

FRAGYLE

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THE YALGORUP PLAIN - The History of its Making

The Yalgorup Plain is a well preserved late Pleistocene coastal geomorphic unit in the Perth Basin, southwestern Australia. It is long and narrow, some 60 km long and 5 – 6 km wide. Though generally of low relief and undulating surface, there is local relief of 5 – 10 m in the form of aeolian limestone ridges or quartz sand ridges.

The Plain is bordered to the east by an ancestral hinterland ridge (the Mandurah-Eaton Ridge) that is a linear, moderately high (20 m) system and 3 – 4 km wide, extending in a north-south direction for 90 km from Mandurah to Eaton. (Semeniuk, 1995). There is a local shore-parallel ridge of Pleistocene limestone, now largely eroded, forming a line of rocky reefs (the Bouvard Reefs) some 4 – 5 km offshore, commencing in the central area and extending northwards. (Semeniuk, 1995)

The overall history of the Yalgorup Plain records sedimentation and progradation in a coastal setting, changes in sedimentation style from cusate foreland and shoreface accretion to barrier formation, and alternation in sedimentation from carbonate-rich to quartz-rich. (Semeniuk, 1995)

The Quindalup Dunes contain a variety of aeolian landforms developed by regional climatic, geomorphic and sedimentological factors, as well as local coastal/strandline processes and vegetative and pedogenic processes.

Analysis of the distribution of reserves for flora and fauna within the Quindalup Dunes indicates that the regional variety of landforms and vegetation habitats is not adequately represented. In particular, there is no reservation of Quindalup landforms and habitats representative of the barrier dunes of Leschenault-Preston Sector. (Semeniuk et al. 1989)

The Yalgorup/Preston sector comprises a barrier dune terrain composed predominantly of mobile and fixed parabolic dune systems. Yalgorup National Park covers only a small area of the northern part of The Leschenault-Preston sector of the coastal Quindalup dunes which is not typical of this sector.

The Holocene sedimentary sequence in the Bouvard Reefs area, south western Australia, is located in a transitional zone between two contrasting coastal sectors. It contains a complex stratigraphic sequence recording a dramatic coastal change associated with a rising, then falling, Holocene sea level (Semeniuk 1995)

Continuing sea-level rise inundated the reefs to sufficient water depth (ie more than 2 m) such that they ceased to shelter the coast which became more exposed, and a barrier dune developed. The barrier dune then retrograded over the cusate foreland (Semeniuk, 1995)

What is different in the Bouvard Reefs area is that the fundamental sheltering effect of inherent basement topography changed and sea levels rose and fell, thus altering the relationship of wave energy to the shore (Semeniuk, 1995)

Our West Australian Geoheritage

In southwestern Australia, a rapidly expanding human population has impacted on the natural history and the geoheritage of the Swan Coastal Plain and its coastal zone. To date, there have been losses of significant sites of geoheritage through re-landscaping of natural landforms, reclamation, urbanization, alteration of soils, diverting of river channels, vegetation clearing, nutrient enrichment of waterways and groundwater, and groundwater abstraction, for example. (Semeniuk & Semeniuk, 2001)

Geoheritage and geoconservation are concerned with the preservation of earth science features, and are important endeavours globally, as reflected in various international and intra-national bodies set up for conservation, with agreements, conventions, and inter-governmental initiatives. (Brocx & Semeniuk, 2007)

Conservation derives from geoheritage, in that it deals with the conservation of earth science features. Globally, it has become important because it has been recognized that Earth systems have a story to tell, and that they are linked to the ongoing history of human development, providing the resources for development and a sense of place, with historical, cultural, aesthetic and religious values. In addition, Earth systems are the foundation of all ecological processes and part of the heritage of our sciences (Torfason, 2001)

While geoheritage concerns the heritage of features of a geological nature, geoconservation is the action that works toward the preservation of sites of geoheritage significance.

Geo-conservation involves the evaluation of geoheritage for the purpose of conservation and land management, leading to the protection of important sites by law.

The United Kingdom is considered to be the birthplace of geoheritage and systematic inventory-based geoconservation, which is now an integral component of its education, tourism, planning and management (Anon, 1990)

The Yalgorup Lake System and Quindalup Dunes constitute structures of significant geoheritage value in Western Australia. It is an area of world-wide scientific interest that should be conserved for research, education, recreation, tourism, health and welfare and a sense of 'place' for the people of Western Australia.

The Unique Features of the Yalgorup Lake System

The eleven lakes in the Yalgorup System are all different. Each has a different limnology, different salinity. In their study of four of the lakes, South and North Lake Newnham, Lake Hayward and Lake Pollard, Burke & Knott, (1989) concluded that the four lakes, all in close proximity and fed by ground water of similar composition, had evolved to quite different limnological characteristics as a result of different biogeochemical processes.

In their study of Lake Clifton, Lake Hayward, Lake Pollard and Lake Preston, (Wood et al. 1991) found that these habitats supported a remarkably diverse range of physiological types of bacteria.

Lake Hayward harbours the brine shrimp *Artemia parthenogenetica*. Brine shrimp of the genus *Artemia* are not native to Australia. It is thought that they have been brought to Lake Hayward and from there spread to other lakes by migrating birds. (McMaster et al. 2007). Despite the seasonal limnological changes in Lake Hayward the brine shrimp regenerate each year despite a complete die-off in some years (Savage & Knott 1998a,b).

In 1972, Williams & Buckney (1976) recorded a salinity of 15.3 gL⁻¹ in Lake Clifton. Moore (cited in Moore et al. 1986) recorded a salinity range of 17 – 30 gL⁻¹ in 1979. In July 1983, after heavy rain, salinity of the lake near the aquifer outflow was 8.4 gL⁻¹. During the 1980s, Lake Clifton was hyposaline and the following salinity ranges were recorded; 17 – 26 gL⁻¹ adjacent to transect A in the north of the Lake, 15 – 32 gL⁻¹ adjacent to Transect C from two sites measured monthly in 1984 (Moore 1993). Transect A was in the locality of the observation jetty. Transect B adjacent to Swan Pond. Transect C was adjacent to Lake Pollard and Transect D adjacent to the south tip of Martins Tank Lake.

Figures indicate that although the mass of salt in Lake Clifton remained relatively constant from 1985 to 1992, it had increased by 40% from 1993 to 2000. Since this calculation is independent of rainfall, this indicates a possible increase in proportion of brackish ground water to fresh ground water inflow into the lake. (Knott et al. 2003)

Microbialites – the Thrombolites of the Yalgorup Lakes

Microbialites are useful in a wide range of applications and scientific disciplines. Stromatolites represent the oldest fossil evidence of life on the planet and may prove valuable as subtle indicators of past environments aiding the interpretation and reconstruction of the Earth's earliest biosphere. They probably hold a wealth of palaeobiological, palaeoclimatological and palaeoenvironmental information (Walter, 1972).

Western Australia is not only host to the world's oldest fossil stromatolites, but contains probably the largest and most varied suite of contemporary microbialite formations in the world. Recent studies on living microbialites in Western Australia have led to a greater understanding and appreciation of the complexity of the process of formation - (Moore, 1998).

In Lake Clifton, thrombolites are the predominant form of microbialite. They exhibit a range of external morphologies including tabular, domical, discoidal and conical formations which vary considerably in size, as well as more irregular and columnar structures up to 1.3 m high.

Sub-recent microbialites are present in Lakes Pollard, South Newnham, South Preston, Hayward and Martins Tank Lake. Tepee structures and eroded microbialite mounds are present along the eastern shore of South Preston. In addition to these, some unusual digitate/crustose formations have been located offshore beyond the tepee zone in water depths of 1 -2 m. (Moore, 1998).

In their study of the fauna of thrombotic microbialites in Lake Clifton, (Konishi et al. 2001) discovered twenty-five species of aquatic fauna from 30 specimens of thrombolites sampled.

However, they reported that there has been a major reduction in faunal diversity and abundance within the microbialites of Lake Clifton since studies began in 1983 (Moore et al. 1983)

In the conclusion to her PhD thesis on “The Modern Microbialites of Lake Clifton, South-Western Australia” July 1993, Linda Moore writes “This study has found that the Lake Clifton microbialites have and will continue to provide a valuable modern analogue for a wide variety of fossil microbial structures. Developing a better understanding of the ecology of modern forms will help expand our awareness of the processes that can be used as models for the interpretation of ancient analogues.”

The microbialites of Lake Clifton present West Australians with a unique opportunity to study the earliest forms of life. This reef of “living” thrombolites, is the largest in the southern hemisphere and the only one in Australia. It is an asset of immeasurable value, not only to the people of Western Australia, but to the people of the world.

It is under threat already from nearby development, increased nutrients in the Lake, raised salinity levels and an increase in algae. Any further development in the area could destroy the benthic microbial communities of the lake (of which the microbialites is but one manifestation), lower the water table so that fresh water no longer seeps into the lakes and thus end the formation of further “living” microbialites.

WETLANDS

“Wetlands”, wrote the Auditor General of Western Australia, in his report in September 2006, “are a vital part of the natural environment. They are indicators of health for the landscape around them and provide refuge, breeding sites and food to vast numbers of animals and plants. Wetlands across the world, including WA, are under threat. For example, since European settlement there has been a 70 percent loss of wetlands on the Swan Coastal Plain.”

In a report on the Peel-Preston Lakelands in 1975, the National Trust of Australia (WA) commented that “as the metropolitan wetlands are very rapidly being affected by urban growth, those in the Peel-Preston area will become more and more important as a natural environment and wildlife habitat.”

Ramsar Status of the Yalgorup Park

In the Yalgorup National Park Management Plan produced by the Department of Conservation and Land Management, the Park is regarded as having high conservation, scientific and educational values.

The Peel/Yalgorup system is registered under the Ramsar convention, as a wetland of international importance. The benthic microbial communities at the bottom of the lakes play a vital role in the feeding chain for thousands of migrating birds. (Burke & Knott, 1989, 1997; Moore 1993; Konoshi et al. 2001)

By signing the Ramsar Convention, the Australian Government has committed itself to preserving and protecting any officially designated Ramsar wetlands. The Peel Yalgorup Region became a designated Ramsar site in 1990.

As far back as 1993 Burne & Moore (1993) have warned that increased phosphate concentrations in Lake Clifton and increased nitrates were paralleled by increased growth of the macroalga *Cladophora* in many parts of the lake, including on the thrombolite reef and this, together with the increasing demand for further semi-rural development in the vicinity of Lake Clifton, would necessitate careful

management decisions to protect this internationally significant wetland from deterioration caused by human impacts. (Moore 1993) Since then nitrate levels in Lake Clifton have doubled and phosphate levels increased alarmingly (Alexander unpublished, 2009).

Surrounding Vegetation

There are a number of mechanisms whereby nutrients enter the lake, the two major ones being overland flow and groundwater discharge. Overland flow is episodic, occurring after substantial rainfall events, while groundwater input is relatively more constant. Surface flow may be intercepted by vegetated buffer zones, reducing the impact of land practices on a wetland. Nutrient enrichment of wetlands may be reduced by adequate buffer zones; however, in the absence of scientific information, arguments for larger buffer zones have had little influence (Lane 1991). Davies & Lane (1996) recommended a buffer zone of at least 200 m to minimise nutrient enrichment of wetlands. Davies & Lane (1996) confirmed that this recommended width was supported by the results of their earlier study.

The vegetation buffer has been impacted historically by clearing for agricultural use, and more recently by visitors. Vegetation near the lake shore can be important in areas of surface and groundwater intrusion as a buffer can significantly reduce the level of nutrients entering the lake from surface flow (Luu et al. 2004)

Consequences of Development outwith the Area

Since the Dawesville Channel was opened in the early 1990s a concomitant, dramatic change in the salinity level of Lake Clifton was noted, commencing in 1992. In the same year the tuart trees in Yalgorup Park adjacent to Lake Clifton, began to show signs of stress. The three dominant tree species of the riverine vegetation of the Harvey River delta showed a general decline in canopy condition over the four years following the opening of the Dawesville Channel. While no direct causal relationship between the opening of the Channel and the decline of the trees has been demonstrated, the period of decline of the trees exactly correlates with the opening of the Dawesville Channel (Gibson, 2001).

TUART WOODLANDS

Tuart (*Eucalyptus gomphocephala*) is a woodland tree endemic to the Swan Coastal Plain of Western Australia and is of great importance to the area as it is one of the few eucalypts that is adapted to calcareous soil profiles (Eldridge et al.1994)

Prior to European settlement there were more than 111,600 ha of tuart woodlands (Hopkins et al.1996) but this area has been reduced to 30,000 (Government of WA 2003). The largest stand of these is in the Yalgorup Park, However these trees began undergoing a severe decline in the early 1990s causing public awareness and concern. In 2001 a “Tuart Response Group” was set up to investigate the causes of this decline.

The loss of tuart will affect fauna. The western ringtail possum (*Pseudocheirus occidentalis*) lives in tuart woodlands. The loss of tuart is expected to cause loss of invertebrate biodiversity (Majer et al. 2000). Some of the tuart understory plants are threatened species (eg *Acacia benthamii* (Priority 2), *Jacksonia sericea*, *Lasiopetalum membranaceum* (Priority 3), *Dodonaea hackettiana* (Priority 4). (Research into the causes and management of tuart decline, Edited by Paul Barber and Giles Hardy, Murdoch University, 2006).

CONCLUSION

The Yalgorup Lake System from Dawesville to Myalup is of world-wide scientific significance. It represents a complex diversity of ecological systems which are all, however, interfaced and intertwined.

The area presents the people of Western Australia with an extraordinary and unique opportunity to explore and research a wide range of diverse, challenging and rewarding biological complexities.

It gives the people of Western Australia a unique opportunity for exercise, for education, for relaxation and re-uniting with nature.

The area should be preserved and protected for the benefit and enjoyment of the people, not only of Western Australia, but from all over the world.

No more development should be allowed at any place on the whole Lake system from Dawesville to Myalup.

The economic benefit of land sale and the allowance of detrimental land use practices to adjoin this system should no longer supersede the environmental costs (Goater 2003)

OUTCOME

We, the members of FRAGYLE, Friends of the Ramsar Action Group for the Yalgorup Lakes Environment, request the Board and staff of the Environmental Protection Authority, to consider very carefully their decision for the future of the Yalgorup Lakes System.

We would remind you that all decisions have Consequences and the Consequences of a wrong decision on this unique area would be catastrophic and irreversible. The loss would affect not only Western Australia, but the whole world would be the poorer for it. Bird populations, bird species, trees, flora, fauna, the precious gift of the thrombolites, all could be lost irrevocably.

We would request you to have Vision. To have the Vision of our forefathers who preserved an area of bushland in the centre of the growing city as a place of recreation and education for the people of Perth and Western Australia. King's Park is now an icon, known around the world.

We would ask you to have the Vision to create a further King's Park of the South West. An ecological oasis in the middle of an expanding concrete corridor. A place of space, a sense of place, a retreat for all.

We put the future of the Yalgorup Lake System in your caring hands.

Hilary Wheeler
Chairman, FRAGYLE

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