Short note

The complete story of Bridge Hill is yet to be told: A reply to Lewis and Clements

R. T BUCKNEY AND D. A. MORRISON
Department of Applied Biology, University of Technology, Sydney, PO Box 123, Broadway, NSW 2007, Australia

INTRODUCTION

The criticisms that Lewis and Clements (1993) make of our paper (Buckney & Morrison 1992) are unfounded. Some of the points they raise are based on unreasonable interpretations of one of our diagrams, some concern misrepresentations of our interpretations of the data and others are based on parts of our paper taken out of context.

The questions discussed in our paper were solely concerned with the patterns of species distribution and abundance (a descriptive study), from which we produced a set of hypotheses that may explain the observed patterns. However, Lewis and Clements (1993) have not interpreted our paper in this spirit, and have therefore misrepresented our work. Although they claim to be presenting the 'real' story of Bridge Hill, what they offer is a promise of additional data which might (or might not) help ecologists and managers to construct, in time, the whole story. Such data are certainly to be welcomed, but they may not resolve the issues raised.

LOCATION OF QUADRATS

Lewis and Clements (1993) assert, from an interpretation of Fig. 1 (Buckney & Morrison 1992), that the majority of our sample points north of the mined dune are on Pleistocene sands (unlike the Holocene sands of the mined dune) and in vegetation communities that are different from those originally present on the mined dune. This was not the case. The purposes of Fig. 1 were to indicate in general terms the location of 35 samples on the adjacent dune, to illustrate the sampling strategy and to contrast the location of these samples with those taken much further away; the scale of the diagram and an attempt to ensure visibility of the locations resulted in their imprecise location on the Figure. Lewis and Clements (1993) have wrongly assumed that our intention was to provide a navigation-quality illustration.

Our practice in locating the quadrat centres to the north of the mine path consisted of the following steps: (i) selecting an area of vegetation dominated by Eucalyptus pilularis/Eucalyptus gummifera, Angophora costata and Banksia serrata; (ii) avoiding areas of swamp forest and swamp; (iii) establishing the first quadrat centre 20-30 m from the edge of the disturbed area (this was, in most cases, sufficient to ensure that quadrats did not include the 2-5 m zone floristically influenced by the disturbance); and (iv) placing replicate samples so that the set of quadrats lay parallel to the edge of the disturbed area. This procedure restricted our adjacent dune sampling to similar vegetation types on the Holocene sand mass.

However it is possible that Pleistocene sand may have been close to the surface in places. Other vegetation types were certainly nearby, so it is of interest to assess the extent to which their characteristic species occur in our data.

Myerscough and Carolin (1986) list 152 species of plants not found in the 'dry' forests of the Myall Lakes area, but found in the 'wet' forests. Of these, 20 can be found in our species list (Appendix 1 of Buckney & Morrison 1992) and consist of three weed species and 17 natives. These 20 species include five that showed significant differences in abundance (out of 81 species showing differences) in the original paper; none (except for one species found in a cleared area under a power line; 2 samples only) has an abundance score greater than 2.3 in unmined areas (out of a possible, albeit unlikely, 13). More than half of the 20 species were encountered only once, a quarter of them were
found only on the mined dune and eight were found only in unmined areas. No more than eight of the 20 species are recorded by Beadle et al. (1982) as in some way restricted to wetter areas. These statistics are not consistent with an intensive sampling of those wetter vegetation types that Lewis and Clements (1993) imply were sampled by us.

PRE-MINING DISTURBANCE

Lewis and Clements (1993) comment that selective logging, activity of off-road vehicles, and fire frequency were all notable disturbances in the Bridge Hill area prior to mining activities. However these factors are only important in an assessment of temporal trends in plant species composition if it can be demonstrated that they have a non-random pattern between the mining path and the surrounding area. We know of no published evidence for any such non-random pattern, and Lewis and Clements do not refer to any. Our sampling was therefore based on the null hypothesis that the effect of all pre-mining factors was spatially random, and we see no reason to reject this hypothesis.

VEGETATION AND SPECIES IDENTIFICATION

Lewis and Clements (1993) erroneously claim that we intended 'implying that the vegetation is a relatively simple and homogeneous plant community'. If this implication was true, then it would not have been necessary for us to sample as many quadrats as we did, nor to have allowed for temporal variation in the unmined area by sampling over so many years.

Lewis and Clements (1993) also claim that the species listed by us are inconsistent with those identified by Myerscough and Carolin's (1986) study of the Myall Lakes area. In mentioning the grass *Zoysia macrantha* (found by us in mined areas 2–6 years after mining), they seem to be advancing the proposition that the recently mined area is more like a dry sclerophyll forest than a foredune; that proposition would be difficult to sustain on the site. Their reference to two other grasses, *Digitaria didactyla* and *Digitaria diminuta*, as being neither in the National Herbarium of New South Wales nor recorded by Anderson (1961) leave us at a loss — both species are recorded (more recently) as occurring in the region (Jacobs & Pickard 1981; Wheeler et al. 1982), and one of the findings of our work was that mining has resulted in the introduction of species to the mined area (both grasses were found on the mined dune). Only one of the species referred to in this context by Lewis and Clements (1993) showed significant differences in abundance between mined and unmined sample sets, so their relevance is minimal, as they have little effect on our conclusions.

All species identification was verified by us at the time of sampling. Of the 163 species encountered in our study, 26 are not listed by Myerscough and Carolin (1986). Of these, 23 are listed as occurring on the north coast of New South Wales by Jacobs and Pickard (1981), and one is the sterile *Sorghum* cultivar introduced during the re-vegetation procedure. Thus, only two of our species (*Hakea propinqua* and *Choretrum candollei*) appear not to have been reported from the area previously.

TOPSOIL HANDLING

The issue of topsoil handling is perplexing. Our description of the topsoil handling process was based on published work, as cited in Buckney and Morrison (1992), and on information gained from personal discussions with mine-site staff during our site visits. We note that Lewis and Clements (1993) dispute our description, and, as the consultant for the revegetation work, John Lewis might be expected to have more detailed knowledge about the operation than we do. We are left, however, with the spectacular failure of the Bracken fern, *Pteridium esculentum*, to re-establish on the mined dune. This rhizomatous species is well known for its ability to withstand chemical defoliation, disturbance of the soil and rhizome damage (see Auld & Medd 1987), yet appears at only token abundances in our samples from the mined area (highest mean abundance score of 0.8, compared to 6.0–10.5 in unmined samples), reflecting its occurrence near undisturbed areas from which it has spread. It is difficult to reconcile this particular result with topsoil storage of only a few days. Perhaps a lot more needs to be known about this ecologically important species.

HYPOTHESES FOR OBSERVED PATTERNS

Topsoil handling was only one of five hypotheses offered by us as possible explanations for some of
the patterns of difference that we found in species abundances. Our study was purely a descriptive one, albeit one that we felt was important, as there appears to have been no previously published long-term study of changes in plant species abundance after sand mining. However Lewis and Clements (1993) insist that we have made a claim that ‘species distribution, abundance and richness are a result of mine rehabilitation procedures’. This erroneous claim notwithstanding, we avoided any suggestion that any one or more of our proposed explanations must necessarily be true. All of these hypotheses need further testing before their true importance can be assessed. Given current published information, it is not possible to reject any of our hypotheses from contention as causal explanations.

One of us (RTB) has recently completed data acquisition to test the significance of soil moisture and nutrient levels in explaining the trends and differences identified in our original paper. The data analysis is not yet complete, but there are indications of interesting trends and relationships between the soil and plant data.

We await with interest the publication of Lewis’ study of cover and frequency data from his long-term transects. One of us (DAM) assisted with these studies in 1983, and disputes the description of the work given by Lewis and Clements (1993). The work undertaken at that time used the transect-intercept method (Bonham 1989) for shrubs, and consequently the transects are unidimensional. Nevertheless, this work should contribute significantly to our understanding of the Bridge Hill ecosystem.

CONCLUSION

It is unlikely that further descriptive studies, no matter how detailed their sampling, will resolve any of the issues raised by Lewis and Clements (1993). These issues can only be adequately dealt with by manipulative experimental studies. However, it is now probably far too late for any such studies to be effectively carried out, as it is 10 years since the mining work ceased. Clearly, there is a need for controlled manipulative experiments on the effects of gross environmental disturbances such as sand mining, and we would encourage mining companies to become actively involved in the setting-up and maintenance of such experiments. It is only in this way that causal relationships between environmental disturbance and human activity can be effectively studied.

REFERENCES

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.