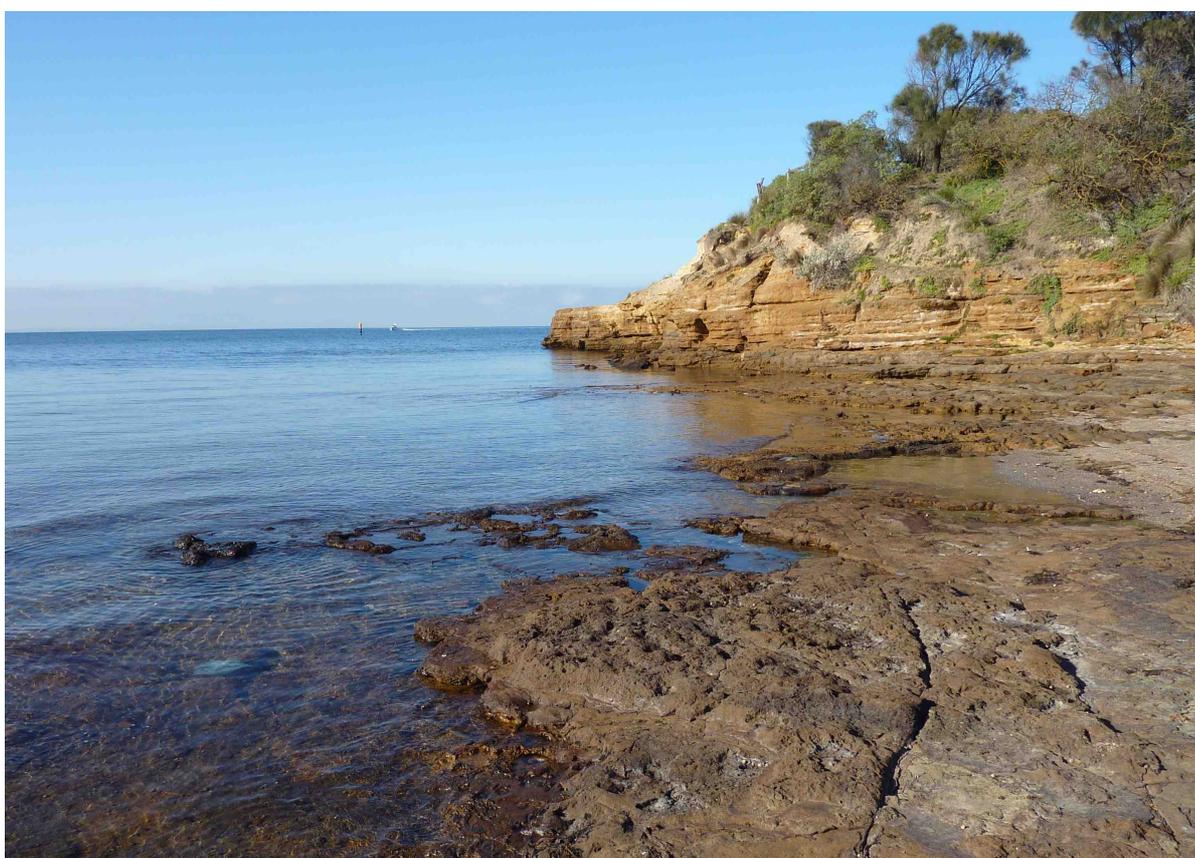


The Beaumaris Bay Fossil Site including the cliffs, the adjacent wave cut platform and the immediate sub-tidal zone.

Appendix F to the 2016 application for Beaumaris Bay to be listed as a Natural Heritage Site.

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This application concerns a specific horizon of the Beaumaris Sandstone that outcrops adjacent to the Beaumaris Motor Yacht Squadron in Beaumaris Bay, VIC. The Beaumaris Sandstone at the Beaumaris Bay Fossil Site (BBFS) contains the greatest abundance and diversity of fossils (marine and terrestrial vertebrates, marine invertebrates and terrestrial flora) of any site in Victoria. The rocks were deposited about 5 million years ago; a period that is otherwise poorly represented in Australia's geological record.



Keefer's Cove, Beaumaris. Photo J. Buckeridge 2009.

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Location: Beaumaris Bay lies between Table Rock Point, Beaumaris and Mentone Corner, Mentone (opposite Charman Rd intercepting Beach Rd, Mentone) on the eastern coast of Port Phillip Bay in Beaumaris.

See link:

<https://www.google.com.au/maps/place/Beaumaris+Bay,+Victoria/@-37.9931055,145.0561162,16z/data=!3m1!4b1!4m2!3m1!1s0x6ad66ddf3112113:0x5f2aac84ea6233d9>

Local Authority: Bayside City Council. The owner of Beaumaris Bay is the Crown, overseen by Department of Environment, Land, Water, Planning (DELWP).

Access details: The Beaumaris fossil cliffs and wave cut platform can be accessed via the Beaumaris Motor Yacht Squadron's driveway and a pedestrian gate at the bottom of this driveway into the car park. The best and safest access is at low tide.

EXTENT OF THE BBFS

About 30ha, being an area enclosed by a polygon commencing at the intersection of Beach Road and Cliff Grove, then southwest via the southern side of Beach Road to Sparks Street, then southeast to a point offset 250m seaward via the alignment of Sparks Street, then northeast to the intersection of the alignment of Cliff Grove and MLW (approximate AMG point 287593680, then northwest to the point of commencement.

The buildings and the car park of the Beaumaris Motor Yacht Squadron, the Moysey Gardens and the car park opposite Keys Street are excluded from this area. Parts of the coastline are only accessible by boats or divers while other parts can be reached at low tide.

DESCRIPTION OF THE BBFS

The site encompasses the immediate subtidal zone, the wave cut platform and the line of cliffs between Table Rock in the southwest and Cliff Grove in the northeast. Isotopic dating and biostratigraphy, dates the Beaumaris Sandstone as late Miocene to early Pliocene age, i.e. 5-6 million years before present (MYBP) (Kenley, 1967; Ter & Buckeridge, 2012). At the Beaumaris Bay Fossil Site, the Beaumaris Sandstone unconformably overlies the highly fossiliferous Gellibrand Marl, previously known as the Fyansford Clay (Geoscience Australia, 2012; Abele, C. *et al.* 1976; Holdgate *et al.*, 2003). The Gellibrand Marl is of early Miocene age (dated at *c.* 16MYBP) and is only exposed locally at the south end of BMYS site.

Although ichnofossils are common throughout the Beaumaris Sandstone (Reeves & Buckeridge, 2012; Ter & Buckeridge, 2012), the most scientifically important fossiliferous exposures are lower in the sequence, and are restricted to Beaumaris Bay where the sandstone has been elevated, exposing the lower 15 metres of the sequence (Buckeridge, 2015). Common fossils in this rock layer include molluscs (Singleton, 1041; Darragh, 1970), brachiopods, echinoderms (Etheridge, 1875), corals and crustaceans (Buckeridge, 1983). At the base of the Beaumaris Sandstone are two thin, gravelly beds that include phosphatic and ferruginous nodules (Ter & Buckeridge, 2012). This nodule bed has yielded a range of vertebrate fossils including >20 species of shark (Carter, 1978) – representing both extant and extinct species such as the largest predatory shark *Carcharocles megalodon* (Kemp, 1991), many species of teleosts (Chapman & Pritchard, 1907), bones of seals (Fordyce & Flannery, 1983), whales (eg. Chapman, 1912, 1917; Fitzgerald, 2012a), the penguins *Pseudaptodytes macraei*, *Pseudaptodytes minor* (Simpson, 1970; Park & Fitzgerald 2012a) and the albatross *Diomedea thyridata* (Wilkinson, 1969). The lower beds of the Beaumaris Sandstone extend below sea level and also contain rich and diverse fossil deposits. Some of the best-known fossils are the numerous and well preserved specimens of the echinoderm *Lovenia woodsi* (Etheridge, 1875; Ter & Buckeridge, 2012).

The Beaumaris cliffs are aligned to the axis of a major tectonic structure known as the Beaumaris Monocline that has downthrown the sedimentary strata to the southeast. The cliffs are steep to vertical and undercut in several

locations, with large blocks of fallen sandstone scattered along the shore. Narrow wave cut platforms front the cliffs and resistant beds of Beaumaris Sandstone occur as offshore reefs running parallel to the monocline.

The Beaumaris Fossil Cliffs and Wave Cut Platform are *scientifically significant* as collectively they have produced greater abundance and diversity of marine invertebrate and vertebrate fossils than any other marine fossil site in Victoria. The fossils were deposited from the late Miocene to the early Pliocene; a period under-represented in Australian geological heritage. With its diverse assemblage of shark, whale, seal and penguin fossils, the Beaumaris Sandstone is the most significant Neogene-age (23-2 MYBP) marine vertebrate site in Australia. Many records are unique, e.g. It has the only fossils of Australia's sea turtles from the last 66 MY.

The sea cliffs, shoreline, intertidal and subtidal exposures of the Beaumaris Sandstone on the west to northwest side of Beaumaris Bay have and continue to yield numerous shallow marine and terrestrial fossils.

The Beaumaris Sandstone was deposited at a time when regionally temperate climatic conditions were closely followed by the series of glacial/interglacial periods ('the Ice Ages') that have dominated Earth's climatic regime for the last two million years. It therefore provides **a unique window on southern coastal Australian environmental conditions at a critical moment in Earth's history**, highlighting the significant changes that have occurred in southern Australian marine ecosystems within the comparatively short space of geologic time. In short, if the Beaumaris Local Fauna were not known to science we would have a substantially impoverished understanding of the origins of the modern marine biodiversity of southern Australia. No other stretch of Australia's 34 thousand kilometer-long coast preserves such a rich sample of Cainozoic-aged marine megafauna.

The Beaumaris Local Fauna is a **lynchpin for establishing the tempo of the evolution of Australia's unique land marsupial fauna**. It provides pivotal evidence for the calibration of the Australian Land Mammal Ages (ALMA) scheme for subdividing geologic time on the Australian

continent. Although < 20 marsupial fossils have so far been found at Beaumaris (representing remains of animals washed out to sea via rivers), they are **nationally significant** because their geologic age is well established by the Beaumaris Sandstone (Long *et al.*, 2002).

Most land mammal fossil sites in inland Australia are imprecisely dated by the 'stage-of-evolution' of the animals rather than rigorous correlation to the international geologic timescale. Because some of the fossil marsupial species from Beaumaris have also been found at key inland fossil sites, it is possible to correlate these with Beaumaris, rigorously establishing their relative age.

Stratigraphic correlation through the Beaumaris Sandstone is crucial for establishing a timeline for the evolution of the Australian continent's unique terrestrial fauna.

This site should be managed as a geological reference site and highest priority given to maintaining exposure of the fossil beds both in the cliff and in the near shoreline. (Victorian Government "Resources Online". Port Phillip and Westernport).

Heritage listing requires applicants to demonstrate that a site has international significance. Research has been carried out on the the Beaumaris Sandstone by leading Australian and non-Australian scientists. Importantly, this research has impacted and continues to impact upon solving 'big picture' evolutionary conundrums that are also of significance outside Australia.

The detailed studies of Beaumaris fossil penguin bones were seminal studies on the evolution of penguins as a group. These peer-reviewed papers were published by of the 20th century's most influential evolutionary biologists, the late Professor George Gaylord Simpson, of Harvard University, USA. Professor Simpson was a founding father of the now global Society of Vertebrate Paleontology, which currently has a membership > 2,300.

In 1969, Professor Simpson felt compelled to write of his concern about the threats to the Beaumaris fossil sites posed by development; a letter from GG Simpson to G. Thomas, Secretary of the Victorian Branch of

the Geological Society, 25th Sept. 1969, confirms the “great scientific significance (of this site) at Beaumaris”.

The BBFS contains rare and endangered aspects of Australia’s natural history.

- Beaumaris is the single most important Cainozoic fossil seabird locality in Australia, having produced 80% of Australian penguins fossils, the only fossil albatross from Australia and the only fossils of the extinct giant ‘toothed’ birds or Pelagornithidae from Australia (Fitzgerald, 2012b; Fitzgerald, Park & Worthy, 2012).
- Beaumaris yields the richest assemblage of Cainozoic fossil sharks from Australia (> 20 spp. are recorded).
- Beaumaris has the only fossil sea turtle from the last 66MY of Australia’s history (Fitzgerald & Kool, 2015).
- Beaumaris has yielded the only fossil of the pig-nosed turtle (Fam. Carettochelyidae) from Australia.
- Beaumaris has produced 75% of the known fossils of seals from Australia including the only known fossilized partially articulated skeleton of a seal from Australia. (*pers. com.* Erich Fitzgerald, Museum Victoria).
- Beaumaris has key cetacean fossils, including the only pygmy right whale in Australia – that constitutes 50% of the worldwide fossil record of the pygmy right whale lineage (Fitzgerald, 2012c).
- Beaumaris is the single most important source of whale and dolphin fossils in Australia in terms of both quantity and scientific quality [unpublished manuscript, Erich Fitzgerald, Museum Victoria).
- Beaumaris is the single most important source of fossil barnacles and

echinoderms in Australia – in terms of phylogeny, dispersal and biogeography (Buckeridge, 1983; Etheridge, 1875).

- Beaumaris is the *type locality* for the large crustacean trace fossil *Ophiomorpha beaumarisensis* (Ter & Buckeridge, 2012).

The BBFS is significantly contributing to an understanding of Australia’s natural history.

The BBFS has both research and teaching value, especially in the fields of palaeontology and geology; importantly, it has the potential to yield further internationally significant palaeontological material that will greatly improve our understanding of Australia’s geological evolution over the past 5-6 million years.

The Beaumaris Fossil Cliffs and Beaumaris Bay comprise the single, most abundant, and diverse example of a Cainozoic marine fossil assemblage in Australia; it is undoubtedly the richest and significant Neogene age (from 2.5-23.0 MYBP) fossil site for marine vertebrates (e.g. sharks, whales, seals, penguins) in Australia.

If the Beaumaris Local Faunas were unknown to science we would have a substantially impoverished understanding of the origins of Southern Australia’s current biodiversity.

Only two *broadly comparable* fossil localities exist in Australia: one near Hamilton and the other at Portland, both in western Victoria. Although these localities have marine vertebrates in moderate abundance, Hamilton is dated to about **4.5 MYBP**, and the Portland deposit was formed between **7-9 MYBP**.

Thus, neither of these deposits sample the critical period of time and Earth’s history (i.e. 5-6 million years ago) preserved at Beaumaris. Further, neither the Hamilton nor Portland sequences produce fossil marine vertebrates in the extraordinary abundance and taxonomic diversity as at Beaumaris.

The Beaumaris Fossil Cliffs and Bay are indisputably of international significance.

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