

# Management and vegetation of coastal sands in New South Wales, Australia, with special reference to Pleistocene beach sands

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## Abstract

On the coast of New South Wales, management of Holocene sands and their vegetation has been well addressed, especially at the beach front, but management of Pleistocene sands and their vegetation has not, particularly in old beach systems. Problems that should be addressed in management of these systems and their vegetation are reviewed, and what is lacking in scientific understanding for their management is outlined. This lack includes an understanding of north-south variation in floristic composition of their vegetation and factors controlling populations of their plants.

*Keywords:* Management; Vegetation; Coastal sands; Pleistocene; Beach sands

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## 1. Introduction

Management of landscapes and their biota requires knowledge of their current states and an understanding of their dynamic processes sufficiently for predicting their future states and manipulating them towards those that are desired. This paper addresses questions of management on coastal sands in New South Wales, Australia (Fig. 1), and particularly seeks to identify the scientific understanding required for their management.

Coastal sands in New South Wales range from sands on current beaches to Pleistocene sands deposited in the last Interglacial period, mostly at the high sea level about 125 000 years ago (see Chap-

man et al., 1982). In New South Wales, management of Holocene sands and their vegetation, particularly on frontal dunes, has been addressed by Chapman (1989) and Clarke (1989). An expert system, DUNEBASE, has been developed by Chapman (1993) for handling and providing information in the management of these frontal dunes. By contrast, management of land and biota on Pleistocene sands in New South Wales has received little formal attention. Even basic information for their management still needs to be identified. This paper seeks to identify this information, particularly for those Pleistocene sands in the form of stranded-beach systems.

## 2. Method and area studied

The coast of New South Wales runs north from Cape Howe to the Tweed River (Fig. 1). The coast

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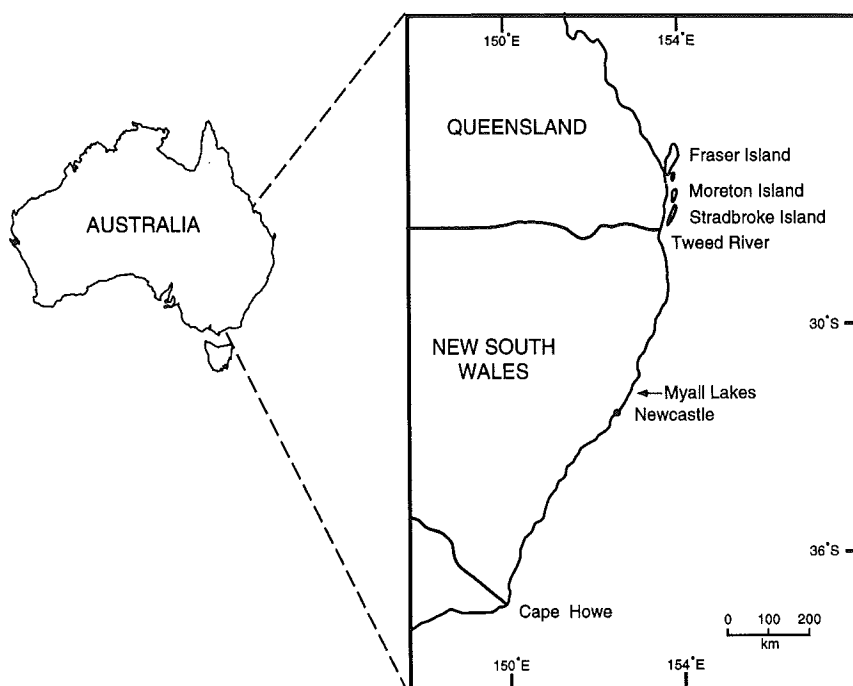


Fig. 1. Locations mentioned in the text.

can be divided at Newcastle into two sectors. South of Newcastle, there are few areas of Pleistocene sands, while north of it, there are extensive areas of stranded Pleistocene beach systems. The coast is tectonically very stable and the level of these beach sands, a few metres above current sea level, is taken to reflect fairly accurately the sea levels at which they were deposited (Thom, 1965; Thom et al., 1992). From Newcastle, areas of Pleistocene sands

occur northward into Queensland. In south-eastern Queensland, there are extensive Pleistocene dunes on Stradbroke, Moreton and Fraser Islands (Chapman et al., 1982), but in northern New South Wales, Pleistocene sands are mainly in the form of stranded beach systems. Characteristically, these Pleistocene beach systems are protected by a seaward barrier of Holocene sand (see Chapman et al., 1982). The form of the Pleistocene beach systems in New South

Table 1

Features in vegetation of foredunes and some issues in their management [based on Chapman (1989) and Clarke (1989)]

Feature	Vegetation	Interaction with environment
Zonation: beach-inland	Strandline complex; foredune complex; hind-dune complex	Cycles of erosion and colonisation ( $10^0$ - $10^1$ years); longer cycles of erosion and colonisation ( $10^1$ - $10^2$ years); stabilised surfaces (except in blowouts); fire
Geographical variation: S-N along coast	Species in vegetation zones vary S-N	? Climatic; ? Historical
Management issues	Destruction of vegetation; modification of vegetation; fires; introduced species, e.g. <i>Chrysanthemoides monilifera</i>	Accelerated beach and foredune erosion; destabilisation of stable surfaces; shelter effects of vegetated foredunes on vegetation further inland
Further ecological knowledge required	Population dynamics of plants in the zones	How population dynamics intermesh with physical processes

Wales is of slightly elevated ridges separated by low-lying swales (e.g. Thom, 1965; Thom et al., 1992).

The sands of the ridges of the Pleistocene beach systems are characteristically highly podsolised and infertile (see Myerscough and Carolin, 1986). In the swales, the soils are generally waterlogged and rich in organic matter. Vegetation of the ridges and slopes into the swales is generally heath (*sensu* Beadle, 1981) dominated by highly sclerophyllous shrubs, while that of the swales is rich in sedges and restiads (see Carolin, 1970; Myerscough and Carolin, 1986). It often burns.

The method is to compare the information collected for effective management of current frontal dunes by Chapman (1989) and Clarke (1989) with that still needed for management of the stranded Pleistocene beach sands.

### 3. Results

Features in the vegetation of frontal dunes in New South Wales and some issues in their management are summarised from Chapman (1989) and Clarke (1989) in Table 1. From the beach, the vegetation shows a characteristic zonation from herbaceous plants on the strandline, through a mixture of woody and herbaceous plants on the seaward face of the first dune ridge, to forest further inland. The zonation is clearly related to exposure to onshore erosive processes and relative shelter from them (Chapman, 1989; Clarke, 1989). Not all beaches have the complete zonation. Latitudinally along the coast, the

species of plants and characteristics of the vegetation in a given zone vary, though what underlies this variation is unknown (Clarke, 1989). At the beach front, stability of the vegetation and sand surfaces is an important issue in management. Beside storms, fires may occur, especially in the woody vegetation inland of the first dune ridge, and human activity such as trampling or vehicular traffic may disturb the vegetation and accelerate erosion. Some introduced species are problems in management on the coast of New South Wales, particularly *Chrysanthemoides monilifera* (L.) Norlindh. Originally introduced from South Africa, it is widespread on the coast of New South Wales competing strongly with native dune plants (Weiss and Noble, 1984). For more informed management of vegetation of the frontal dunes, further knowledge of population dynamics of plants in the various zones would assist, though existing knowledge allows effective management now.

Features in vegetation of Pleistocene beach sands of New South Wales and some issues in their management are summarised in Table 2.

Their vegetation and soils vary with depth to the watertable in a catenary fashion across the systems of ridges and swales (Carolin, 1970; Myerscough and Carolin, 1986). Little is known of the north-south variation of vegetation and distribution of species between Pleistocene beach systems along the coast. Issues in their management are both long-term and short-term. In the short term, mining and other forms of human disturbance alter vegetation, soils and ground water, while, in the longer term, these low-lying systems would be affected by a rise in sea

Table 2  
Features in vegetation of Pleistocene beach sands of NSW and some issues in their management

Feature	Vegetation	Interaction with environment
Catenary variation of vegetation and soils	Ridges: dry heath; slopes: wet heath; swales: swamp	Apparently equilibrated with current levels of water-table [n.b. general infertility and frequent fires]
Geographical variation: S–N along coast	Insufficiently known	
Management issues	Destruction of vegetation by conversion and mining Slow change Geographical variation	Revegetation/restoration; eutrophication of soils and ground water Sea-level — > rise in water-table Geographical factors correlated with this
Further ecological knowledge required	Population dynamics of plants; mechanisms of coexistence and habitat occupancy	Relationships with soil and water-tables

level. For effective management of these Pleistocene beach systems and their biota, geographical variation in their vegetation and constituent species has to be assessed, as well as how individual species occupy specific parts of the catena related to variation in watertable.

#### 4. Discussion

It is clear that in New South Wales management of Holocene dunes and their biota is much more firmly based on relevant scientific information than that of areas of Pleistocene beach systems and their biota. Work in the Myall Lakes area shows that vegetation of Pleistocene sands is diverse both in terms of a large number of species within a given habitat and in variation in species between habitats in the catena between ridges and swales (Carolin, 1970; Myerscough and Carolin, 1986; Myerscough et al., 1995). Heaths and swamps on these sands fit into broad categories in existing general classification of Australian vegetation (Beadle, 1981; Myerscough and Carolin, 1986), but as yet little is known of how catenas of vegetation and soil vary from one system to another along the coast. For effective conservation of biota of these sands, some knowledge of their geographical variation is required. At present, there is little relevant scientific information available to assist professional land managers, or voluntary groups similar to DUNECARE groups that operate on frontal dunes (see Ingram and Chapman, 1993), in managing areas of Pleistocene beach sands in New South Wales.

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