IS COAST REDWOOD AN ANSWER TO THE MANGATU PROBLEM?

R. D. BURDON*

Abstract

Some special problems of erosion in the East Coast-Gisborne region have been tackled by afforestation. Pinus radiata *has been the main species used, but despite its great short-term advantages it can hardly provide a long-term solution. Various characteristics of redwood make this species highly attractive in the long term. The outstanding disadvantage of redwood, namely, its notoriously slow and erratic start, might be overcome by using quicker-starting species as nurse crops which it could supersede.*

The East Coast-Gisborne region has some major erosion problems. Of these problems the most spectacular and economically important is presented by the upper Waipaoa Catchment, with its fertile but very soft mudstones which are prone to massive gullying, earthflows and slumping (Olsen, 1970; Allsop and Johns, 1973). This situation has led to the establishment of Mangatu Forest.

A forest cover is preferred there partly because of the anchoring effect of the root systems of trees, and partly because the transpiration of a tree canopy is believed to remove more of the water which percolates downwards and causes instability below the limits of rooting. The erosion hazard undoubtedly varies considerably between different sites within the forest, and accordingly the constraints on felling and logging practices will vary. It is doubtful whether a very reliable classification can be made of microsites according to erosion hazard, so it is probably better to err on the side of pessimism. Where the erosion hazard is high, or where it must be assumed to be so, a permanent tree cover seems almost imperative, but it is debatable how the tree cover should be managed. One could argue for maintaining a low cover, by regular intervention if necessary, to minimize the risk of wind damage; or, alternatively, it might be appropriate to keep the level of disturbance low by very infrequent and incomplete cuttings. In any event it seems desirable to have a tree cover which allows great

*Forest Research Institute, Rotorua.

flexibility of treatment. The silvical requirements of an ideal tree cover are numerous, but they appear to be as follows:

Immediate requirement:

1. Rapid early growth, for quick stabilization.

General requirements:

2. Tolerance of local soil and climatic conditions.
3. Dense canopy, which is presumably needed for maximum transpiration of water from soil.
4. Evergreen habit, for removal of water during the winter which is the most critical period.
5. Freedom from diseases and pests.
6. Fire resistance, or at least tolerance.
7. Deep rooting, for better stabilization.

Long-term requirements:

8. Windfirmness.
9. Ability to coppice to allow rapid restoration of full canopy after logging, and so roots remain alive and sound.
10. Amenability to regimes other than clearfelling.
11. Amenability to long intervals between cuttings, which would minimize site disturbance.
12. Production of large volumes of high-quality material, even from coppice shoots; this could stand the costs of special logging techniques which would be necessary if timber were to be harvested.

It is, however, far too much to expect any one species to meet all these requirements. In the event, most of the planting has been done with pure crops of a single species, *Pinus radiata,* and its faults have been accepted along with its advantages. Its rapid and consistent early growth, its ease of establishment, added to its productivity, represent outstanding short-term advantages. In the longer term, however, the position looks less satisfactory. If the even-aged crops are going to be replaced with *P. radiata* there seems to be no alternative to clearfelling (intentional or otherwise) on the soft soils, and in the high-risk sites this would create a very dangerous situation for some years. To harvest this species would probably entail frequent logging, which is hardly desirable. With

P. radiata in critical catchments the risk of fire becomes exceptionally serious; not only is fire carried readily, but such a fire would halt all transpiration on the site for some time.

Eucalypts have the advantage of extremely rapid (although often uneven) early growth, and some can produce high-quality wood. However, the very light canopies which they eventually develop do not seem well suited for water removal. Many species coppice, but as far as is known the coppice crops would only be amenable to short cutting cycles for pulpwood production. Freedom from pests and disease is hardly assured.

Cupressus spp. are under consideration; they can make fairly rapid early growth, and can apparently produce large volumes of high-quality timber. But they do not coppice and their rooting depth and stability are in question. Although they may be suitable for large areas in the region, they are probably not the answer for critical catchments.

Poplars, despite fast early growth and deep rooting, have the outstanding drawback of being deciduous. Health is also a problem in the presence of *Melampsora* rust.

To date, the efforts have been directed mainly at the short-term needs, but the long-term requirements must be faced. Since no known species meets every need it is reasonable to think of either mixtures or successions. We should perhaps consider what species would provide a long-term solution and then how to bridge the short-term and long-term remedies.

Coast redwood (*Sequoia sempervirens*) appears especially suitable in the long term. Its silvical characteristic in California have been reviewed by Roy (1966). Many of the characteristics in New Zealand are well enough known (Weston, 1971), but in the balance it remains at best unproven for ordinary commercial forestry. Its outstanding attribute, however, is probably its coppicing behaviour. Not only does it coppice very freely, but it can produce large, high-quality stems from coppice shoots without any tending (Anon, 1972; Lundquist and Palley, 1963). Growth from coppice shoots is generally rapid, and in California, where part of the natural range of the species seems to reflect past climates rather than present conditions, this second-growth is vigorous over a surprising range of sites (W. J. Libby, pers. comm.). Even long-suppressed trees can grow very rapidly on release, as can be seen where larch was felled next to the Memorial Redwood Grove in Whaka Forest. The sprouting behaviour allows rapid recovery after stem breakage. Windthrow is almost unknown in New Zealand, but in a stand where it has occurred in Britain vigorous resprouting has taken place (C. G. R. Chavasse, pers. comm.). Fire would be unlikely in a redwood crop and at the worst the trees could be expected to resprout. When once redwood has taken possession of a site, it seems

almost impossible to eradicate, and at this stage it should be extremely productive.

Problems with tolerance of normal soil conditions in the region are unlikely, since redwood grows naturally on a variety of soils, which range from being fairly acid to appreciably alkaline (Roy, 1966). Some of these soils are actually bentonitic in origin (W. J. Libby, pers. comm.), as at Mangatu, and steps are being taken to import redwood seed from a bentonite zone in California. There is one edaphic tolerance of the species which could be of especial significance at Mangatu — its ability to survive smothering of the roots with silt by producing adventitious roots near the new ground surface (Stone and Vasey, 1968). Admittedly, it is very doubtful whether redwood could survive the sort of root smothering which all too frequently occurs in gullies at Mangatu, but even a slender possibility is worth pursuing in this situation. Redwood is notably free from diseases and insect pests.

Quality of redwood timber in New Zealand appears to have been very variable (Weston, 1971). However, the evidence suggests that, with long rotations, adequate stocking, and probably pruning as well, a high value material can be produced.

The outstanding problem with redwood is, of course, its slow start in the first rotation. Unless the site and the existing vegetation are extremely favourable it can remain in check for many years.

The growing of redwood with a fast-growing nurse crop could meet this problem in two ways. First, the species appears to be much less prone to check in the presence of a nurse crop. Secondly, the slow start would not matter seriously if in the meantime the nurse crop was stabilizing the land and producing timber. What would be important is that redwood should supersede the nurse crop so that a good forest cover is maintained. Although the pilot plantings of pure redwood at Mangatu are making reasonably fast growth, they are confined to better sites, and are still too slow for immediate protection needs.

Eucalypts appear promising as a nurse crop, with their very rapid early growth and with the light canopy as they get older. There is the possibility that even *P. radiata* could serve as a nurse crop. I have seen redwood planted in mixture with *P. radiata* in California, and there is clearly going to be a good pole stand of redwood when the time comes to fell the pines. *P. radiata* may well produce excessive shade in New Zealand, but it might be possible to underplant redwood as stands get a bit older.

Developments in nursery and establishment techniques might also contribute to faster early growth. Trials in this connection have already been initiated by Dr G. B. Sweet at

the Forest Research Institute, and this include the testing of alternative nurse crops. Seed from three widely separated Californian provenances has also been obtained.

The proposed use of redwood could involve carrying the establishment costs for the full term of the nurse crop before the redwood even begins to make significant growth. Long rotations for the redwood would add to the costs, but the operation could still be cheap in relation to the underlying problem. And in really critical catchments any wood production is essentially a bonus.

The species has caused many disappointments in the past, and its value even in this case is speculative. Nevertheless, it has a practically unique combination of silvical characteristics which may well offer the best long-term solution to an exceptional problem. It therefore warrants serious investigation.

ACKNOWLEDGEMENTS

Special thanks are due to Professor William J. Libby who taught me much of what I know about the silvics of redwood in California. Thanks are also due to Dr R. J. Cameron, C. G. R. Chavasse, and Dr G. B. Sweet for their comments.

REFERENCES

Allsop, F.; Johns, J. H., 1973. The story of Mangatu, the forest which healed the land. *N.Z. For. Serv. Inform. Ser. 62.*

Anon., 1972. *A Review of Redwood Harvesting.* California Division of Forestry, Sacramento, California. 28 pp.

Lundquist, J. L.; Palley, M. N., 1963. Empirical yield tables for young-growth redwood. *Div. Agric. Sci., Univ. Calif., Calif. Agric. Sta. Bull. 796.*

Olsen, P. F., 1970. Mangatu: a production forest with major protection value. *N.Z. Jl For., 15*: 169-83.

Roy, D. F., 1966. Silvical characteristics of redwood (*Sequoia sempervirens* (D.Don) Endl.). *U.S. For. Serv. Res. Pap., Pacif. Sthwest For. Range Exp. Sta., PSW-28.*

Stone, E. C.; Vasey, R. B., 1968. Protection of coast redwood on alluvial flats. *Science, 159*: 157-61.

Weston, G. C. (Ed.), 1971. The role of exotic genera other than *Pinus* in New Zealand forestry. *N.Z. For. Serv., For. Res. Inst., Symp. 10*: 60-5.