

Coal, Bees and Fossils: The History and Significance of the Redbank Plains Formation Fossil Sites, South East Queensland

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ABSTRACT

The Redbank Plains Formation, between Brisbane and Ipswich in South East Queensland, provides fossil evidence of the fauna and flora of the earliest part of the Cenozoic era, and is dated from the Paleogene Period, specifically the late Paleocene–early Eocene (66–55 Ma). These fossils have been collected and studied for over 120 years, but the conjunction of agriculture in the then-rural Redbank Plains district, and the mapping of the valuable Ipswich coalfields, led to their palaeontological significance being recognised and documented. Scientific study began in 1916 and has continued since, revealing some of the earliest evidence of modern Australian fauna and flora. However, the area's rich underground coal resources and a hunger for residential land in a rapidly developing urban corridor, has resulted in the loss of or threats to the fossil sites. One deposit has been given local government status as a Conservation Park and remains accessible for scientific study, but the lack of either national or state protection for such significant sites in Queensland and Australia imperils our national geological heritage and its scientific contribution.

Keywords: Cenozoic, Eocene, Ipswich coal measures, fossil fish, fossil insects

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Introduction

In Australia there is just one Formation from the Paleocene–Eocene (66–55 Ma) which contains fossilised plants, along with vertebrates and invertebrates. This is the Redbank Plains Formation of South East Queensland, situated approximately 35 km south-west of Brisbane. First reported by settlers in 1900, the fossils tell us much about the palaeoecology of south-eastern Queensland during the early Cenozoic, and offer some of the earliest evidence of modern Australian fauna and flora, including fish, reptiles, birds, insects and some Australian plant families. Accordingly, this Formation is acknowledged as an important element of Australia's national geological heritage (Australian Heritage Council, 2012).

When the first fossils were found over a century ago, Redbank Plains was part of an isolated rural bushland settlement far from the city. Investigation by scientists has been spasmodic: two major research publications in the first half of the 20th century drew attention to the sites, which were then largely forgotten for several decades. The 're-discovery' of the Formation and its scientific significance occurred amid nearby mining and extractive industry and in the shadow of urban development of new housing estates on what was considered 'vacant' bushland.

Today, however, the Redbank Plains Formation deposits reflect the fate of a world-class fossil site located in a peri-urban area under intense pressure from rapid housing and associated development.

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Only one small locality, at Redbank Plains, remains as a recognised and accessible outcrop of these strata, and its proximity to Brisbane means that suburban housing has now surrounded it (Figure 1).

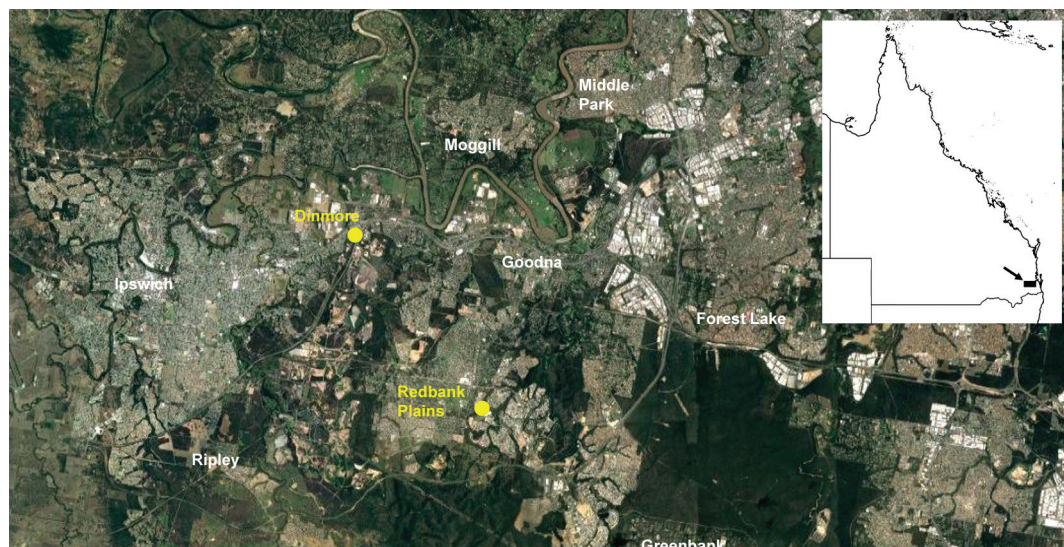


FIGURE 1. Map of Redbank Plains, Dinmore and surrounding urban development, with the Redbank Plains and Dinmore outcrops marked in yellow. Map background created using the *Atlas of Living Australia* (<https://www.ala.org.au/>), reproduced here under a Creative Commons Attribution 3.0 Australia Licence.

This paper reviews the history of the discovery and scientific understanding of the Redbank Plains Formation fossil sites, their geological and palaeontological significance, and their place in Australia's geological heritage.

The Redbank Plains Formation: The Cenozoic Geological Setting

In the Paleocene-Eocene periods, Australia was still connected to East Antarctica as part of the late Gondwanan land mass, although the process of separation from Antarctica was already well under way (McLoughlin, 2001). At northern latitudes a warm, wet climate encouraged the growth of broad-leaved forests (Byrne et al., 2011), and a plethora of fishes, insects, mammals, birds and smaller amphibians and reptiles was present. A variety of these are represented in the Redbank Plains Formation fossil fauna and flora.

There are several Cenozoic basins in South East Queensland, with the Redbank Plains Formation being part of the Booval Basin (Jell, 2013). These basins appear to have been lacustrine environments, hosting a rich diversity of plant and animal life. The fossils of the Redbank Plains Formation, therefore,

provide insight into the history of Australia's modern biota, prior to the widespread speciation and radiation of more dry-adapted taxa during the subsequent Miocene and Pliocene periods (Byrne et al., 2008).

The Booval Basin outcrops in two remnant areas, near Dinmore and Redbank Plains (Figure 1) and unconformably overlies the Triassic-Jurassic Ipswich Basin. *Geology of Queensland* describes the geology of the area as follows:

... The Booval Group consists of the Redbank Plains Formation and the conformably overlying Silkstone Formation ... The Redbank Plains Formation comprises claystone, sandstone and shale averaging 67 m thick and interpreted as fluvial to lacustrine. Surface exposures are subdued, but commonly comprise ferruginised mudstone nodules ... The Redbank Plains Formation is regarded as Paleocene-Eocene, with some authors preferring Eocene (Jell, 2013, p. 594).

The single accessible fossil-bearing remnant of the Redbank Plains Formation occurs in the Ipswich City suburb of Augustine Heights. It lies across two adjacent properties and covers approximately

15 hectares, with a eucalypt tree cover and patchy understorey of shrubs and grasses. There are no visible rock faces or impressive strata of layered sediments. The fossils are mainly impressions within an iron-rich mudstone, weathering out from the overlying soil across the site. Deeper excavation reveals layers of shale and fragmentary mudstone interspersed with clays. Several younger igneous intrusions have also produced a prolific scattering of trachyte fragments and silica-rich rocks. These latter were shaped and used by Indigenous peoples in the past as tools, remnants of which are still *in situ*.

The separate site at Dinmore (some 7 km distant) was a former clay quarry, mined since the early 1900s, and was well known for its plant impressions in shales and clays, along with some insects, but the shallow quarry has been filled in and the site is no longer available for study.

Geological Mapping of the Ipswich Coal Measures

Determining that the Redbank Plains Formation was Cenozoic in age took some years (Jones, 1927), underpinned by the Geological Survey of Queensland's (GSQ) intensive mapping of the Triassic coal deposits of the Ipswich area in the 1890s and following decades. The Ipswich coalfield was an important source of fuel for early Brisbane, and for the Queensland industrial and power sector until the 1970s. The GSQ therefore put great effort into investigating its extent and possible exploitation, including coal deposits under Redbank Plains (Denmead, 1955; Mengel & Carr, 1976; Murray, 2010; Whitmore, 1991).

The Assistant Government Geologist, Walter Cameron, completed the first comprehensive report on the Ipswich coalfield in 1899. While GSQ's initial mapping did not include Redbank Plains in the east, it did so in Cameron's later work on the Ipswich coal measures, which included a second report in 1907 and comprehensive maps which were published in 1923 (Cameron, 1899, 1907, 1923).

In discussing the geology of the Ipswich coalfields in 1907, Cameron (1907) made the following comments about what he designated the "Redbank Plains beds":

About the farming district of Redbank Plains there occurs an area of fissile shales which are

seen to lie with a more or less distinct unconformity on the coarse grits and sandstones of the Bundamba Beds. They can be traced all round the southern margin of the beds of volcanic rocks, which give the chocolate soil of the plains, and been sunk on in various shafts along Six-mile Creek and on the farms in the south-eastern corner of this district. They have afforded some fragmentary fish remains and remains of Dicotyledonous plants, which latter circumstance points to a probable identity with the supposed Cretaceous beds found about Darra and Wolston (Cameron, 1907, p. 17).

Ettingshausen (1895) had originally interpreted the nearby Darra Beds as Cretaceous, but both Skertchley (1908) and Marks (1910) concluded that the Darra Beds were "Tertiary", and by 1913 Cameron had altered his assessment of Redbank Plains to "Cretaceous-Tertiary". His investigations of the coal prospects in the Redbank Plains area were referred to in the GSQ Annual Report of 1913 and in an analysis of the Tertiary beds lying across some of the Ipswich coalfield (Cameron, 1913). In the latter he provided (p. 412) a map of the "tertiary mudstones, sandstones and basalts over the Ipswich Coalfield" and argued that the pre-Tertiary denudation of the coal seams was infilled by considerable depths of Tertiary strata, up to 460 feet in one bore at Bundamba. His 1923 mapping subsequently showed a "Tertiary System", in which he distinguished between the "Redbank Plains Series" and the overlying "Silkstone Series". More exploratory work on the Ipswich coalfield was conducted from the 1950s onwards, including core drilling to determine stratigraphy in the Redbank Plains area (Denmead, 1955). The impact of this on the future survival of the fossil deposits is discussed below.

Redbank Plains Fossil Discoveries: The Jones Bee Farm as the Type Locality

There is a rich cultural and social history associated with the Redbank Plains fossil site. The area had long been inhabited by Indigenous peoples and used by them for ceremony and stone tool making. Local tribes of the Yuggara and Ugarapul peoples inhabited the area until the late 1800s. An archaeological study in 1991 found three Indigenous sites

and a few isolated artefact scatters within the Woogaroo and Opossum Creek catchment area (which includes the fossil zone) (Ipswich City Council, n.d.).

Following the foundation of the Moreton Bay penal colony in 1824 and Ipswich in 1827, Redbank Plains was settled by Europeans for farming from the mid-1800s. It was not until 1900 that fossils were discovered, from a well on a property near Six-Mile Creek, and soon thereafter by the family of Mr Lewis Jones from surface rocks on their property, from where they operated an apiary business.

The Jones family patriarch, Lewis Jones, had migrated from Wales in the 1860s, purchasing land at Redbank Plains in 1865, where he lived and successfully grew cotton and other crops, later extending into cattle. This type of farming activity was the economic basis of rural Redbank Plains, supported by the Ipswich-to-Brisbane railway which came to the village of Goodna, 4 miles (6.4 km) to the north, in 1874. Jones named his house and farm 'Pentwyn', after his Welsh birthplace. The family also built the neighbouring 'Oakleigh' homestead (which still stands), where son Henry (H. L. Jones) established his apiary hives, with a honey factory and sawmill in Goodna. The Mel Bonum Apiary was a very successful business, renowned in Australia and overseas for its quality, with a focus on breeding Ligurian queen bees, and over 500 hives for honey production (Anon., 1892, 1894a,b, 1925).

The Jones land at Redbank Plains comprised 300 acres (122 hectares), bounded on the eastern side by Woogaroo Creek and next to the road from Goodna (now Keidges Road). Newspaper reports of the period extolled the virtues of the prosperous farms in the area and the diversity of produce grown (Anon., 1883, 1890).

The Jones land happened, however, to be situated on slopes that constituted the only fossiliferous surface outcrop of what later became known as the 'fossil fish bed' of the Redbank Plains Formation, now recognised as the type locality of this Formation. Several lengthy press articles in the 1890s about the local farming make no mention of fossil finds, however. Instead, *The Queenslander* on 27 January 1883 (p. 152) did report about the Jones farm that "good coal was known to exist on this property, but has not yet been worked".

Early Fossil Finds

In its mapping operations, GSQ was keenly interested in the palaeontology of the Ipswich coal-field areas. Fossils were first reported officially from "Goodna" in GSQ's Annual Report of 1900, where the Assistant Government Geologist, Benjamin Dunstan, reported that fish and plant fossils were discovered "at the head of Goodna Creek, about three miles south of the Ipswich Railway line" (p. 192).

The head of the GSQ, William Rands, sent for identification two specimens of fish remains from "near Ipswich" to the Director of the Australian Museum in Sydney in April 1900 (Geological Survey of Queensland, 1899, p. 654), and the Minister for Mines was advised in December 1902 that, although they had a single specimen of fossil fish from "Goodna", it had not been described and "no definite age can be assigned" (Geological Survey of Queensland, 1902, p. 50).

As Acting Government Geologist in 1904, Dunstan visited the Ipswich "locality where fossil fish have recently been found" on 16 July, and H. L. Jones was reported in the *Queensland Times* of 12 April 1904 (p. 2) as having "an excellently-preserved specimen of a fossil fish found at Redbank Plains", which he donated to the Ipswich Technical College Museum. It was not until 1914, however, that Jones donated a specimen to the Queensland Museum (QM), registered as QMF612. This was the first Redbank Plains fossil acquired by the Museum.

From that time onwards, reports and collections became more frequent. Staff from the Museum collected chelonian, fish and ostracod material in 1916, while in 1922 the geologist F. W. Whitehouse donated to the QM "remains of fossil fishes found in lenticular patches of iron-stained material in oil-shale deposits in H.L. Jones' property" (QM Archives, Donor Schedule 12 June 1922).

An additional reason that the Redbank Plains fossils became well known from this time was that the Jones family were active members of Ipswich society and regularly hosted visitors to their farm, including identities such as Sir Arthur Conan Doyle (Doyle, 1921). "Music, tennis, horses, mangoes, the bush and the bees were all magnets that attracted people to 'Oakleigh' from afar ...

Henry Jones's daughter Queenie recalled 'This was before the day of the motor car, but we always had company. Professors, doctors and scientists used to stay weekends and tap over the bushland for fossil

fish'" (Pullar & Cook, 2005, p. 11). The geologist F. W. Whitehouse (who later became professor at The University of Queensland) was a dapper young visitor around this time (see Figure 2).



FIGURE 2. The young geologist F. W. Whitehouse with Ms Queenie Jones and friends at 'Oakleigh', the Jones Bee Farm homestead, early 1920s. Photo courtesy of Picture Ipswich, qips-2010-02-16-0074a.

Finding Fossils at the Dinmore Site

The Redbank Plains Formation also outcropped at Dinmore, 7 km to the north-west from Redbank Plains, and both flora and invertebrate fossils were collected from the site until it was covered over in recent years. Stratigraphic or dating comparisons between the locations have not been made. Collecting of fossils from Dinmore is not documented until 1917 for GSQ, and the 1940s for the Queensland Museum. Holdings by the latter are numerous. Riek noted, in regard to the Dinmore site, that "... The Dinmore Beds of mudstones and clay shales have an entirely different lithology so that it is a little doubtful whether they are strictly homologous with the Redbank Plains series" (Riek, 1952a, p. 5). Pole, in his study of the Dinmore flora, interpreted the site as early Eocene (Pole, 2019).

Situated close to the main road and railway line between Brisbane and Ipswich, the clays at Dinmore and its neighbouring suburb Ebbw Vale

were the basis of an important Ipswich industry, and were worked since the late 19th century by brick and pottery companies, producing a wide range of pipes, sanitary ware, pottery, bricks and tiles (Ford, 2004). The fossiliferous clays and shales were located primarily south of the railway line, an area with coal mines, quarries and attendant factories, now bisected by the Cunningham Highway.

The Queensland Museum does not appear to have received its first Cenozoic plant fossils from Dinmore until May 1949, collected by J. T. Woods and the Swedish palaeobotanist Oscar Selling, from a "clay pit between Ebbw Vale and Dinmore". The Dinmore site was, over the decades, less well visited than the Redbank Plains site, but it has nonetheless been investigated: Riek described Cenozoic fossil insects (Isoptera and Orthoptera) from Portion 230, and Pole provided an overview of the diversity of the Cenozoic leaf flora from the Dinmore site (Riek, 1952b; Pole, 2019).

Scientific Study of the Redbank Plains Fossils

Extensive scientific analyses of the Redbank Plains fossil material occurred in two main phases: from 1916 until the 1950s, describing some of the fishes (the most prolific fossils on-site) and the insects; and later from the 1980s onwards, after further discoveries and additional research on fish, turtles, insects and other fauna, and also flora.

The eminent entomologist R. J. Tillyard described a fossil lacewing (osmylid) insect from the Redbank Plains Formation (from the Jones Bee Farm) in 1916 – in a paper with Benjamin Dunstan of the GSQ on the Mesozoic and Tertiary insects of Queensland and New South Wales (Tillyard & Dunstan, 1916). The specimen of what was described as *Euporismites balli* was a “wing in yellow rock”, which Tillyard recognised as a “very beautiful Osmylid (Neuroptera: Planipennia), allied to *Psychopsis*”. “This last is interesting,” Tillyard commented to Dunstan on 19 July 1915, “seeing that *Psychopsis illedgei* still occurs (very rarely) on Mount Tamborine [in South East Queensland] . . .” (National Library of Australia (NLA), 1990, obj-2127648725). Tillyard published a second paper in 1923 with a single specimen of a ricaniid (plant-hopper, Hemiptera) from the same location, which he suggested was “probably Upper Miocene” in age (Tillyard, 1923, p. 19).

The well-preserved fossil fishes from the Jones property had attracted more attention from the GSQ and the Queensland Museum. They were the focus of the first paper dedicated to Redbank Plains fossils, by Edwin Sherbon Hills, then a young geologist at the University of Melbourne and later one of Australia’s foremost geological scientists (Hills, 1934). The fish fauna from Redbank Plains included four species: a lungfish (*Epiceratodus denticulatus*), an osteoglossid (*Phareodus queenslandicus*), a gonorynchid (*Notogoneus parvus*) and a percomorph (*Percalates antiquus*).

Hills’s initial interest was in the fossil fishes of the Devonian, a subject on which he worked for his doctorate in London. While in London he had asked the GSQ for information on Devonian specimens, but also enquired about Tertiary fish, as he had “already prepared a description of . . . a well-preserved tail of *Epiceratodus* in a pale yellow-brown mudstone” that was in the British Museum (Whitehouse Papers, Box 2).

That specimen of lungfish had been sent to the British Museum for examination in 1927 by the GSQ, identified as “*Sagenodus* (?) Bundamba, Brisbane. Tertiary spec. for description (Q.G.S. property)”, “which we require to be returned” (Natural History Museum, Dunstan, 9 September 1927). Hills worked on this fossil while in London, and it was eventually returned to Brisbane, where it is held in the Queensland Museum collection (QMF5956).

The GSQ asked F. W. Whitehouse, then on staff, to gather further Tertiary specimens for Dr Hills, who had returned to Melbourne in early 1932 (GSQ Archives; Hills Papers; Whitehouse Papers). At Whitehouse’s suggestion, the GSQ asked Hills in July 1932 if he would prepare a full study of the Redbank Plains Tertiary fishes, using material collected by Whitehouse from Mr Jones’s land and a neighbouring property. Hills’s 1934 paper was the result. He continued his interest in Queensland Tertiary fishes, publishing a related paper in 1943 (Hills, 1943).

Ostracods were studied by Chapman (1935) and Beasley (1945), which furthered discussion on the likely age of the Redbank Plains beds. O. A. Jones had in 1927 surveyed the Tertiary deposits of South East Queensland, including those at Redbank Plains. Both Chapman and Beasley concluded that the environment was lacustrine and freshwater with, according to Chapman, occasional marine incursions, although this interpretation is not widely accepted.

The entomologist Edgar Riek completed a study of the fossil insects in 1952 (Riek, 1952a). He described the lithology and stratigraphy of the Series and surveyed the fauna of the deposit as it was then known, and its significance. Riek also described two new fossil insects (both Mecoptera or scorpion flies) and included a re-description of the neuropteran (lacewing) named by Tillyard in 1916, with new material collected by University of Queensland personnel.

Riek produced three further papers on Redbank Plains and Dinmore insects (Riek 1952b, 1954, 1967), describing several Diptera (flies), an isopteran (termite) and orthopteran (grasshopper) from Dinmore, and an update on his original mecopteran. Lambkin followed up much later with a record of a megalopteran (alderfly), and additional work

on the neuropteran and mecopterans (Lambkin, 1987, 1992, 2018), while Houston (1994) studied additional termites and planthoppers. Willmann (1977) erected a new family to accommodate Riek's *Austropanorpa* (1952). The insect taxa described from Redbank Plains comprise representatives of seven extant orders and ten extant families, the most diverse Cenozoic insect fauna in Australia.

As more lungfish fossils were found at Redbank Plains, including toothplates, skull anatomy, scales and body structures, Kemp in 1997 referred the Redbank Plains "*Epiceratodus*" to *Mioceratodus gregoryi*, a new genus of Cenozoic fossil lungfish widespread across central and northern Australia, as she considered it indistinguishable from this widespread taxon (Kemp, 1977, 2018).

Reptiles also received attention, following Riek's highlighting of reptilian remains in his 1952 paper. Lapparent de Broin and Molnar in 2001 identified five freshwater turtle taxa from Redbank Plains, representing both main Australian chelid groups, the *Emydura* and *Chelodina*, including a new species of the latter. They were noted to be "not only the oldest described Australian Cenozoic turtle material, but also the oldest Australian specimens definitely attributable to freshwater chelids" (Lapparent de Broin & Molnar, 2001, p. 45).

In addition, a bird foot had been discovered, similar to dromornithids (large flightless birds) and potentially an early member of the clade – indeed the oldest such member from Australia (Vickers-Rich & Molnar, 1996). As yet, no amphibian or mammal remains have been identified from the Redbank Plains Formation.

Flora from Redbank Plains and Dinmore have been extensively collected, with research done on the Dinmore fossils. Selling (1950) undertook some study of Australian Tertiary plants, including a specimen from Dinmore, and Churchill (1969) established *Lygodium dinmorphyllum* in 1969. Since that time it has been Rozefelds and others who have written on both Redbank Plains and Dinmore plants, specifically *Eucalyptus* fruits, a survey of Australian *Lygodium* (including Dinmore material) and a new genus of water fern (Rozefelds et al., 1992, 2016; Rozefelds, 1996). Pole's 2019 study of the Dinmore flora shows that angiosperms dominated, with 20 taxa identified.

The Queensland Museum concluded that:

... The array of leaf types suggests that the local environment may have been rainforest. Some of the leaves are comparable to modern rainforest plants belonging to the laurels (Lauraceae), banksias and macadamias (Proteaceae) and eucalypts and myrtle (Myrtaceae) families (Queensland Museum, 2015, p. 219).

See Figure 3 for examples of Redbank Plains Formation fossils.

The Fossil Site Under Threat

That the Redbank Plains fossil site still exists in 2022 was unlikely to have been predicted in the 1970s. As was discussed above, the Redbank Plains area has been known since the late 19th century to have coal reserves. The named mining areas "Redbank Plains" and "Redbank Plains Extension" (Cranfield & Green, 1983) formed the easternmost part of the Ipswich coalfield and took in large areas of what today are the suburbs of Redbank Plains, Bellbird Park and Augustine Heights. Further core drilling in these areas took place between 1967 and 1970, and results indicated that "some of the Blackstone [Formation] coals persist in workable conditions ... at depths of 500 to 600 feet" (Queensland Department of Mines, 1969, p. 95).

The potential for mining of the coal in Redbank Plains was therefore real. Mengel & Carr, in GSQ's survey of the Ipswich coalfield, outlined activity in the Redbank Plains Extension as follows:

Most of this area is a Departmental Reserve, but Rylance Collieries and Brickworks Pty Ltd hold coal mining leases and an authority to prospect over the eastern part near Woogarook Creek ... The coal seams do not crop out and they deteriorate to the east ... This part of the area has been included in the southern part of a satellite town planned by the Queensland Housing Commission, and the remainder of the area is being sub-divided in a similar manner to Redbank Plains (Mengel & Carr, 1976, p. 14).

GSQ recognised that "the area, because of its geographic location and pleasant environment, is ideally suited for semi-rural residential subdivision ... The activities associated with a deep shaft mine may not be acceptable".

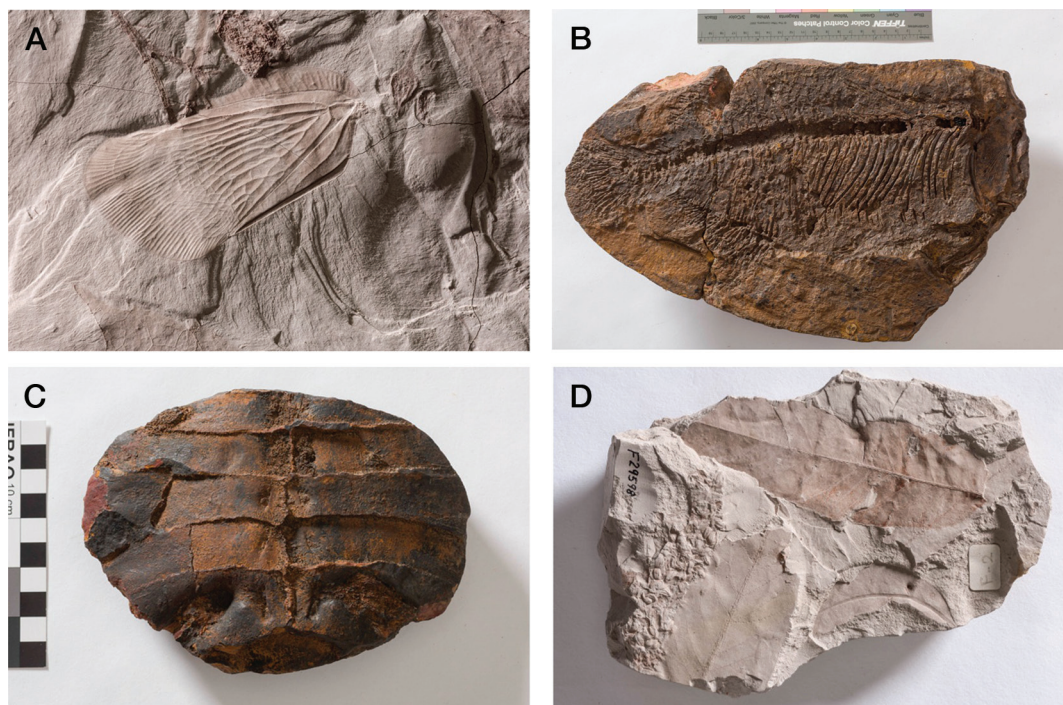


FIGURE 3. (A) QMF14808, wing of a planthopper *Scolypopites* sp.; (B) GSQF1960, body of osteoglossid fish *Phareodus queenslandicus*; (C) QMF37913, internal mould of carapace of an emyduran turtle; (D) QMF29598, leaf and seed material from Dinmore. Permission to use all images provided by Queensland Museum (QM). Photographer: Peter Waddington, QM.

Potential mining had become more difficult when the Queensland Housing Commission purchased land in July 1971 for a new housing estate, which fully incorporated the fossil site and beyond. The area of over 600 acres of land was intended to provide a suburb for some 10,000 residents in due course, a substantial boost to the local population (Anon., 1972).

As well as these plans for residential expansion, there was also a proposal by the State Electricity Commission for the siting of a thermal power station where the Augustine Heights and Brookwater suburbs are now located, only 2 km from the just-announced new housing development. GSQ was requested in March 1973 to undertake a geological assessment of the proposal: only one borehole was drilled, but it revealed that the Tertiary sediments below were unsuitable for high-bearing loads (Barker, 1973).

An environmental impact study was conducted, which showed that the proposed power station site

would incorporate several hundred acres, coal would be accessed from a mine already projected within Mining Lease 587 north of Jones Road, a water pipeline would require a 66-foot easement to cut directly across the fossil site land, and visual, noise and air-pollution impacts would be significant on the surrounding areas (Coffey & Hollingsworth, 1973). The project did not proceed.

Despite GSQ's negative views about exploitation of the coal reserves, exploration continued. From the late 1960s, Rylance Collieries and Brickworks was actively drilling and planning for coal mining in the area. In 1979 the Housing Commission abandoned its proposal for a new subdivision and sold the land in its entirety to Rylance for \$620,000, of which \$558,000 was controversially loaned to the company for this purpose, including a three-year non-repayment period (Queensland Parliament, 1981).

The company quickly gained approval for new mining leases at Redbank Plains, formed a joint venture company with Japanese interests and undertook

further drilling. This showed that open cut mining would be difficult, but that 59 million tonnes of coal were present from 100 to 400 metres below the surface, with approximately 10 million tonnes of mineable clean coal. The coal was “good steam coal with a low sulphur content and high ash fusion temperature”, and most of this was for export to Japan (Redbank Plains Resources, 1982, p. 6).

The Federal Government approved the proposed Japanese investment (Foreign Investment Review Board, 1982), and the Queensland Government considered the construction of a railway line to transport coal from the mine. Nonetheless, after such extensive exploration work, political manoeuvring, government approvals and commercial arrangements, the mine did not go ahead. This was because of organised opposition from local government and local residents (Murray, 2010), plus the significant costs associated with the infrastructure, transport, freight and remediation of a mine and its dedicated railway, in an already settled and rapidly developing suburban area (Queensland Treasury, 1979–1983).

At no stage, however, in any of the public objections, court proceedings, environmental impact reports or government statements at the time, was any reference made to the Redbank Plains fossil site, either as a part of the local natural environment likely to be impacted by the mine development, or as a scientific issue to be considered.

In short, the recognition by the GSQ of the palaeontological and scientific significance of the site, the local knowledge of the fossils through the long ownership by the Jones family and the research conducted over 80 years had not affected the decision making by government or impacted on the wider public. The geological heritage and scientific value embodied in the fossil site were simply part of an exploitable landscape and had no place in development planning at the time. The discontinuation of the proposed mine in 1983 was purely a result of the commercial and infrastructure costs involved, and political and press agitation about the impact on local lifestyle and amenity – neither science nor heritage had any place.

Status of the Redbank Plains Formation Sites After 1990

The original Jones house block was held by the Jones family until 1969 and is now partly zoned

‘Conservation’. Parcel conditions include ‘Character Place – Historical Miscellaneous Places’ (Ipswich City Council PD Online; Buchanan Architects, 1997). The house itself, the original Bee Farm residence ‘Oakleigh’, is not listed on the Queensland Heritage Register but is recognised by the Ipswich City Council as a heritage site.

The neighbouring block, originally owned by Jones but later acquired by Rylance, was re-surveyed in 1992 to fully incorporate the known outcropping fossil area and was acquired by the Ipswich City Council as a conservation reserve. Subsequently, housing and a primary school were built on surrounding land. The fossil zone remains intact as of June 2022, is zoned ‘Conservation’ and also contains as a parcel condition ‘Character Place – Historical Miscellaneous Places’. It is owned and managed by the Ipswich City Council, which is aware of its scientific importance.

The ‘Redbank Plains Fossil Site’ is listed on the Commonwealth Register of the National Estate as Indicative Place 18128. The site has been recognised in publications by the Australian Heritage Council (2012) and by the Queensland Museum (2015).

The Cenozoic fossil site at Dinmore is now inaccessible. It is part of an area which remains available for clay mining and associated industrial operations, and is subject to future development.

Conclusion: Preserving Scientific and Geological Heritage

Australia’s abundant palaeontological resources are generally poorly protected and preserved. Apart from a limited number of World Heritage or similarly important localities (such as Riversleigh in Queensland), the vast majority of fossil deposits across the continent are unprotected and do not fit easily into existing legislative or administrative conservation regimes (Creswell, 2019). Geo-conservation has not been part of the vocabulary of environmental protection in Australia, and the field evidence of the fossil history of Australia, a part of our national geological heritage still largely under-explored and under-studied, remains at risk.

Fossil sites are today sometimes recognised by local communities, particularly if they have been studied over many years (e.g. the Chinchilla Local

Fauna in southern Queensland (Wilkinson et al., 2021)). Sometimes they are managed to advance the economic and tourism interests of the community: for example, Ulladulla in New South Wales, or the Winton and Eromanga dinosaur sites in out-back Queensland, all now popular palaeo-tourism destinations.

In Australia, heritage sites of national importance are registered under the National Heritage List and protected under the *Environment Protection and Biodiversity Conservation Act 1999*. Five fossil sites are included therein: Naracoorte (SA), Riversleigh (Qld), Lark Quarry (Qld), Nilpena Wilpena (SA) and Yea (Victoria). A search of the National Heritage Database yielded 118 sites where the term ‘fossil’ was relevant to their significance, but most of these are only registered and are not formally recognised under the Act.

Although two Queensland fossil sites are on the important National List, no fossil localities are included in the Queensland State Heritage Register. This Register refers to only one “geological formation” (the Glasshouse Mountains near Brisbane), as most entries refer to the history of human activity. The *Queensland Nature Conservation Act 1992* (as amended, Section 8) does recognise not just ecosystems but “all natural and physical resources,

and natural dynamic processes” as coming under protection through national parks and related conservation areas. Some areas with fossils come within national parks or “Nature Conservation (Protected Areas)”, but the Redbank Plains site is not of itself recognised under the Act or associated regulations.

More often, fossil sites are ignored. In the case of the Redbank Plains Formation, it has taken over a century for the science to be documented (with new discoveries continuing), but the sites have been threatened for 50 years, and protection of their scientific values is not assured.

The housing, population and industrial development pressures on maintaining the scientific integrity of the Redbank Plains Formation type locality are real. The enduring scientific value of this fossil site will depend on its status as a conservation reserve being maintained and managed into the future. The strong heritage focus of the Ipswich City Council potentially provides a basis for recognition of geo-heritage, as the Council already manages several conservation parks, including Denmark Hill, internationally renowned as a Triassic fossil site for over a century (Rix, 2021). In the meantime, the Redbank Plains fossil site continues to be investigated and its significance promoted.

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