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# GAIRLOCH MORaine

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*OS Grid Reference: NG792815*

## Highlights

This site demonstrates the best representative assemblage of landforms associated with the Gairloch Moraine, a feature formed by the Wester Ross Readvance of the Late Devensian ice-sheet.

## Introduction

The Gairloch Moraine (NG 792815) extends over a distance of about 10.5 km in a north–south direction across the peninsula between Loch Gairloch and Loch Ewe. It provides important geomorphological evidence demonstrating a readvance of the Late Devensian ice-sheet in north-west Scotland, the Wester Ross Readvance, which has been identified so far over an area extending from Applecross to north of Loch Broom (Robinson and Ballantyne, 1979). The only published description of the site is by Robinson and Ballantyne (1979).

## Description

The Gairloch Moraine marks the western limit of a former glacier nearly 25 km across, which occupied Loch Gairloch and Loch Ewe and the intervening low ground (Robinson and Ballantyne, 1979). The moraine (Figure 6.2) can be traced northwards from a point (NG 771780) 3 km west-north-west of Gairloch, where the former ice margin is marked by a belt of boulders and a drift limit. This is continued northwards and westwards by a discontinuous moraine ridge up to 4 m high. A pair of beaded eskers up to 10 m high terminates just east of this ridge. From NG 797821 to NG 789866, the moraine takes the form of a well-marked, though discontinuous, boulder ridge 4 km long (Figure 6.3). At the foot of the Loch Maree fault-line scarp the former glacier limit is represented by broad till ridges (for example, near NG 778901), although the moraine resumes its bouldery character 1 km from the coast, at NG 780915. The total length of the former ice margin delimited by the Gairloch Moraine is about 10.5 km. The form of the moraine is very similar to that of the moraines associated with the Inland Ice near Søndre Strømfjord in West Greenland (see Ten Brink and Weidick, 1974; Ten Brink, 1975). Like these, it runs across country for long distances over low undulating topography, with loops extending down the main valleys.

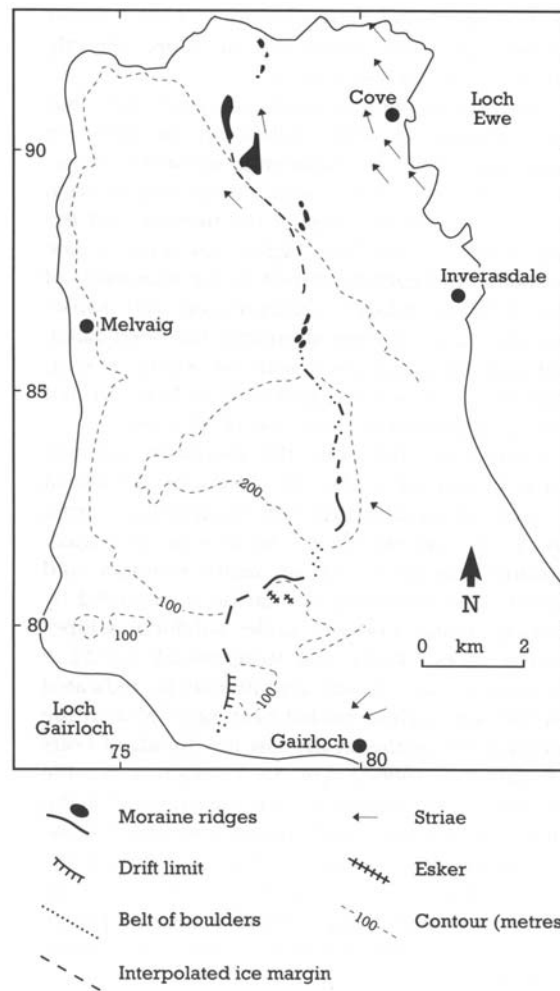


Figure 6.2: The Gairloch Moraine and associated landforms (from Robinson and Ballantyne, 1979).



Figure 6.3: The Gairloch Moraine, in the valley of the River Sand north-west of Gairloch, comprises a low ridge of boulders. (Photo: J. E. Gordon.)

Local equivalents of the Gairloch Moraine, comprising boulder ridges, moraine ridges and drift limits, have been identified on the Redpoint and Applecross peninsulas near Aultbea, on An Teallach (Robinson, 1977, 1987b; Robinson and Ballantyne, 1979; Sissons and Dawson, 1981) and on the flank of Ben Mòr Coigach (Sutherland, 1984a, figure 10). Robinson (1977) and Robinson and Ballantyne (1979) record that some of the individual features were first noted by officers of the Geological Survey on their manuscript maps, although their significance was not then recognized (but see Wright, 1937). However, a whole system of ice-marginal features has now been traced out (see Sutherland, 1984a) and interpreted on geomorphological grounds as marking the maximal extent of a glacial readvance, the Wester Ross Readvance (see Figure 6.1), that interrupted the retreat of the Late Devensian ice-sheet (Robinson and Ballantyne, 1979). This event is tentatively dated to 13,500–13,000 BP (Ballantyne *et al.*, 1987), the approximate time when the oceanic polar front migrated northwards of the west coast of Scotland (Ruddiman and McIntyre, 1973). Sissons and Dawson (1981) argued on glaciological grounds that a readvance is more probable than a stillstand. A readvance is also indicated by changes in the orientation of striae on either side of the Redpoint Moraine (Robinson and Ballantyne, 1979), but it is as yet unconfirmed by stratigraphic evidence and is of unknown magnitude. The presence of an end moraine, however, demonstrates active retreat of the last ice-sheet in this area.

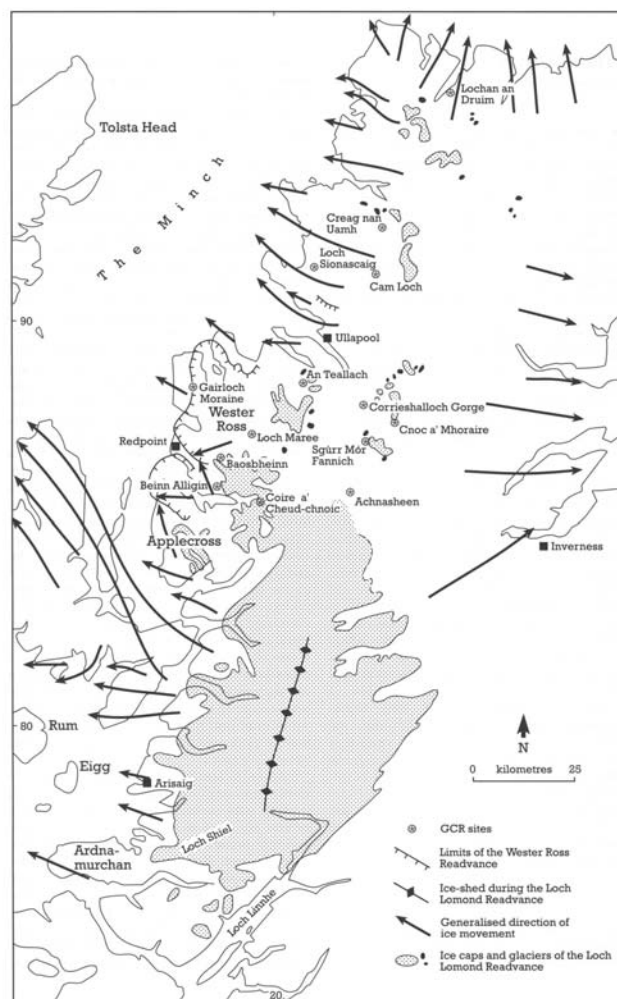


Figure 6.1: Location map and principal glacial features of the north-west Highlands (modified from Johnstone and Mykura, 1989).

## Interpretation

In the past, numerous readvances of the Late Devensian ice-sheet in Scotland have been proposed (see the reviews in Sissons, 1967a, 1974c and 1976b; and also Charlesworth, 1926b, 1956; Synge, 1966, 1977b; Synge and Stephens, 1966; Smith, 1977; Synge and Smith,

1980), but the evidence for most of these has now been reinterpreted (see reviews in Sissons, 1974c, 1976b; Gray and Sutherland, 1977; Sutherland, 1984a). The evidence from Wester Ross, however, and particularly the continuity of the ice-marginal features across large tracts of country, appears to substantiate a readvance. Significantly, also, the marine limit outside the moraine represents a broadly synchronous shoreline formed at approximately the same time as the moraine (Sissons and Dawson, 1981).

Relationships between the Wester Ross Moraine and former ice limits elsewhere are uncertain (Ballantyne *et al.*, 1987). For example, Smith (1977) and Synge (1977b) described a putative readvance limit at Ardersier (but see Firth, 1989b), and D. J. Balfour (unpublished data) has identified former ice limits near the mouths of a number of valleys on the north coast of Sutherland. Sissons and Dawson (1981) considered the possibility that the Wester Ross Readvance might relate to former ice limits associated with sharp drops in the marine limit at Stirling (Sissons *et al.*, 1966) and Otter Ferry (Sutherland, 1981b) and to a stillstand or readvance suggested by Peacock (1970a) in Inverness-shire. However, the evidence is conflicting (Sutherland, 1984a). On the one hand, the gradient of the Main Wester Ross Shoreline associated with the moraine is similar to that of the Main Perth Shoreline which terminates inland near Stirling. In contrast, the gradual drop in the marine limit as the ice retreated from the Wester Ross Moraine appears to argue against such correlations (Sissons and Dawson, 1981). Ballantyne (1988) has also suggested that the readvance may be represented by the "Strollamus Moraine" in southern Skye, but subsequently reinterpreted the latter as a medial moraine deposited at the convergence of two ice streams (Ballantyne and Benn, 1991).

Similarly, it is not possible to substantiate correlations with the end moraines described in Easter Ross (Sissons, 1982a; Sutherland, 1984a; Ballantyne *et al.*, 1987) for it is as yet unclear which of those moraines relate to ice-sheet deglaciation and which relates to the Loch Lomond Readvance.

The continuity and extent of the Wester Ross Moraine is of considerable importance in providing the clearest geomorphological evidence yet for a readvance of the Late Devensian ice-sheet in Scotland. This evidence is particularly well developed in the Gairloch area where the features marking the ice limit are all clearly demonstrated and seen in close geographical association – drift limits, boulder ridges and till ridges. Here too, eskers occur as part of the landform assemblage. The Gairloch Moraine site may therefore be regarded as the single most important locality demonstrating key geomorphological features of the Wester Ross Readvance. Elsewhere, other aspects of the readvance are represented at An Teallach, notably the relationship with Loch Lomond Readvance moraines.

## Conclusions

This site demonstrates end moraine and other landforms formed by a readvance (the Wester Ross Readvance) of the Late Devensian ice-sheet, about 13,500–13,000 years ago. It includes the best assemblage of landforms that mark the former limit of the ice and is therefore an important reference locality for the geomorphological expression of the event.

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