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THE HISTORY OF *BANKSIA* IN TASMANIA

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INTRODUCTION

The genus *Banksia*, in the family Proteaceae, is a prominent member of the Tasmanian flora today, but has a relatively low diversity, with only *Banksia marginata* having a widespread distribution. The other species of *Banksia* on mainland Tasmania, *B. serrata*, is restricted to only a few populations in the north west. Both Tasmanian species are widespread on mainland Australia. The fossil history of *Banksia* in Tasmania is relatively abundant, and demonstrates a much more diverse suite of species than today's remnants would indicate. In this paper we summarise the fossil history of *Banksia* and its near relatives in the state and consider the reason for the relatively low species diversity here today.

THE CURRENT DIVERSITY OF *BANKSIA*

Banksia is a widespread plant genus which characterises much of Australia's so-called "heathland"—areas with a classic mediterranean climate with hot dry summers and cool wet winters. More importantly, it is an integral part of the sclerophyllous flora, which is believed to have evolved primarily in response to soils with low nutrient levels, and in particular low levels of phosphorus and nitrogen. There are currently about 73 species of *Banksia* (Wrigley and Fagg 1989), with the greatest concentration of species being in southwestern Australia (more than 60 species). However, along the east coast of Australia there are 14 species, and, more importantly, it is not uncommon to see three or more species growing in close contact in the same ecosystems.

Related to *Banksia* (in the tribe Banksieae) are the genera *Dryandra*, which has at least 72 species, and is restricted to Western Australia; *Musgravea*, with two species in north Queensland rainforest; and *Austromuellera* with at least one and possibly two species, also in north Queensland rainforest. *Banksia* is occasionally found on rainforest margins, but apart from possibly one taxon, *B. integrifolia* var. *compar*, it is not recognised as a rainforest plant today.

Thus the diversity of *Banksia* in Tasmania today is relatively low compared to similar habitats in other parts of Australia. An intriguing aspect of this low diversity is that *Banksia marginata*, the common species in Tasmania, occurs in a very wide variety of habitats, from the alpine zone to coastal heath. A similar diversity of habitats is filled by several *Banksia* species in Victoria. This makes the history of the genus very important, since there are at least two options to account for this present day anomaly:

1. *Banksia* has always been relatively depauperate in Tasmania; or
2. *Banksia* was once much more common in Tasmania but has been restricted in diversity by one or more factors.

THE FOSSIL RECORD

One of the problems with the *Banksia* macrofossil record is that most specimens are leaves. While the leaves of *Banksia* are quite distinctive, it is difficult (and sometimes impossible) to separate them from *Dryandra*. Because of this, the fossils are put into the noncommittal genus *Banksieaephyllum* (see Hill and Christophel (1988) for a discussion of this). Each of the types of leaf which are assigned to *Banksieaephyllum* could have come from a true *Banksia*, an ancestor to *Banksia*, an extinct near relative of *Banksia*, or *Dryandra*. The first three options are quite likely in Tasmania, the last is less so, although even the possibility of finding a genus now restricted to Western Australia in Tasmania cannot be discounted.

The oldest evidence of *Banksia* comes from moulds of cones in Western Australia, which date from about 40–50 million years ago (McNamara and Scott 1983). The preservation of these cones is very good and there is no doubt about their identity. This provides the present benchmark for the maximum age of *Banksia*, which should be kept in mind during the following discussion. The oldest leaves of *Banksieaephyllum* are from slightly older sediments in southern New South Wales (about 55–60 million years), where two species occur, one of which probably represents an extinct genus, while the other is very similar to living *Banksia* species in Western Australia.

Fossil localities in Tasmania which contain *Banksia*-like leaves are shown on Fig. 1. The oldest fossils which resemble *Banksia* in Tasmania are leaf impressions which occur in sediments on the west coast (Regatta Point) which are about 50-55 million years old. There are at least two distinct leaf forms present. These do not have adequate organic preservation to fully confirm the generic identity, but

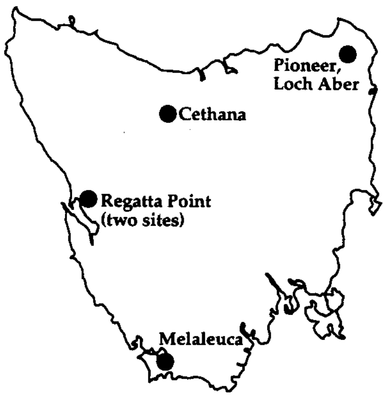

Fig. 1. Map of Tasmania showing the sites which have yielded *Banksia*-like fossils. There are two sites at Regatta Point that are mentioned in the text. Sites at Pioneer and Loch Aber, which are close together, are approximately 20-25 and 40-45 million years old respectively.

there is no doubt that they are of the *Banksia*-type, and can be placed in the genus *Banksieaeformis*, which is reserved for leaves of the *Banksieaephyllum*-type that have no organic preservation.

From this time onwards *Banksia*-like fossils are relatively common, but one site deserves special mention. The Cethana sediments in north central Tasmania, which are about 35 million years old, contain a very diverse flora, including at least seven species of *Banksia*-type leaves. Given that all species are well preserved it is reasonable to conclude that these species were growing within reasonable proximity of one another and thus represent a larger species diversity within a small region than in any similar area of the living Australian vegetation. It is also interesting to consider the form of the leaves that are present at about this time in Tasmania. Among the living species there are basically three main leaf types. Some species are entire margined, some are relatively finely serrate, and a third group are heavily serrate, sometimes with the serrations reaching right in to the mid-vein of the leaf (Fig. 2). All three leaf types occur in Western Australia, but in eastern Australia only the former two types are found. That is, the deeply serrate *Banksia* leaves are now totally restricted to Western Australia. It is therefore of great interest that leaves of this type commonly occur in the fossil record of south-eastern Australia, including Tasmania. One of the species at Cethana very clearly illustrates this type. Thus a leaf type which, on the basis of

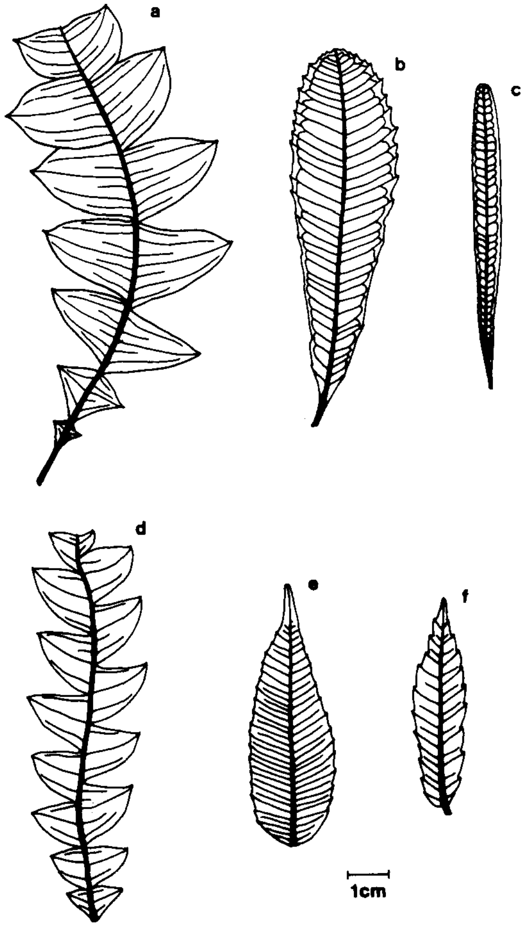

Fig. 2. (a-c) Living *Banksia* species: a,*B. grandis*.; b,*B. conferta* var. *conferta*.; c, *B. marginata*. These three leaves illustrate the range from very deeply serrate through to entire margined. (d-e) Tasmanian fossil leaves refereable to a *Banksia*-type: d, Undescribed *Banksieaephyllum* leaf from Cethana; e. *Banksieaephyllum attenuatum* from Loch Aber; f. *Banksieaephyllum regularis* from Pioneer.

living plant distribution, may have been predicted to have always been restricted to Western Australia, was once more widespread. The reason for the restriction of this type to Western Australia is unknown, but offers a particularly challenging palaeoecological problem.

There is a gap in the Tasmanian fossil record from about 25 to about 2.5 million years ago. However, the record of *Banksia* in Tasmania over the last approximately 2 million years is particularly interesting. The oldest macrofossil-bearing Quaternary sediments in Tasmania are mudstones at Regatta Point on Macquarie Harbour (about 0·7 to 2·5 million years old). These mudstones contain beautifully preserved leaves of two species of *Banksia*, both of which are extinct in Tasmania today (Jordan and Hill 1991). One, *B. strahanensis*, is typical of a group of species which have long, thin leaves with highly revolute margins. The most familiar example of this type in the living flora is *Banksia ericifolia*, which is a common garden plant which copes very well with the Tasmanian climate. The other is a large, broad-leaved species which is similar to *B. saxicola*, which is found today at high altitudes in the Grampian Mountains in Victoria. The interesting feature of these two species is that both are related to living species that could be expected to survive well in Tasmania today. This poses a pertinent question about the change in environment which brought about the relatively recent demise of such species here.

The Melaleuca sediments (approximately 40 000–150 000 years old) have yielded both leaves and cones of an extinct species of *Banksia* which may be the same as the broad-leaved species at Regatta Point. This places the time of extinction of this species very close to the present.

These records bring the glaciations of the last 2 million years sharply into focus as a possible cause of extinction of *Banksia* species. Some aspects of the fossil record are beyond dispute:

1. Prior to 25 million years ago, *Banksia* or *Banksia*-like plants were diverse in Tasmania.
2. Even since the onset of glacial cycles there were at least two species of *Banksia* in Tasmania which are now extinct.
3. Two species of *Banksia* remain in Tasmania today.

These points can be briefly discussed sequentially. The large number of older species is proven beyond doubt, but it is not certain when they began to decline. However, it is probable that there were less species present by about 25 million years ago. Part of the reason for this seems to be a shift in ecological preference among the taxa involved. At least some of the older taxa (which may or may not have been true *Banksia* species) were clear rainforest elements, having leaves with long drip tips (e.g. Fig. 2e,f) and very thin cuticles, whereas *Banksia* species today are predominantly members of open vegetation, although the related genera *Austromuellera* and *Musgravea* retain the rainforest habitat. The reasons for this shift from rainforest habitats to open vegetation are uncertain. One possibility is that the rainforests prior to 25 million years ago had a different canopy structure to those of today, without a closed upper layer, but more conical forms suited to the capture of incoming radiant energy at a low angle and from a continuously varying direction at the prevailing very high latitudes. This would have suited mid-sized trees or shrubs which are shade intolerant and/or animal pollinated. A rainforest structure with the canopy spread vertically rather than horizontally would allow efficient capture of energy from a sun which is continually low in the sky. In such a forest, shade intolerant small trees or shrubs have access to direct sunlight, but as the landmass moved into lower latitudes and the sun appeared at a relatively higher angle, the tops of the forests would have closed over and smaller plants would have been disadvantaged because they no longer received high loads of direct sunlight. Another option is that in a more stratified rainforest, pollinating animals (especially birds) have much freer access to plants at lower levels, whereas they may be less frequent visitors beneath a closed canopy. Thus the closure of the rainforest canopy at the uppermost level may have excluded normally smaller plants like *Banksia*, and restricted them to more open (drier) habitats. This offers a possible explanation for the demise of at least some of the older species.

By the onset of the glaciations it is probable that the *Banksia* species present had a similar niche to that occupied by extant species, given their close morphological similarity to living forms. Why then did some species become extinct while others did not? One possibility is that all *Banksia* species became extinct from Tasmania during glaciations, but only some dispersed back. A more probable option lies in adaptability. *Banksia marginata* is an extremely adaptable and tolerant species in Tasmania (and other areas) today. This poses a "chicken or the egg" type of question. Is *B. marginata* adaptable and thus able to survive while other *Banksia* species became extinct, or has *B. marginata* evolved rapidly in recent time into a number of empty niches left by species which became extinct in the region? The former is the most likely. In difficult times it is the adaptable that survive rather than the adapted. *Banksia marginata* had the advantage of being relatively adaptable and thus was able to survive the rapid changes which occurred during the glaciations, whereas other species became extinct. During relatively mild times, like the present interglacial period, such a species does particularly well, expanding into a wide range of habitats. During the height of a glaciation it may be much more restricted, presumably to that end of its range which is most tolerant of cold and probably dry conditions, but its genetic flexibility has apparently been retained and it is able to expand rapidly when conditions permit.

Thus in Tasmania today *Banksia* is, in terms of numbers of species, a relatively unimportant genus. However, the species which occur here now and which occurred here in the past, reveal important aspects of the history of this characteristically Australian genus.

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METALLIC SKINKS *NIVEOSCINCUS METALLICUS* SAMPLED BY A CATTLE EGRET *ARDEOLA IBIS* IN HOBART

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A cattle egret, *Ardeola ibis*, crippled due to a wing injury, was found on a highway near Fitzroy Gardens in Hobart late in the morning of 15 September 1982. When rescued the egret regurgitated a food bolus composed entirely of 25 small freshly eaten metallic skinks, *Niveoscincus metallicus* . The recorded diet of cattle egrets in Australia is diverse: a very wide variety of arthropods, as well as frogs, reptiles and a few small mammals. These are taken from the surface of pasture or in shallow water (Hindwood 1971; McKilligan 1984). Egrets are catholic and opportunistic feeders in pasture. Lizards, especially small skinks, are the main veretbrate food of cattle egret chicks in a breeding colony near Gatton in south-eastern Queensland (McKilligan 1984). It appears lizards are a significant part of the diet only in Australia (McKilligan 1984).

The cattle egret is from Asia and is only recently naturalized in Australia. Its spread in Australasia is well recorded (Blakers *et al.* 1984). It was first reported as a visitor to Tasmania in 1965 (Thomas 1966). Since then some cattle egrets have regularly migrated to Tasmania spending winter here and then returning to breed in northern New South Wales and Queensland (Maddock 1990).

The recording of the egret eating lizards in Tasmania is not in itself remarkable; unless this was causing damage to lizard populations through added predation.

However, this seems unlikely. Of greater interest was the sample of 25 skinks, all the same species, that the bird had collected that morning from the same locality. This is a difficult thing for people to do efficiently and the opportunity to examine a sample from a population of these lizards collected in such a way is rare.

The sample contained animals of different sizes ranging from 27mm to 60mm in length from snout to vent (s-v). Four groups were apparent based on s-v length. The first group, containing the greatest number of animals (n=10), was 27mm to 34mm (x=30·7, s.d.±2·0); the second (n=6) was 41mm to 45mm (x=42·7, s.d.±1·4); the third (n=8) was 50mm to 54mm (x=52·1, s.d.±1·3) and the last (n=1) was 60mm s-v length.

The species is ovo-viviparous and young are born in January with an approximate s-v length of 15mm. The four groups above probably correspond to different age classes, the first with an average age of 9 months and successive groups each older than its predecessor by a year so that the largest animal in group four would have been approximately 3 years 9 months of age.

Breeding activity in spring in this skink coincides with the development of a coppery-red colour on the otherwise whitish-grey belly. The specific function of this colouration which occurs in both sexes is unknown. All 25 animals were examined for the intensity of the colour which ranged from very bright, to bright, to no colour at all in some. Some belly colour occurred in all animals in all groups except the youngest in which none except the largest animal (34mm s-v length) was coloured. All animals in the two oldest groups and only one animal (42mm s-v length) in the preceeding age group were very brightly coloured. Thus ten animals had very bright, six had bright and nine out of ten juveniles had no coppery-red colour on their bellies when they were collected.

This information is quite useful when it is realized how little is known of one of our most common and accessible reptiles.

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A COLONY OF THE HAIRSTREAK BUTTERFLY, *PSEUDALMENUS CHLORINDA* S.SP. NEAR *ZEPHYRUS*, PROTECTED WITHIN A FOREST RESERVE.

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INTRODUCTION

Prince (1988) reviewed the conservation status of the hairstreak butterfly *Pseudalemenus chlorinda* in Tasmania and concluded the species warranted the status of vulernable within the IUCN definition (Wells *et al.* 1983). The hairstreak butterfly has suffered a reduction in numbers over wide areas of former occupation. Couchman and Couchman (1977) recorded the presence of the species at 66 sites in the late 1940's which had declined to about 10 in 1977. The survey undertaken by Prince (1988) in 1985 found only 15 of the original sites to be occupied.

The hairstreak butterfly exhibits marked geographical variation and various subspecies have been recognised. An unnamed endemic subspecies is similar to the mainland subspecies *P. c. zephyrus* and so it has been referred to as *P. c.* near *zephyrus*. This subspecies was recorded by Prince (1988) as only being known from four areas in coastal regions between Port Sorell and the north-east. Prince (1988) considered that the subspecies should be regarded as endangered This paper reports on a new locality for a breeding colony of *P. c.* nr. *zephyrus* within the boundary of an established Forest Reserve.

SITE DESCRIPTION

The Scamander Forest Reserve was established in 1987 to preserve dry coastal *Eucalyptus sieberi* forest not reserved elsewhere (Duncan 1985). The rocky east facing slopes carry *E. sieberi* as the dominant eucalypt,with *E. viminalis* and *E. amygdalina* as scattered individuals. A sparse understory of *Acacia dealbata* and *Allocasuarina littoralis* with*Daviesia latifolia, Pteridium esculentum, Lepidosperma* spp. and *Pultenaea gunnii* as the main ground cover species.

THE COLONY

The hairstreak butterfly requires a unique combination of food plant, pupation site, and attendant ant protection in order to complete its life cycle. In the Scamander Forest Reserve many small gullies harbour patches of young dense *A. dealbata* with one or several mature *E. viminalis* amongst them. In two of these gullies populations of *P. c.* nr. *zephyrus* were found. Despite extensive searching of suitable gully sites in the reserve over several seasons no other populations were found.

Larvae were easily detected on the food plant by looking for the large mass of attendant ants, *Anonychomymra bicomvexa* (Santschi), formally *Iridomyrmex foetans*, which were present at all stages of larval development and were also frequently found attending the pupae under the bark of *E. viminalis*. The larvae were present on *A. dealbata* from early December through to late March, while adults were on the wing from late October to early January. Several larvae were collected on 9 December 1987 and reared on *A. dealbata* foliage. The larvae were reared without the attendant ants suggesting that the ants play a purely protective role in the field. The larvae may provide ant appeasement substances as have been demonstrated for many other lycaenids. Pupation occurred between 6-10 January 1988 and adults emerged between 24-30 October 1988. Two pairs were retained for the Forest Insect Reference Collection at the Tasmanian Forestry Commission and the remaining male and two females were released at the Scamander site on 2 November 1988 in good condition. Their forewing measurements were as follows:

	Mean(mm)	Range	N
Male	14·3	13·7–14·8	5
Female	17·1	16·9–17·2	3

DISCUSSION

In 1985 Prince (1988) examined in detail five sites on the southern banks of the Scamander River, including Couchman's original locality, without finding any *Pseudalmenus* pupae. Couchman located a colony in 1961 but when Hewer looked in 1964 the site was already disturbed. Much of this area has been lost as a suitable habitat due to housing and land clearance.

Dispersal of the butterfly to apparently suitable sites is very limited and clearly habitat requirements are very specific. Prince (1988) notes that at several colonies only one individual eucalypt is used as a pupation site, often for many years, despite the presence of other accessible host trees. The necessity of close proximity of food plant and pupation site, never exceeding five metres, and the dependance on ant trails to guide the larvae between the two are very limiting factors in delineating habitat requirements. Adult flight is weak and very localised being similar to that of the ptunarra brown butterfly *Oreixenica ptunarras* (Neyland 1992) which itself has very restrictive habitat requirements.

It is a pleasure to report that, although the isolated population described by Couchman (1964) has disappeared, the new colony recorded in this paper has some degree of protection under government legislation within the Scamander Forest Reserve. However, Prince (1988) gives fire, in the form of fuel reduction burns, as the greatest danger to the survival of this beautiful endemic butterfly. It is therefore important that fire management plans for the reserve take into account the requirements of this population of the hairstreak butterfly.

ACKNOWLEDGEMENT

My thanks posthumously to Len Couchman for identifying the lycaenid butterfly *Pseudalmenus chlorinda* s.sp. near *zephyrus*.

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TASMANIAN FIELD NATURALISTS CLUB INC.

G.P.O. Box 68A, Hobart, Tas. 7001
Founded 1904

OBJECTS

The Tasmanian Field Naturalists Club aims to encourage the study of all aspects of natural history and to advocate the conservation of our natural heritage. The club is comprised of both amateur and professionals who share a common interest in the natural world.

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The Club publishes the journal, *The Tasmanian Naturalist*. This journal provides a forum for the presentation of observations on natural history and views on the management of natural values in both formal and informal styles. Examples of material included are flora and fauna surveys, observations of unusual or unknown aspects of a species' natural history, overviews of contemporary issues, views on the management of natural values and book reviews.

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Membership of the Tasmanian Field Naturalists Club Inc. is open to any person interested in natural history. *The Tasmanian Naturalist* is distributed free to all members, the club's library is available for use and a quarterly bulletin is issued with information covering forthcoming activities. Enquiries regarding membership should be sent to The Secretary at the above address or to the Clubs' President Don Hird can be contacted by phoning 344293.

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