

Temporal and spatial patterns of ‘wind driven rain’ in western Ireland, 1957-2000, with implications for landscape management

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Introduction

Eroding hill peat (high-level blanket peat) is a widespread and well-documented phenomenon in western Ireland. Research to date is equivocal about the causes of blanket peat erosion. The accumulation of blanket peat depends on specific conditions including annual rainfall in excess of 1200 mm, while erosion is accelerated by high intensity storms (Tallis, 1981). The ‘toadstool’ profiles of the exposed banks of hill peat indicate that wind and rain are important agents of erosion. While wind and rain are individually well quantified in terms of frequency and intensity, the product of both, known as wind driven rain (WDR) or ‘driving rain’, has received scant attention. It is usually expressed as $\text{m}^2\text{s}^{-1}\text{y}^{-1}$ (Murphy, 1973). The objective was to quantify patterns of ‘driving rain’ on an hourly basis in order to determine if a parallel existed with reported environmental damage in the late 1980s and to assess the possible implications for landscape management in this environment.

Materials and Methods

Continuous, hourly records of rainfall and wind to the year 2000 were available for 44 years for the group of five western, synoptic stations (Met Éireann), Valentia, Belmullet, Malin Head, Claremorris and Shannon. An arbitrary minimum of ≥ 2 mm was chosen for the hourly rainfall records. A threshold was not applied to the accompanying wind records. A new ‘driving rain’ index, the pluvio-æolian (P-Æ) index expressed in $\text{mm}^2\text{s}^{-1}\text{h}^{-1}$, was established. P-Æ values greater than 36 occurred rarely. Four P-Æ indices were established: 0 = 0; I = >0 to 12; II = >12 to 24 and III = >24 $\text{mm}^2\text{s}^{-1}\text{h}^{-1}$. The frequency and the intensity of the indices on an 11-year basis were analysed by the SAS procedures GENMOD and GLM respectively. The effects of period, season and station and inter-actions between them were also assessed.

Results and Discussion

The proportion of P-Æ occurrences in the period 1957 to 2000 ranged from 1.16% of total hours in Malin Head to 2.29% in Valentia. The percentage frequency of the indices (Table 1) indicates that index I was clearly dominant and that Malin Head had the highest proportion of index III.

Table 1: Frequency (%) of P-Æ Indices (1957-'00)

Station	0	I	II	III	Tot. obs.
Valentia	0.5	84.0	14.1	1.4	8,894
Belmullet	0.3	85.8	12.6	1.3	5,610
Malin Hd.	0.5	82.2	15.5	1.8	5,090
Claremorris	0.9	93.6	5.3	0.2	5,682
Shannon	0.6	94.4	4.6	0.4	4,497

Index 0, where ≥ 2 mm fell in windless conditions occupied a small proportion of the total P-Æ

occurrences and decreased significantly ($P < 0.05$) by 11-year period.

Autumn had the highest proportion (31-36%) of all P-Æ values in almost all cases and spring had the lowest (15-19%). The various stations did not significantly affect inter-season differences.

The frequency of indices I and II did not vary significantly throughout the 11-year periods. The stations at Claremorris and Shannon had significantly higher values in index I and lower values in index II than the coastal stations. There was a significant increase in index II in the final 11-year period at Belmullet.

Index III occurred comparatively rarely ranging from 18 observations in Shannon to 126 in Valentia. While there was an overall increase over time, the significance occurred only in relation to inter-station differences, particularly Malin Head. It had substantial increases in the final two 11-year periods compared to the earlier two.

The intensity of the various indices remained relatively constant over all 11-year periods. The values for indices I and II were significantly lower at Claremorris and Shannon than at the other stations.

The inter-station differences in the frequency and intensity of all indices confirm that WDR is mainly a coastal phenomenon. The frequency of the indices increased relative to 1957-'67 (Fig. 1).

These increases were largely coincident with the reported environmental damage and an increase in hill sheep population.

The landscape in which minor landslides are endemic during autumn and winter clearly underwent increased pressure from WDR 1979 to 2000.

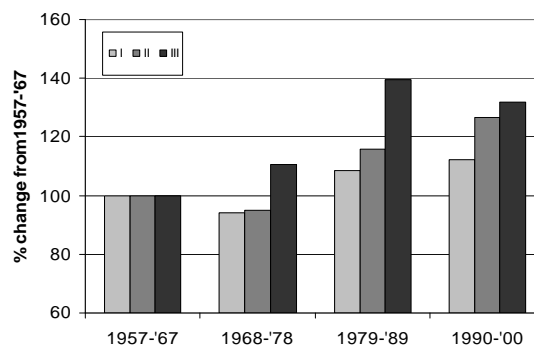


Fig. 1. Percent change in frequency of P-Æ indices I-III for all stations by 11-year period. Data Met É.

Conclusion

The frequency rather than the intensity of WDR increased over time and was a coastal phenomenon. The combination of increased frequency of WDR and erosion-sensitive soils indicates that the landscape and land use interactions require regular monitoring.

References

- Murphy, E.J. (1973). Distribution of driving rain in Ireland. Climatological Note No. 3, Dublin, Meteorological Service.
- Tallis, J. (1981). Environmental pressures on the moorland. In; Peak District Moorland Erosion Study.