

Dune Subsystems of the Swan Coastal Plain

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INTRODUCTION

A feature of the Swan Coastal Plain not generally recognised is the existence of distinct ridges running more or less parallel to the presentday coastline. In the Perth region itself for example, it is relatively easy to trace a strip of near-coastal high ground through suburbs such as Karrinyup, and note its separation from a similarly high ridge running through the suburb of Yokine seven kilometres to the east. The eastern flanks of these ridges are generally more pronounced than their western flanks, and there are many spots where it is possible to stand upon an elevation and see that there is an extended north-south hillslope, with a vista to the east, usually as far as the Darling Range. Sandwiched between these two there is a third moderately distinct ridge line - but generally of slightly lower elevation - running through the suburb of Balcatta.

These ridges consist for the most part of surface yellow sands overlying dune limestone, with variable amounts of limestone caprock cropping out in areas nearer the coast. Their origin as coastal dune systems has been understood for some time, and collectively they go under the name Spearwood Dunes (McArthur and Bettenay, 1960). The limestone beneath the sands is referred to in geological terms as the Tamala Limestone (Playford et al 1976), and it is within the Tamala Limestone that the caves and other karstic phenomena of the region occur.

MINERALOGY

The limestone itself is an aeolian calcarenite, with variable and often considerable amounts of siliceous sand. In the Perth region the calcarenite typically contains around 30-40 percent quartz, rarely as little as 20 percent, and sometimes as much as 60 to 70 percent. Such material even when consolidated yields a very friable "stone". The yellow sand over the limestone is residual sand left over from limestone dissolution, as the dunes have degraded. A hypothesis that the yellow sand is inland desert sand that has been blown over the dunes during times of severe aridity has been disproven on mineralogical grounds (Bastian, 1996).

Mineralogically the Tamala Limestone does not reveal any trends that can be used to differentiate the ridges: the general composition is variable and the limestone beneath any ridge may find its match in any other. However, the yellow sands developed over the ridges vary in age, the more eastern sands having more mature profiles, and becoming progressively younger in the western direction. The author, working on the assumption that the eastern ridges would be older, has from 1984-on analysed the mineralogy of the residual sands during work at the Chemistry Centre WA., with particular attention to their heavy mineral content. The results up until 1994 were published in the paper cited, and additional work continues part-time with a special funding.

A "Maturity Index" was devised to compare ilmenite and its alteration product leucoxene, with several unstable minerals that tend to weather away in the soil environment. These are garnet, amphibole and epidote. The results revealed a very pronounced maturation trend, which enabled the major dune ridges to be confidently distinguished.

DUNE SUBDIVISION

While the plural name Spearwood Dunes implies a multiplicity of dune events, it has not been possible to distinguish each individual event because of the proximity and often considerable overlap of the ridges. However, since as a general principle growth of the coastal plain will have occurred in the western direction, a partial subdivision of the Spearwood Dunes has been made, based on those ridge lines with intervening swales which can be clearly distinguished.

- (i) The more inland ridge has been named the Yokine Dunes. Northwards the ridge lies to the east of a chain of freshwater lakes extending between Lake Goollelal (south of Wanneroo) to Loch McNess at Yanchep. It is broad and has a complex topography, suggestive of a number of major dune events overlapping.
- (ii) The ridge to the west of the lake chain, usually somewhat lower, has been named the Balcatta Dunes. Its topography is for the most part simpler than the Yokine, but in the central Perth area at least two major dune events appear to be represented.
- (iii) The higher ridge near the coast has been named the Karrinyup Dunes. There is generally an intervening valley between the Balcatta and Karrinyup, which however usually does not contain lakes. The Mitchell Freeway runs mostly along this valley.

In the region northwards from Perth to as far as Yanchep the three major ridges abovementioned are not difficult to recognise. However, vegetated Holocene dunes (the Quindalup Dunes of McArthur and Bettenay) overlap the Karrinyup Dunes in many places, an overlap which tends to increase northwards, and covers much of the Karrinyup in the Yanchep region.

Besides these three, a lesser ridge west of the Balcatta Dunes, which in some places is distinct but in others almost merging topographically with the latter, has been named the Gwelup Dunes. However the ridge cannot be distinguished in the Yanchep area. A coastal or near-coastal ridge, which in places forms low but rugged coastal cliffs wherever it has not been covered by the Holocene dunes, has been named the Trigg Dunes. In the Yanchep region it is almost completely covered by the Holocene, except for isolated offshore rock stacks. To the east of the Yokine a further ridge which appears quite distinctly in some places - but elsewhere overlapped by the Yokine - has been named the Gnangara Dunes. Thus from west to east the full sequence so far identified consists of the Trigg Dunes, Karrinyup Dunes, Gwelup Dunes, Balcatta Dunes, Yokine Dunes, and Gnangara Dunes (Bastian, op.cit.).

Ridges as published in the 1996 paper covering the Yanchep to Peel Inlet region are shown in Figure 1.

It is important to note that these six ridges do not by any means exhaust the number of dune ridges on the coastal plain. Their considerable overlap tends to camouflage ridges: there are numerous spots where elements of a separate dune ridge will appear for perhaps one or two kilometres, then disappear beneath its neighbour again. In the Yanchep area itself, a more substantial dune ridge emerges immediately east of Loch McNess, with a narrow and in places swampy valley separating it from the Yokine complex. The trend, which is herein named the Yanchep Dunes, can be traced with a few gaps for fifteen kilometres southwards as far as Lake Neerabup, and the author considers that remnants of it can even be seen farther to the south. The ridge is relatively small and narrow compared to its neighbours, and the main chain of lakes/swamps may be impounded either immediately east or immediately west of it. The ridges identified in the Yanchep area, including the added Yanchep Dune trend, are shown in Figure 2.

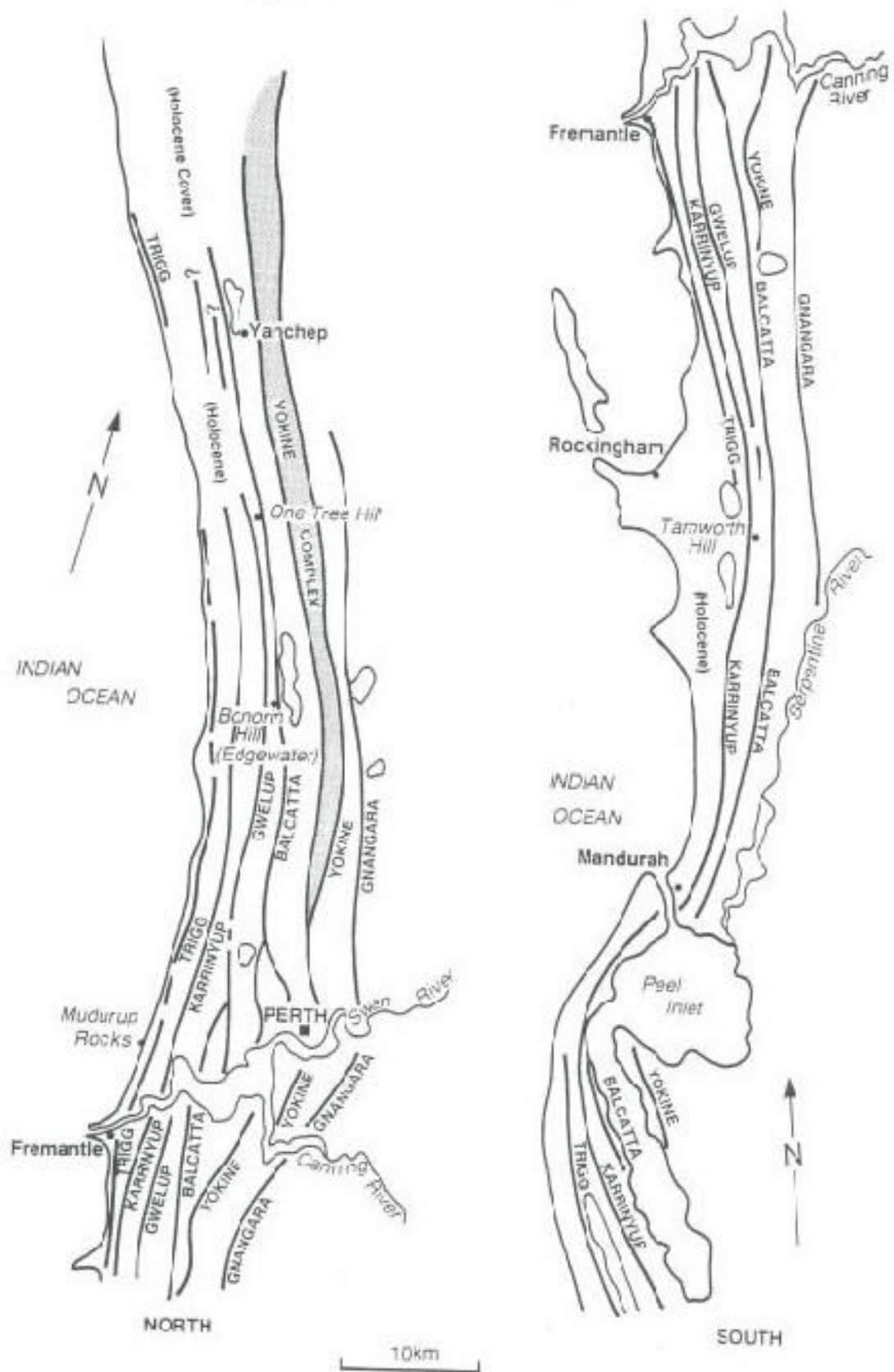


Figure 1 - Dune trend lines in the Yanchep to Peel Inlet region (from Bastian, 1996)

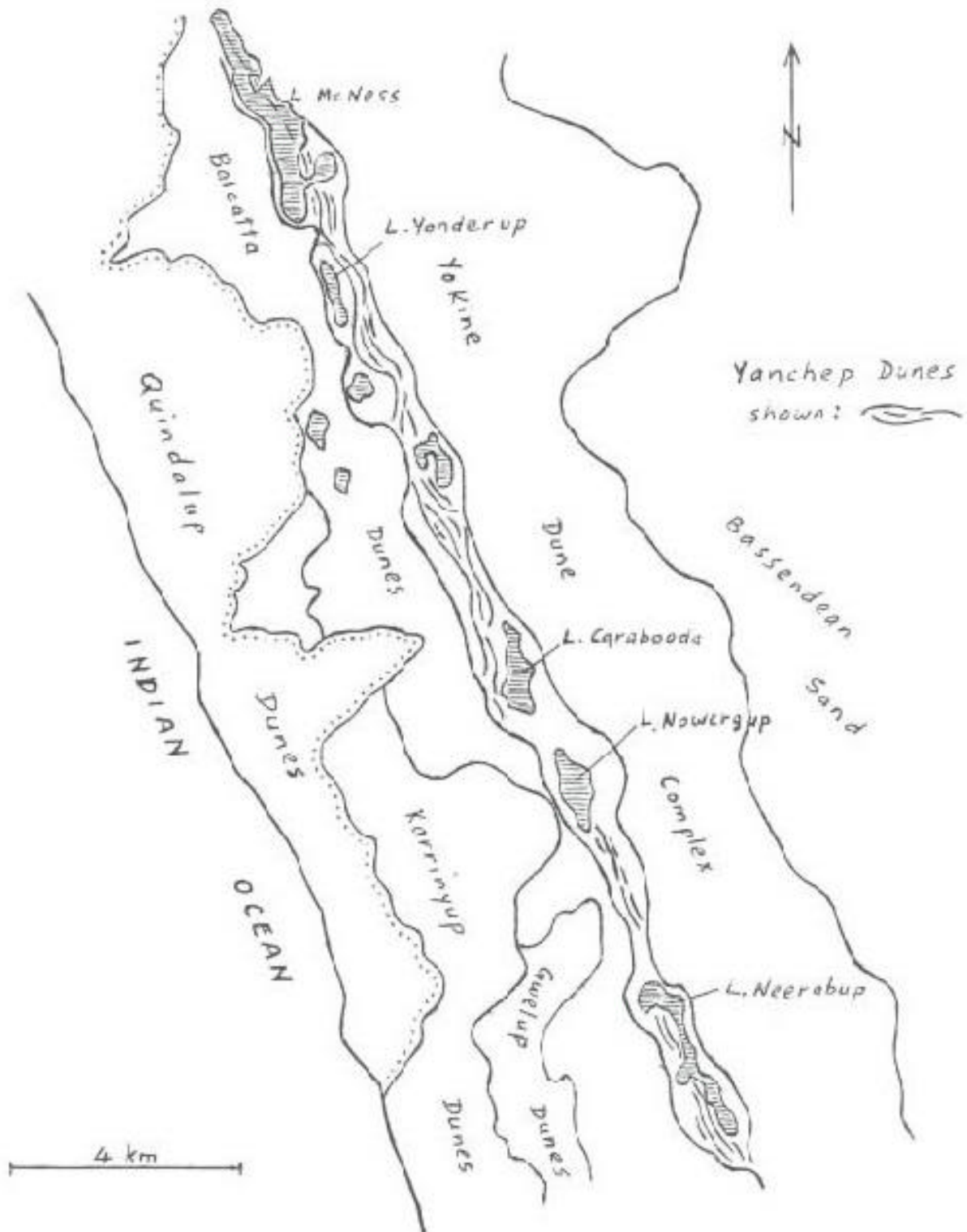


Figure 2 - Dune systems in the Yanchep-Neerabup region

It is concluded that the west coast dune trend lines broadly correspond with those identified as Ranges in southeast South Australia, and that probably every coastal dune belt seen South Australia had its counterpart along the west coast. However, because this coastline was not emergent they abutted or overlapped each other too closely for most of the individual lines to be recognised. In addition to these onshore elements there are offshore at least three reef lines of submerged dune belts, showing that rising sealevels were capable of reoccupying older dune belts, which had probably occurred with the named features. For example, the topographic complexity of the Yokine may well be the result of several repeated incursions of the ocean at different times. This means that those named cannot be equated with any specific Range, and that most if not all the ridges so far identified must be a composite of two or perhaps more dune belts.

At this point it is necessary to correct a persistent tendency among writers to compress the whole Tamala Limestone complex into too narrow a time-frame, with various authors limiting its maximum age to 120,000 years B.P. (eg. Maxlow, 1994). The present author's studies have indicated much older ages for the more inland elements of the Tamala complex, which have recently been confirmed by speleothem datings from caves on the Naturalise/Leeeuwin ridge. It is now considered that the oldest Tamala is in excess - probably well in excess - of 500,000 years.

On the basis of ridge size, topographic complexity, and distance inland the Yokine Dunes are suggested to be the possible equivalent to the Naracoorte Range. Recognising that in this region there has been submergence of the westernmost ridges, then the outer island chain of Rottnest-Garden Island is possibly equivalent to the Woakwine. Those between would at this stage be very difficult to correlate without extensive dating, and no attempt will here be made to do so.

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