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# Rhinog Fawr

## Highlights

A key locality showing the largest stone stripes in Britain, evidence of periglacial activity on a large-scale during the Late Pleistocene.

## Introduction

Rhinog Fawr [SH 643 286] is an important geomorphological site for a series of well developed large-scale stone stripes. The stripes are thought to be well preserved relics of Late Pleistocene periglacial conditions, and they occur at a larger-scale than sorted stone stripes described elsewhere in Britain. They were first noted by Ball and Goodier (1968), and their age and geomorphological significance was discussed by Foster (1970a). The site has also been mentioned in studies by Foster (1968), Goodier and Ball (1969), Ball and Goodier (1970), Whittow and Ball (1970) and Allen and Jackson (1985).

## Description

Rhinog Fawr, in the Harlech Dome, consists of outcrops of Lower Cambrian Rhinog Grit (Matley and Wilson 1946) which reach 720m OD. The stripes occur on the south-west facing slopes at an altitude of 425–490m OD, lying at the margins of a drift-filled basin near the head of Cwm Nantcol. The stripes are visible over an area of about 10ha, occurring on slopes between 12° and 18° (Ball and Goodier 1968). There are two main elements in the stripe morphology —1) exposed stripes composed of sandstone and conglomerate (Rhinog Grit) boulders of a general size range between 0.60m and 1.50m, and a repeat distance between crests of 5–8m, 2) intervening vegetated zones composed largely of small shrubs dominated by *Calluna vulgaris* (L.) Hull. A trench across a typical pattern showed that the sub-surface boulder zone, was wider than that exposed on the surface, and that in the centre of the vegetated zone, fine earth was present to a depth of about 1m. At about 1.5m from the centre of the vegetated/fine earth zone, an area of large boulders occurred with a fine earth matrix, and in turn this was succeeded at a further 0.75m distance towards the exposed boulder stripe, by a change of matrix from fine earth to a non-stratified peaty humus. This zone extends for a further metre until the unvegetated, matrix-less stripe is reached. Dip and orientation measurements showed that only boulders in the central, unvegetated part of the stripes had a strongly preferred fabric, with steep dips and a marked downslope orientation between 213° and 252° — coincident with the direction of the ground slope at about 218° (Ball and Goodier 1968).

## Interpretation

It is generally held that the processes of sorting by freeze and thaw coupled with solifluction movement on gentle or moderate slopes, can produce stone stripes (Ball and Goodier 1968; Washburn 1979). Patterned ground in Britain has been recorded from a number of localities, and it has been interpreted either as a relic of Pleistocene periglacial conditions or as the result of contemporary formation. Sorted stripes of c.2m pattern width, for example, were recorded by Galloway (1961) at 950m on Ben Wyvis, Scotland, and smaller contemporary stripe patterns of less than 1m repeat width have been described from Tinto Hill, Lanarkshire by Miller *et al.* (1954). In Wales the occurrence of small active polygons at 940m in the Carneddau (Snowdonia) was noted by Pearsall (1950) and Tallis and Kershaw (1959), and larger-scale, fossil sorted stone stripes (repeat width up to 6m) were described from the Stiperstones in Shropshire by Goudie and Piggott (1981). The features described by Ball and Goodier (1968) at Rhinog Fawr, however, are of a larger-scale than any of those previously reported in upland Britain, although similar scale features have been described in the Arctic (Sharp 1942) and in the Appalachians (Rapp 1967).

Ball and Goodier (1968) interpreted the Rhinog Fawr examples as 'fossil' features for the following reasons —1) the present climate of the area is too temperate to allow contemporary formation of the features at such altitudes, 2) the

central vegetated zones are developed over mature podzols, 3) the exposed boulders possess weathered rinds and are covered by lichens, and finally, 4) nineteenth century walls beneath which the features pass are undisturbed. Ball and Goodier, however, suggested that a lack of detailed knowledge of the glacial history of the area prevented precise dating of the features. Although it has been shown that periglacial processes were important in the region during the Devensian late-glacial, especially during the Younger Dryas (for example, Seddon 1962; Ball 1966; Ince 1981; Gray 1982a), Ball and Goodier thought that the location, low altitude and large-scale of the Rhinog Fawr stripes indicated that they were formed at an earlier stage of ice retreat from the region. They further suggested that the drift cover in the higher areas of the Rhinog Mountains had been largely removed, probably by intense solifluction following glaciation, and that preservation of the stripes was due to an unusual combination of circumstances: the aspect of the south-facing hollow was conducive to producing numerous freeze-thaw cycles and the drift contained a suitable size range of frost-resistant boulders to allow sorting. They noted that indistinct patterning was present beneath the entire drift-filled basin, suggesting that the stripes were covered by peat and colluvium. They concluded that most of the Rhinog site had been similarly covered for much of the Holocene, with exhumation of the boulder stripes only occurring subsequent to woodland clearance, grazing and burning in the area. A series of post-Neolithic vegetation changes in the western Rhinogau has been confirmed by pollen analyses made by Walker and Taylor (1976).

Foster (1970a) suggested that the large, sorted stone stripes were formed during periglacial conditions after the last major Late Devensian glaciation of the area, probably during the readvance of ice that formed the Bryncir-Clynnog moraine in northern Llŷn. This readvance has been radiocarbon dated at sometime after 16,830  $\pm$  970 –860 BP (Foster 1968), although doubt has been expressed concerning the validity of this particular date (Simpkins 1968; Bowen 1974). Indeed, there is no firm evidence to confirm the association between this readvance of the ice and the formation of the Rhinog Fawr stripes, and a later Devensian, Younger Dryas age is equally, if not more, likely.

The sorted stone stripes at Rhinog Fawr are some of the finest in Wales, and are larger-scale examples than those elsewhere in Britain.

Although the scale of the features makes them unique in Britain, they cannot be dated exactly. The features, however, are an important record of Late Devensian periglacial conditions and the site contrasts with those at Moelwyn Mawr and Y Carneddau, where there are periglacial landforms associated with contemporary processes of formation. In particular, the Rhinog Fawr examples contrast to the largely unsorted, vegetated and much smaller-scale stripes that are found elsewhere in Wales' (for instance, Y Garn and Y Llethr).

## Conclusions

Rhinog Fawr displays a series of well developed stone stripes. They are notable both as an uncommon landform and because their scale is greater than comparable features elsewhere in Britain. The age of the stripes is not known although they are believed to have formed during a periglacial phase in the last ice age, by sorting processes under exceptionally cold conditions.

## References