found on small, broken blocks of limestone on steep slopes with very sparse vegetation. Uncommon flowering plants such as hoary whitlow grass, moss campion and purple saxifrage occur in these areas. The other habitat has quite large blocks of limestone with crevices and overhangs which shelter relatively lush vegetation dominated by ferns such as green spleenwort, holly fern and maidenhair spleenwort. This latter habitat is concentrated on the east side of Cnoc a' Choilich Beag, with a small outlier on the steep, north-facing slopes of the Glac Mhaolagain.

Over 80% of the site is covered by blanket bog. This habitat is found in the hollows between the limestone knolls on the gently undulating peaty plateau above the cliffs. Common species in this part of the site include *Sphagnum* mosses, deergrass, hare's-tail cottongrass, crowberry and cross-leaved heath.

Flushes are areas of damp ground where slowly moving water has concentrated nutrients that are otherwise scarce. The flushes on this site support a common yellow sedge - yellow saxifrage plant community. A small area of the moss *Cratoneuron commutata* – red fescue spring community is found below the road. Other species found in these habitats include velvet bent and the nationally scarce rock sedge.

The upland habitats were surveyed in 2005 and 2006 and although found to be in favourable condition, there were concerns about the grazing and trampling impact of sheep and deer on some parts of the site.

Other interests

There are some areas of scrub woodland on ledges along the main cliff face. The trees present are predominantly birch with the occasional rowan. Kestrel, raven and buzzard breed on the cliffs.

Past and present management

The land is owned by two estates and Knockan Common Grazings occupies the northern part of the site. Scottish Natural Heritage owns and manages Knockan Crag National Nature Reserve (NNR), which covers 22ha in the southwest of the site. More details of Knockan Crag NNR can be found on the National Nature Reserve website http://www.nnr-scotland.org.uk/

Both estates manage the land within the SSSI for sporting interests, mainly for red deer. The site is also currently grazed by sheep and cattle. Peat cutting and muirburn have been undertaken in the past. A shelter belt of trees has been planted on the northern edge of the site (to the west of the road).

Knockan Common Grazings has received funding for the conservation management of the site through a series of agri-environment schemes, including funding from the Scotland Rural Development Programme Rural Priorities scheme in 2010.

Knockan Crag National Nature Reserve interprets the Moine Thrust for the general public and provides access to the site along a series of trails. There is an unmanned visitor centre and SNH runs events and guided walks to promote understanding of the geology of the area and explain the historical importance of the site. A major programme of work was undertaken on the cliff face above the visitor centre in the winter of 2008/9 to remove unstable rocks.

Objectives for Management

We wish to work with land managers to protect the site and to maintain and where necessary enhance its features of special interest. SNH aims to ensure that site condition surveys, monitoring and research are continued as appropriate, to increase our knowledge and understanding of the site and its natural features and to monitor the effectiveness of the management.

The list of Operations Requiring Consent and the discussions on land management involved in the issuing of formal consents are intended to minimise the threat of any damage to the natural features.

1. To maintain the condition, extent, visibility and access to the key geological features by keeping them free of obstructions. This objective can be achieved by maintaining the present management.

SNH will continue to manage Knockan Crag NNR to encourage access to the important geological features and provide educational material and interpretation of the geology. Knockan Common Grazings will also help to make the geology accessible to visitors as part of their Rural Priorities contract. Way markers are to be erected to indicate the route to the limestone cave (Uamh an Tartair) and an interpretation board is to be situated close to the cave to promote an understanding of the geology.

2. To maintain the condition, distribution and extent of the upland habitats, by keeping the stocking of grazing animals (sheep, cattle and deer) at a level that is low enough to prevent obvious damage to the vegetation from grazing or trampling. The Rural Priorities contract with the grazings shareholders will achieve appropriate grazings levels by livestock. Appropriate deer management by the sporting estates and on the NNR is also important.

Burning could seriously damage some of the upland habitats and the steeper parts of the site should not be burned. Parts of the site that are managed by Knockan Common Grazings already have a no-burning agreement. SNH should be consulted if muirburn is being considered elsewhere on the site.

Date last reviewed: 8 July 2010