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PLOUGHING BLOCK MOVEMENT ON THE DRUMOCHTER HILLS IN THE GRAMPIAN HIGHLANDS, SCOTLAND

Abstract

Ploughing blocks on the hillslopes in the Drumochter area in the Grampians are active under the present climatic conditions. A study on seven blocks during 1978—1980 showed that their annual movements, ranging from 0.1 to 0.8 mm, are controlled largely by the combined effect of altitude, slope gradient and summer saturation.

INTRODUCTION

Ploughing blocks or the blocks that slowly move downslope under the existing cold climate have been reported from many parts of upland Britain (e.g., GALLOWAY, 1961; KING, 1968; TUFNELL, 1972, 1976; SHAW, 1976; BALLANTYNE, 1981; CHATTOPADHYAY, 1982, 1983). In the previous work of the author (CHATTOPADHYAY, 1982), dealing with ploughing blocks on the Drumochter hills in the Grampians, it was inferred that the blocks on higher slopes are more active. The aim of this paper is to present a study of contemporary movements of a number of ploughing blocks in the same area.

There is general agreement that in upland Britain ploughing blocks show detectable contemporary movement under favourable ground conditions, although there are differences of opinion as to the rate at which the blocks move downslope. TUFNELL (1972, 1976) measured the movements of five ploughing blocks at altitudes varying between 658 and 820 m on slope angles between 5° and 22° on the Moor House Reserve in the period 1965—1975. The total amount of annual movement for all five blocks combined ranged from 10.8 to 14.3 cm. He also observed that the movement of individual blocks within a 12 month period ranged from nothing to almost 8 cm. From his study TUFNELL found that (1) blocks that moved fastest in any one year did so in other years and vice versa, (2) movement rate was influenced by the block size; small blocks travelling faster than larger ones and (3) rates of movement varied on slopes of approximately equal steepness. SHAW (1977), from his three years' study on twelve „gliding boulders" in the south-east Grampians, found the average annual movement

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rate for individual blocks from 0.03 cm to 0.87 cm. A more recent study by BALLANTYNE (1981) revealed the annual movement rate of 0.6 cm to 3.45 cm for seven „ploughing boulders" in the Northern Highlands.

METHOD OF STUDY

The present study is based on a two-year (1978—1979 and 1979—1980) investigation of movements of seven ploughing blocks on the Drumochter hills in the central Grampians. The sites were installed in September 1978 on the north-westerly slope of A'Mharconaich and displacements were measured in September 1979 and September 1980. The equipment used consisted of iron stakes, drawing pins and tape. An iron stake of one metre length was placed on the ground about 40-50 cm from the upslope edge of each boulder, more than half of it being inserted into the ground to avoid any chance of displacement due to frost heave and mass movement. Drawing pins were set on the upslope edge of the block with the help of strong adhesive with their points facing upslope and measurements were taken of the distance between the back-edge of the stake and the points of the drawing pins on the block. The following table gives details of the study (Tab. I).

Table I

Characteristics and movements of seven ploughing blocks on the Drumochter hills

Site	Altitude (m)	Slp. ang. (deg.)	Diameter (m)	Furrow length (m)	Movements (cm) '78—'79	'79—'80	Total
1	850	8	0.87	6.5	0.3	0.2	0.5
2	840	13	0.73	1.5	0.3	0.3	0.6
3	790	15	0.57	4.0	0.2	0.1	0.3
4	800	17	0.78	3.5	0.3	0.2	0.5
5	860	22	0.79	2.0	0.5	0.4	0.9
6	870	26	0.83	9.5	0.6	0.5	1.1
7	880	32	0.84	7.6	0.8	0.6	1.4

The table shows that the selected blocks are at altitudes between 790 and 880 m and on slope gradients from 8° to 32°. Block altitudes are random but blocks that had moved a considerable distance, as indicated by a distinct furrow behind, were selected. A range of slope gradients was decided in an attempt to determine the influence of slope on the rate of movement. The annual movement of each block was determined from the increased distance between the stake and the points of the drawing pins on the block. Initially it was attempted to monitor movements twice a year: in spring (late April) and at the end of sum-

mer (late September). But the spring displacements for both the years were negligible (<0.2 cm) and in most cases no movement was detected. Hence only the annual recording has been used.

CHARACTERISTICS OF MOVEMENTS

From the findings of a limited two-year survey, it is difficult to draw firm conclusions about the nature of ploughing block movement in any area. However, certain inferences relating to the block movement can be made from the above table as follows:

1. Each of the seven ploughing blocks moved downslope during 1978—1980, a minimum of 0.3 cm for Block 3 resting upon a 15° slope and a maximum of 1.4 cm for Block 7 upon a 30° slope being found. The trend indicates that the rates of ploughing block movement on the Drumochter hills are distinctly lower than those in the Moor House Reserve in northern England (TUFNELL, 1972, 1976) and in the Northern Highlands (BALLANTYNE, 1981), but not very different from those in the south-east Grampians (SHAW, 1976).

2. Blocks 6 and 7, which moved the maximum distances (1.1 cm and 1.4 cm respectively), are associated with higher elevations, steeper slopes and longer furrows. The influence of altitude upon movement has been established by correlation analysis (CHATTOPADHYAY, 1982, 1983). The present-day movement also suggests that the blocks at higher elevations and on steeper slopes are more active.

3. The length of furrows does not always correspond with the present-day movement of the blocks; for example Block 2, which is associated with a furrow only 150 cm long, travelled 0.6 cm in two years whereas Block 3, with a furrow of 4.0 m, travelled only 0.3 cm during the same period. It would appear that for the present slow-moving Block 3 the relatively long furrow reflects former faster movement.

4. The present rate of movement shows no relation with slope gradient at and below 17°.

5. Block size has no direct relationship with movement rate. There is no indication that smaller blocks moved longer distances as revealed by the study of TUFNELL (1972, 1976). In the present instance the second largest block (Block 7) has moved the farthest distance and the smallest block (Block 3) travelled the minimum distance. Hence factors other than size appear to control ploughing block movement in the present area.

6. The movement was found to be virtually restricted to the summer months (May-September), suggesting that the block movement is largelly resulted from spring thaw and associated summer saturation.

7. A slightly higher rate of movement was detected in 1978—1979, a year that had an exceptionally severe winter and wet summer.

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