
USING TATTER FLAGS TO ASSESS EXPOSURE IN UPLAND FORESTRY by Angus L. Mackie and Paul W. Gough

Abstract

This Research Information Note (RIN) updates and replaces RIN 96 (Reynard and Low, 1984). Cotton tatter flags provide a simple, low-cost method of assessing windiness and relative exposure. On-site assessment of exposure will guide the choice of tree species and the selection of upper planting limits. The use of tatter flags in upland forest areas is described and details of the technique are given, along with details of the current service provided by Silviculture (North) Branch of the Research Division.

Background to tatter flags

1. 'Exposure' or 'tatter' flags have been used in British forestry since the mid 1950s as a simple and inexpensive method of assessing relative levels of exposure. The basic principle originated many years ago in Orkney, where an estate owner chose the most sheltered site available for his house by studying the extent to which cotton flags were worn away by wind action over winter. After trials on various upland sites, Lines and Howell (1963) concluded that the tatter flag was a valuable tool in the assessment of exposure as the rate of flag attrition, or tatter rate, could give a guide to expected tree growth rates. Subsequent investigations showed that tatter rate was well correlated with mean windspeed. Since then the technique has been further developed and widely used to assess relative site exposure (Miller et al., 1987). Rate of tatter has been an important aid in guiding the choice of tree species, defining commercial upper planting limits (Reynard and Low, 1984), developing yield predictions (Worrell, 1987), and determining wind zonation for windthrow hazard classification (Miller, 1985). Recently, flag data have been used as the basis for a revised set of windiness scores for the revised windthrow hazard classification (Quine and White, 1993). A network of flags has also been sited on the Western Isles of Scotland to identify suitable planting areas within crofting communities.
2. Tatter flags are particularly useful in areas where there are sparse Meteorological Office data and where complex terrain makes extrapolation of wind speed measurements difficult. The low cost, robustness and ease of use make the tatter flag a most useful management tool. To date, flags have been flown on over 2000 sites, not only in the United Kingdom but also in the Falkland Islands, Iceland, Canada and Japan. The technique has been proven over a long period of time and an extensive database has been developed. Investigations continue into the detailed relationship between tatter and windiness.

Field siting of tatter flags

3. Flag sites must be representative of the landform to be assessed if they are to provide general estimates of exposure. They should therefore be on open ground, avoiding localised features of topography such as humps, hollows and rough ground, and away from the shelter of trees, shrubs and tall vegetation. Major changes in aspect of slope within an area should also be sampled. Where the aim is to define upper planting limits, flags should be spaced at vertical intervals of 20–30 m up the slope.
4. When setting up flags it is important that the following site details are recorded:

OS National Grid reference	– from 1:50 000 maps
Elevation	– read from map or altimeter
Aspect of slope	– site observation and compass bearing
Topex	– using compass and clinometer on site

The topex value is obtained by measuring the angle of inclination of the permanent horizon (the skyline) at the eight principal points of the compass. It is helpful to keep the sector values separate, but the eight values can be added together to give a total topex value (Pyatt, 1977). The Field Record Sheet at Appendix 1 should be used to record these site details. (Please photocopy the Appendix, as required.)

Tatter flag installation

5. Tatter flags are manufactured from unhemmed Madapollam cotton, sewn onto a wire holder which is located on a wire mount (Figure 1). A treated wooden post (round or square, approximately 100 mm top diameter), is driven firmly into the ground so that the top is 900 mm above ground level. The flag mount is fixed vertically to the post by means of two 40 mm staples. Correct positioning is obtained when the top of the flag is 1.5 m above ground level. The two eyes of the flag holder are threaded onto the mount and secured by tightening the retaining knob on the greased, threaded end of the mount. The flag should rotate freely between the retaining knob and the tufnol bearing washer. Badly worn bearing washers should be replaced and care must be taken when changing a flag in wet conditions to ensure that the washer is not lifted off with the flag. The identification number of each flag site is marked on the post by means of a suitable tally or scribe mark. This is particularly important where several flags are located close together. If there is a risk of damage to the flag from deer or livestock, then three posts, approximately 1 m apart, driven into the ground around the flag site with barbed wire stapled to them should provide an adequate deterrent.

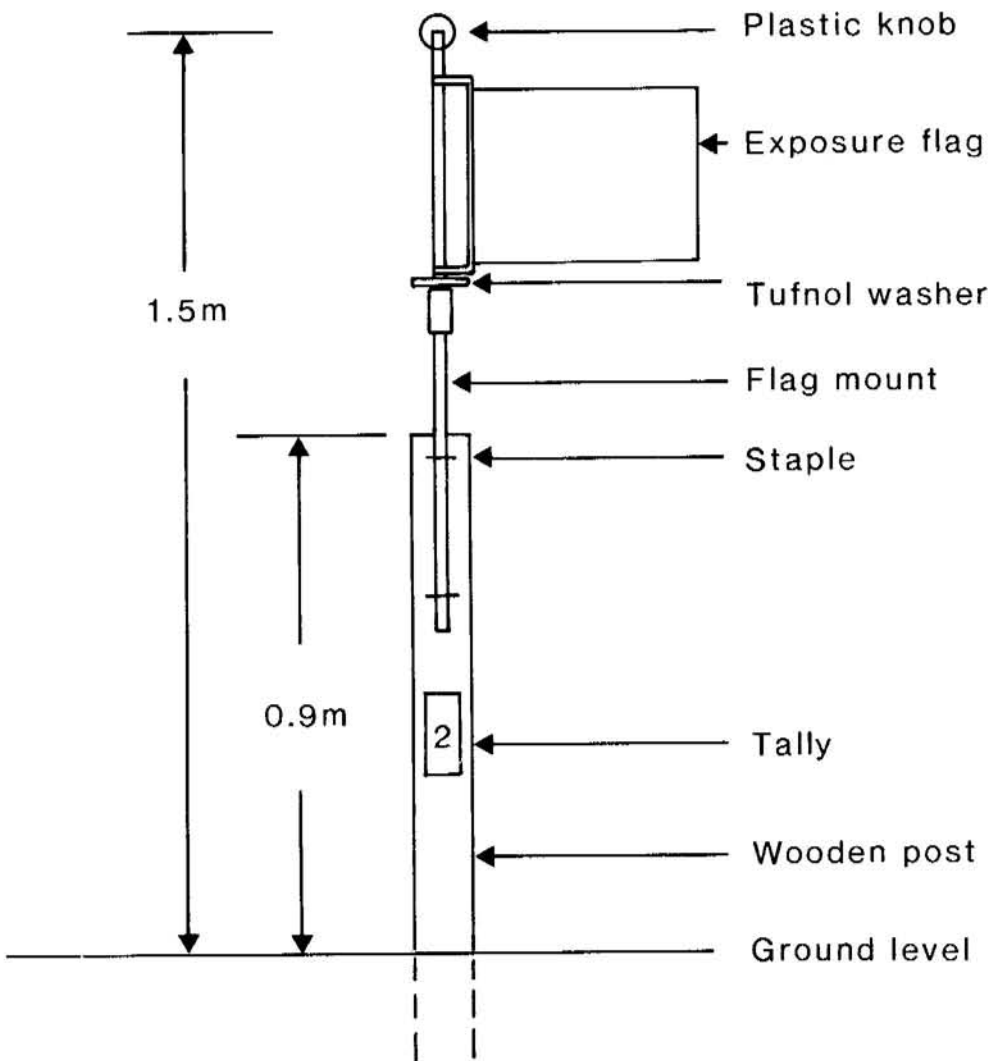


Figure 1: Exposure flag specifications.

Changing tatter flags

6. In standard use, tatter flags have been changed every two months and the assessments have normally continued for three years. This period prevents wind climate variability giving misleading results. Flag run periods may be modified with special needs. Several long-term flag sites currently exist and on the windiest sites monthly flag changes may be preferred. However, for the standard run, flags are changed on or as near as possible to the following dates:
 - 1 January,
 - 1 March,
 - 1 May,
 - 1 July,
 - 1 September,
 - 1 November.
7. It is important that flags are not exposed for less than 55 days or for more than 67 days. At each change the exposed flag should be clearly identified by writing on the flag, with a soft lead pencil, the site name and number and the dates of the exposure period. Relevant comments about the condition of the flag should be added, particularly if it is damaged or torn, e.g. Ben More Flag 2, 1 July 1993–1 September 1993. Relevant comments about the condition of the flag should be added, particularly if it is damaged or torn.

Current services and supply of tatter flags

8. Tatter flags can be supplied, measured and interpreted by the Silviculture (North) Branch of the Forestry Authority's Research Division. Requests for a supply of flags should be made using the application form at Appendix 2, which also shows prices of materials, interpretation and analysis. (Please photocopy the Appendix as required.) Further advice can be obtained from the address shown in this Appendix.

Sequencing and naming of flag runs

9. Once flags have been commissioned, advice will be given on naming and sequencing the flag run. This will avoid any confusion with previous flag runs on the database, particularly when new flags are being set up in areas where flags have previously been flown.

Set-up and procedure for using tatter flags

10. The initial batch of flags and flag mounts will be supplied prior to the start of the flag run. Field set up of flag sites should be carried out according to details in paragraph 5, and the details on the field record sheet must be returned to the address at Appendix 2. This will enable a predicted tatter rate to be calculated using the site details. Exposed flags should be returned at the end of each two month period as outlined in paragraph 6. Replacement flags will be forwarded in good time for the next flag change.

Interpretation of results

11. On receipt of the exposed flag, the amount of tatter is measured and the actual tatter rate ($\text{cm}^2 \text{ day}^{-1}$) is calculated.
12. Tatter flag results are sent to participants at the end of each flag run year. At the end of the standard run (three years) a full set of results is supplied giving site exposure in terms of a windiness score. The windiness score provides the basis for the subsequent calculation of the site windthrow hazard class (Quine and White, 1993). A sample output of results and their explanation is shown in Appendix 3.

Further information

13. Further information and advice are available from The Forestry Authority, Research Division, Kielder, Hexham, Northumberland NE48 1ER. Telephone 0434 250235 or fax 0434 250191.

References

- LINES, R. and HOWELL, R. (1963). *The use of flags to estimate relative levels of exposure of trial plantations*. Forestry Commission Forest Record 51. HMSO, London.
- MILLER, K.F. (1985). *Windthrow hazard classification*. Forestry Commission Leaflet 85. HMSO, London.
- MILLER, K.F., QUINE, C.P. and HUNT, J. (1987). The assessment of wind exposure for forestry in upland Britain. *Forestry*, **60**(2), 179–192.
- PYATT, D.G. (1977). *Guide to site types in forests of north and mid Wales*. Forestry Commission Forest Record 69. HMSO, London.
- QUINE, C.P. and WHITE, I.M.S. (1993). *Revised windiness scores for the windthrow hazard classification: the revised scoring method*. Research Information Note 230. Forestry Commission, Edinburgh.
- REYNARD, B.R. and LOW, A.J. (1984). *The use of 'tatter' flags for exposure assessment in upland forestry*. Research Information Note 96. Forestry Commission, Edinburgh.
- WORRELL, R. (1987). *Predicting the productivity of Sitka spruce on upland sites in northern Britain*. Forestry Commission Bulletin 72. HMSO, London.

Issued by:
Research Publications Officer
The Forestry Authority, Research Division
Alice Holt Lodge, Wrecclesham
Farnham, Surrey GU10 4LH

July 1994

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ISSN 0267 2375

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Field Record Sheet

Tatter Flags Site Details

Date

Forest

1:50 000 OS Sheet No.

	Flag no.	Flag no.	Flag no.	Flag no.	Flag no.
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Six figure grid ref.

Elevation (m)

Aspect

Topex readings

- N
- NE
- E
- SE
- S
- SW
- W
- NW

Topex total

Remarks, e.g. – surrounding vegetation, clearfell site etc.

N.B.: All details must be sent to the Kielder Research Office at the start of each tatter flag run.

Application form and details of cost

Tatter flag costings per flag site for standard three year run (as at 1 April 1994)

Tatter flag mount	£7.25
Tatter flags (x18)	£51.45
Tatter flag measurement and analysis	£20.00
Total	£78.70 (Plus P & P)

To: The Forestry Authority
 Research Division
 Kielder
 Hexham
 Northumberland
 NE48 1ER

Tel: 0434 250235
Fax: 0434 250191

Please supply tatter flag mounts and tatter flags for tatter flag sites.

Name

Address

.....
.....

Contact tel no.

Contact fax no.

I enclose a cheque/postal order for £.....

(Please make all cheques payable to the Forestry Commission.)

The intended location for the proposed flag run is:-

Forest/Estate

County/Region

OS National Grid Reference

Sample output of results

Exposure flags: Kielder Scotchcoulterd

The three exposure flags at this site have now completed the standard three year run and the results are given in Table 1 below.

Table 1.

District: Kielder Forest District Site: Scotchcoulterd experimental site						
Summary of three years						
Flag ID	Start date	End date	MDTR	CDTR	DAMS	Diff
240301	020590	300493	5.01	13.03	14.26	-1.23
240302	020590	300493	5.83	13.90	14.35	-0.45
240303	020590	300493	6.65	14.78	15.15	-0.37

National Grid references and individual topex scores for these flag sites will be found in the site details form, completed at the start of the flag run.

The explanation of these results is given below.

1. Use in exposure assessment

Mean Daily Tatter Rate ($\text{cm}^2 \text{ day}^{-1}$) for the flag over the measurement period is shown under the column headed 'MDTR'. This allows a direct comparison with tatter rate from other sites you may have assessed in the past. To gain a broad assessment of the exposure of the site these MDTR results may be compared with Table 2 below.

Table 2.

Tatter Rate ($\text{cm}^2 \text{ day}^{-1}$)	Exposure Class
> 13.0	Severely exposed
10.1 – 13.0	Very exposed
6.6 – 10.0	Moderately exposed
4.0 – 6.5	Moderately sheltered
< 4.0	Very sheltered

2. Use to assess windthrow hazard classification

The Converted Mean Daily Tatter Rate is shown under the column headed 'CDTR'. This result shows the tatter rate (MDTR) converted to arbitrary units of windiness score as used within the Windthrow Hazard Classification. This measurement effectively integrates the influence of wind zone, elevation, topex and aspect for this site. Addition of the soil score to the CDTR will give the total hazard class score which can be converted to a windthrow hazard class using Table 6 in Forestry Commission Leaflet 85.

Windiness score may also be **predicted** based on site details by applying the Detailed Aspect Method of Scoring (DAMS) outlined in Research Information Note 230 (Quine and White, 1993). The column headed 'DAMS' shows the **predicted** windiness score as calculated from scores for site details (windzone, elevation, topex and aspect).

The **actual** windiness score (from CDTR) may then be compared with the predicted windiness scores (from DAMS) and the last column in the table (Diff) shows the difference. Positive differences suggest

that the site is windier than the general method predicts and negative differences that the site is less windy. Any differences may be due to a number of factors including lack of information for this area or site at the time the general model was produced, variation in wind climate etc. However if the flag results are to be used to classify a wider area for windthrow hazard classification and the difference is substantial, we recommend that the difference is applied to the wind zone score (obtained from Figure 1, RIN 230) when calculating windthrow hazard classification.