Letters to the Editor

SOME PEDOLOGICAL TRENDS FROM RECENT WEST COAST SOIL SURVEYS AND THEIR RELEVANCE TO FOREST USE: — A DISCUSSION

Sir,

Mew and Leamy (1977) have provided a useful and clear synthesis of a large volume of carefully-gathered data in their identification of four major pedological trends on part of the West Coast of the South Island. They have also been largely successful in their attempt to cast these trends in the most useful light for forest management. Nevertheless, we are concerned that the third trend they identify (Increasing instability with increasing angle and length of slope on certain rock types), with which we concur in general, wrongly emphasises some factors and is supported by examples which are at variance with published data, and at least in part with Forest Research Institute studies.

(1) Published data (N.Z. Met. Service 1973) for Maimai (F21173) rainfall station indicate a mean annual rainfall of 2615 mm. Data from F.R.I. recording gauges in a transect across the Maimai block reveal that rainfall does not decrease markedly from west to east at least until the divide between the Mawheraiti and Inangahua Rivers is reached (Pearce **et al.**, 1976), and that annual rainfall at station F21173 is no more than 150 mm greater than the average rainfall over the Maimai block. Thus, mean annual rainfall for the Maimai block is close to 2500 mm, rather than 2000 mm (Mew and Leamy, 1977: pp 157-8).

(2) Detailed sampling of slope angles and detailed contour maps prepared for six small catchments selected as representative of the Maimai block reveal a mean slope of 36°, with few slopes lower than 25° (Webster, 1976, Pearce **et al.**, 1976, O'Loughlin **et al.**, 1978 Table 1). Variance of slope angles is small (Webster, 1976). We believe Mew and Leamy are incorrect in claiming that most slopes lie in the range 25-30°.

(3) Detailed geological maps (1 : 30 000 scale) of the Mt Riley-Mt Fox area in O'Loughlin and Gage (1975) show that little, if any, of that part of Omoto Forest is underlain by Old Man Gravels. The principal underlying rock is brown weathered sandstone of the upper Blue Bottom Group, unconformably overlain on the ridges by Waimaungan-age glacial gravels. In this respect, the Omoto area is similar to the Notown block of Mawhera Forest and is quite unlike the Maimai block.

(4) Mew and Leamy state that the rainfall for the Mt Fox-Mt Riley area is between 2500 mm and 3300 mm but give no reference for either of these estimates. N.Z. Met. Service (1973) data for two Greymouth stations (F21421 and F21422) reveal mean annual rainfalls of 2530 mm and 2490 mm. Mean annual rainfall at Dobson (F21431), 10 km north of Mt Fox-Mt Riley, is 2795 mm. F.R.I. data for two gauges at the Notown block, 15 km northeast of Mt Fox-Mt Riley yield annual rainfalls averaging 2370 mm. In the absence of specific data for Dunganville or for the Mt Fox-Mt Riley ridge, it appears that annual rainfall on the Omoto Forest block is close to 2500 mm, and is unlikely to exceeed the Dobson rainfall (2800 mm). Thus, annual rainfall totals for the Maimai, Omoto Forest, and Notown blocks are all similar, and are probably within ± 10% of each other.

(5) O'Loughlin and Gage (1975) and O'Loughlin and Pearce (1976) contend that the principal reason for failure of the soils over the bedrock surface in the Notown and Omoto areas was the loss of the tensile strength of the tree-root network during the lengthy delay after clearfelling and burning and before replanting and establishment of a replacement root network. On the rectilinear slopes typical of Notown and Omoto Forest, where potential and actual failure surfaces parallel the slope, and where slope length and width are much greater than the thickness of the soil over the failure surface (i.e., an "infinite" slope), position along the slope profile (and therefore slope length) does not influence slope stability to any marked extent. For such an "infiinite" slope, stability conditions for any small segment of the slope should be indicative of the stability of the slope as a whole.

Position along the profile in the real world, rather than a simplified model of the slope, does in fact control the location of failures to a limited degree. In the uppermost few tens of metres of the slope the catchment area is too small to produce saturation of the soil profile even in drainage depressions, thus pore pressures do not rise sufficiently to produce failure. Beyond this zone, saturation occurs in nearly all gullies and slope depressions, and some further distance downslope, saturation of the soil occurs on slopes that are straight in plan, and failures occur even on these straight slopes. The various critical distances for saturation of the profile are all very much shorter than the total slope length at the Notown or Omoto areas as is shown by the presence of failures on the middle and upper sections of slopes that are straight or nearly straight in plan. The great majority of failures at both Notown and Omoto in fact occur in the upper one-half of the slopes and thus cannot be influenced by the absolute length of the slope. Position along the contour (i.e., whether a site is a drainage depression, gully or ridge) is important in the real world as is made clear by the preferential location of failures in drainage depressions, where saturation occurs most rapidly and where pore pressures rise higher and more quickly. As noted above (2), mean slope steepness in the Maimai block is **not** markedly different from that in the Omoto area.

In short, Mew and Leamy have attempted to explain differences in slope stability between the Maimai and Omoto areas on the basis of higher rainfall, and steeper, longer slopes at Omoto Forest. The first two parameters do not differ markedly between the two regions, and the third has been shown in previously-published work to be relatively unimportant in controlling slope stability, especially in comparison to the lithological differences between the regions which appear to have been ignored by Mew and Leamy.

(6) Mew and Leamy also contrast the Notown area with the Maimai block in terms of slope steepness and rainfall totals. Rainfall and slope steepness data in Pearce **et al.** (1976) and O'Loughlin and Pearce (1976) refute this supposed contrast. The difference in lithology and soil type between the two areas is correctly pointed out by Mew and Leamy. It is these factors which are responsible for the large potential differences in slope stability between areas which are otherwise remarkably similar in topographic form, slope steepness, and rainfall.

There **are** very important relationships between erosion hazard and slope steepness, soil and underlying rock type and rainfall climate in north Westland, which can, and must, be taken into account if land management is to proceed sensibly. It will be most unfortunate if Mew and Leamy have confused this important issue by their choice of examples, by the use of inappropriate slope steepness and rainfall data, and by emphasising the factor of slope length which has been shown in previously-published analyses to be less important than either the mainly lithologically-controlled differences in slope stability, or the reduction in soil shear strength caused by the decay of tree-root networks following clearfelling and burning.

REFERENCES

MEW, G. and LEAMY, M. L. 1977: Some pedological trends from recent West Coast soil surveys and their relevance to forest management. **N.Z. J. For. Sci. 7:** 151-61.

NEW ZEALAND METEOROLOGICAL SERVICE, 1973: Rainfall normals for New Zealand 1941 to 1970. **N.Z. Meteorological Service, Wellington, Miscellaneous Publication 145:** 34 pp.

PEARCE, A. J., O'LOUGHLIN, C. L. and ROWE, L. K., 1976: Hydrologic regime of small, undisturbed beech forest catchments, North Westland. Proceedings of Soil and Plant Water Symposium, Palmerston North, 1976. **D.S.I.R., Information Series No. 126:** 150-8.

O'LOUGHLIN, C. L. and GAGE, M. 1975: A report on the status of slope erosion on selected steep areas, West Coast Beech Project area. **N.Z. For. Serv., For. Res. Inst., unpublished report.** 86 pp.

O'LOUGHLIN, C. L. and PEARCE, A. J. 1976: Influence of cenozoic geology on mass movement and sediment yield response to forest removal, North Westland, New Zealand. **Bull. Intern. Assoc. Eng. Geol. 14:** 41-6.

O'LOUGHLIN, C. L., ROWE, L. K. and PEARCE, A. J. 1978: Sediment yields from small forested catchments North Westland-Nelson, New Zealand. **J. Hydrol. (New Zealand):** in press.

WEBSTER, J. 1976. The physical characters of the forest floor under beech forest in North Westland and Nelson. **N.Z. For. Serv., For. Res. Inst., Protection Forestry Rep. 134** (unpubl.). 21 pp.

Andrew J. Pearce and C. L. O'Loughlin
Forest Research Institute,
New Zealand Forest Service, Ilam

5 July 1978

SOME PEDOLOGICAL TRENDS FROM RECENT WEST COAST SOIL SURVEYS AND THEIR RELEVANCE TO FOREST USE: REPLY

Sir,

We are grateful that Drs Pearce and O'Loughlin have taken the trouble to comment so fully on our paper; have in large part found it useful; and have enhanced the value of the study by bringing a closer scrutiny to specific sectors. There does not appear to be much variance over questions of fact, but only over points of interpretation. However concerning some of the data used, we make the following points (paragraph numbers correspond to those used above):

1. There are in fact two N.Z. Met. Service rainfall stations named Maimai; they are Maimai (F21173) and Maimai Two (F21172). Maimai Two rainfall is given as 1744 mm/annum. The rainfall at Reefton varies between 1951 mm and 2016 mm (all figures N.Z. Met. Service 1973). At the time the original paper was written the Forest Service recording gauges across the Maimai transect had only been in operation for an extremely limited period and an average of long-term rainfall normals for the area as a whole was used.

2. The catchments used for Forest Service experiments are not necessarily representative of the Maimai block, as the area in which they fall was chosen primarily on the grounds of all-weather access.

Traverses by the teams making the soil survey were located in several different parts of the Maimai block as a whole and until more detailed evidence is presented we would stand by our original figures.

3. The only **published** geological map (Warren, 1967) although at a scale of 1 : 250 000 shows all the hill cappings (approximately upper thirds of slopes) immediately east of, also to the north and south of Mount Riley in Omoto State Forest as being Old Man Gravels. The soft, weathered conglomerates observed in the course of soil survey may be subject to other geological interpretations but in terms of erosion characteristics are thought to offer a basis for comparison with the Maimai block. O'Loughlin and Gage (unpublished, 1975) say (p. 40) that "Sixty-two percent of the landslides (in the Omoto area) originated on partly weathered and cemented sandstone/conglomerate substratum while only 38 percent of the failures initiated on the capping gravels;" however if, as is thought, fresh gravels and strongly weathered gravels form intricate mixtures in this area, confusion may well have arisen as to on what material the slips actually did originate.

4. Sources for the Mt Fox-Mt Riley area rainfalls are N.Z. Met. Service isohyet maps, and the normals from the nearest N.Z. Met. Service rain gauges at Dobson and Kaimata (2959 mm). This would still seem to suggest rainfalls "between 2500 mm and 3800 mm"