

# Aboriginal names of mammal species in south-west Western Australia

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## ABSTRACT

Approximately 1100 records of Aboriginal names for the native mammal species present in south-west Western Australia have been collated and interpreted from published and unpublished sources. Of the 51 terrestrial species occurring within the range of Noongars (south-west WA Aborigines), reliable names for 40 species are presented. Many of these names appear more apposite than existing vernacular names. To facilitate their adoption, spelling and designation of syllables have been aligned to conform with modern conventions as determined by Noongars.

## INTRODUCTION

The Aborigines (Noongars) of south-west Western Australia (Fig. 1) are descended from humans who colonized Australia c. 50 ka BP. First studied closely by Europeans in 1791, they depended as hunter-gatherers on an intimate knowledge of the distribution, seasonal abundance, and habits of edible species of plants and animals.

Most of their comestibles came from freshwater, estuaries, and the land, where they lived off fish, crustacea, insects, seeds, corms, tubers, bulbs, rhizomes, fruits, nectar, birds and their eggs, reptiles, frogs and mammals (Meagher 1974). They did not possess watercraft (Abbott 1980) and so did not exploit marine resources such as seals, whales, or fish unless these animals became stranded. Noongars did not consume gastropods.

Their major source of protein comprised many mammal species, with the men hunting the largest species of kangaroo, wallaby and possum with the *ketj* (spear), *karli* (boomerang) and *koitj* (stone axe), sometimes with the aid of pitfall traps and brush fences. The women collected small species (bandicoots, rodents) killed by *karla* (fire). Widespread burning of vegetation ensured an ongoing supply of green pick for browsing and grazing mammal species, thus optimizing the availability of meat.

The Noongar population, estimated to have originally occurred at a density of c. 5–10 people/10 000 ha (Hallam 1989), declined after 1826 when Europeans settled in Western Australia (WA). Several pioneers attempted to live in harmony with the Aborigines, developing friendships which enabled people of both races to learn elements of each other's language. The happy outcome was that names applied by Noongars to some plant and animal species were recorded before Aboriginal society was fatally disrupted. Noongars did not have any written records, so there is no equivalent of a dictionary available. According to Paterson (1896), many of the names used by Noongars are adapted from the natural sounds that the animals produce.

Common names of mammals in Australia currently recommended for use (Strahan 1995) are based mainly on names bestowed by the early colonists or are anglicized versions of Latin generic names. In recent years, however, it has been recognized that some of these names are inaccurate (e.g. Honey-possum). Some Aboriginal terms have become widely accepted by modern Australians, including Chuditch, Numbat, Quenda, Woylie and Quokka in south-west WA and Quoll, Bilby, Wombat, Koala, Potoroo, and Euro in other parts of Australia. Vernacular names of native rodents have mostly been formed artificially by an English translation of the Latin binomial. In 1995 a list of Aboriginal names of all native rodent species was published (Braithwaite *et al.* 1995), together with one preferred name for each species.

There are several reasons for preparing an exhaustive synthesis of Noongar names for south-west WA mammal species. First, there is an obvious gap in knowledge compared with that of birds (Serventy and Whittell 1948) and plants (Abbott 1983). Second, scientists seem reluctant to use Noongar names, e.g. when *Potorous gilbertii* was rediscovered in 1994, the English common name coined in 1841 was revived and modified (Sinclair *et al.* 1996). Third, official and popular usage of Noongar names by Western Australians constitutes a tribute to the original inhabitants. Fourth, many of the early word-lists provide only a vague clue as to the identity of some species and this is an impediment to assigning Noongar names to the correct species. General terms such as 'small species of mouse', 'a species of mouse', 'a large species of mouse' (Grey 1840), 'field mouse' (Moore 1842) or 'un piccolo

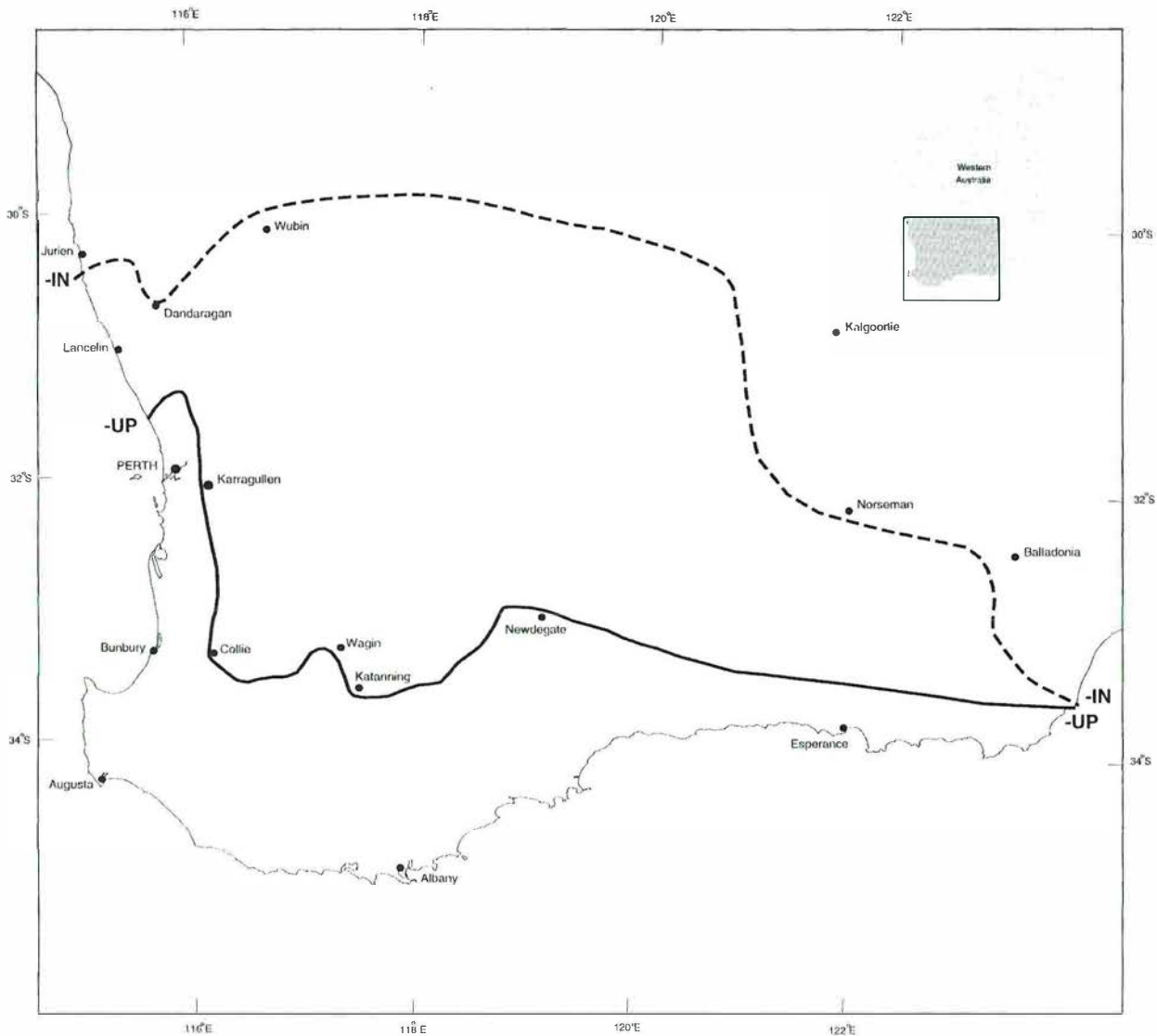


Figure 1. Northern limits of place names in south-west Western Australia ending in -up or -in (or -ing). The -IN line indicates the geographical limit of Noongar populations.

animale' (Salvado 1851) are not by themselves helpful to the zoologist.

Research on this project commenced in 1996 when Dr Clemency Fisher of the Liverpool Museum, UK kindly provided me with copies of the manuscript mammal lists of John Gilbert (here styled as MS1 and MS2). These had not been available to inform the valuable research of Whittell (1954a, b).

The objectives of this paper are similar to those of Abbott (1983):

- (1) To collate all available records of Noongar names of south-west WA mammal species;
- (2) To determine so far as is possible the most accurate version of each name, allowing for local variation and errors in transcribing names;
- (3) To provide a list of Aboriginal vernacular names that can be recommended for more general use, both by mammalogists and the general public in south-west WA, and thereby replace unsuitable common names in current use.

## METHODS

I located and extracted records from books written by early visitors to, and settlers in, south-west WA, as well as reports or other documents written by explorers, historians and anthropologists. I also consulted word lists (manuscripts or typescripts) held in libraries in Perth and Canberra. Time did not permit perusal of unpublished letters and diaries held in libraries.

It quickly became apparent from searching the comprehensive word-lists published by Grey (1840) and Moore (1842) that Noongar names recorded for small mammal species could not always be linked to known species because of the brevity and vagueness of descriptions. In fairness to these men, few south-west WA mammal species had been named by scientists before 1845, well exemplified by the list published by Gray (1841).

I therefore decided to give primacy to the Noongar word-lists assembled by John Gilbert and Guy Shortridge who collected *inter alia* extensive series of mammals in 1839–42 and 1904–07 respectively (Fig. 2). This was

before many mammal species became extinct or had dramatically contracted in geographic range. Both collectors are known to have been assisted by Aborigines (Whittell 1949; unpublished letters of Shortridge to O. Thomas). The names recorded can therefore be regarded as authoritative, except in a few instances discussed later in this paper. Subsequently, when I searched word-lists assembled by non-mammalogists, I could confidently assign most Noongar names to the correct species.

## SOURCES OF NOONGAR NAMES

The following list details, in approximate chronological sequence after Gilbert and Shortridge, the various sources of information located and utilized during this study. Chronological, rather than alphabetic, sequence has been preferred because this arrangement highlights the greater reliability of the earlier records. Biographic and historical information has been taken from several sources, especially the Dictionary of Western Australians (6

volumes), the Bicentennial Dictionary of Western Australians (4 volumes), the Australian Dictionary of Biography (14 volumes), and Whittell (1949, 1954a).

Gilbert MS. John Gilbert (1810–1845), naturalist and collector for John Gould (1804–1881), collected mammals in south-west WA between March 1839 and February 1840, and between July 1842 and December 1843. MS refers to two slightly different versions of his hand-written notes (?1843) sent to Gould. I have quoted most extensively from MS1, and have then listed any variants occurring in MS2.

Gilbert in Gould. See Gould (1863). As these volumes were not available for consultation, I relied on Dixon (1983).

Gilbert in Whittell. See Whittell (1954b).

Gilbert in Wagstaffe and Rutherford. See Wagstaffe and Rutherford (1954, 1955).

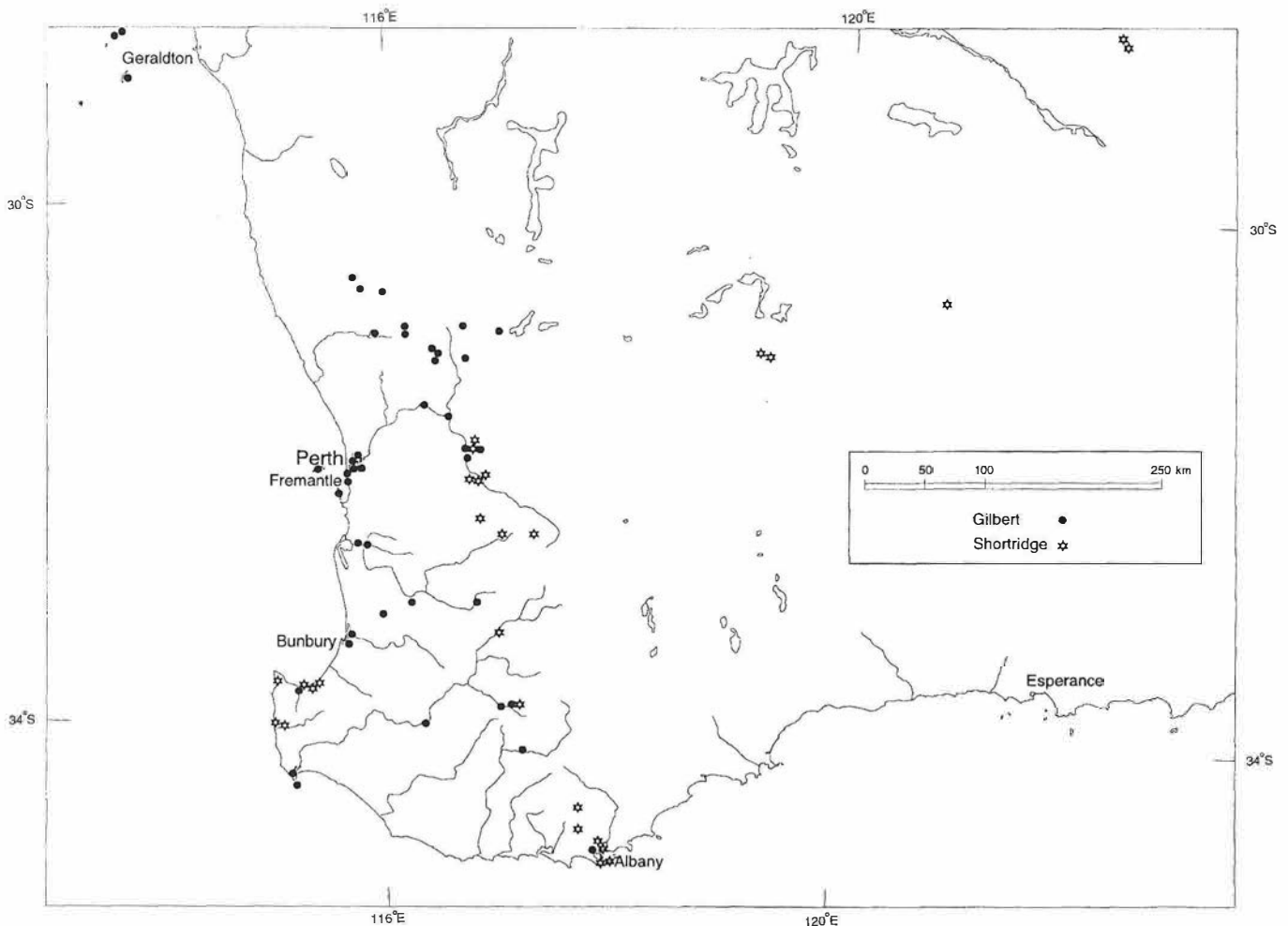


Figure 2. Localities visited by Gilbert or Shortridge. Although mammals were not collected at all of these sites, it is likely that observations of mammals were made at many of them. Localities that Shortridge visited north of Geraldton are not shown. Localities mentioned by Gilbert have been extracted from Fisher (1992).

Gould [ex Gilbert]. See Gould (1865).

Shortridge. Guy Shortridge (1880–1949) visited WA in 1904–07 and collected for W.E. Balston, who had farming interests near Albany (Shortridge 1910, 1936; Thomas 1906a, b).

King. Phillip Parker King (1791–1856) visited south-west WA (King George Sound) several times. In 1817 he recorded some Aboriginal names (King 1827, p. 145).

Nind. Isaac Scott Nind (1797–1868) was medical officer at the convict establishment at King George Sound from December 1826 to October 1829. Nind (1831) includes an extensive list of Aboriginal words.

Wilson. Thomas Braidwood Wilson (1792–1843) visited Swan River and King George Sound from October to December 1829. His book includes a short list of Aboriginal names collected at King George Sound (Wilson 1835).

Anon (1834). The observations recorded in this paper (Anon 1834) are generally attributed to Alexander Collic (1793–1835), who arrived in WA in 1829 and was appointed first Government Resident at Albany from March 1831 until September 1832.

Lyon. Robert Menli Lyon (b. 1789) lived from 1829 to 1834 in WA. He published (Lyon 1833) several newspaper articles containing the first list of Aboriginal words from the Swan River area. Moore (1884) stated that the list contained 'many inaccuracies and much that was fanciful'.

Bunbury. Henry William St Pierre Bunbury (1812–1875) was a military officer in south-west WA during the period March 1836–November 1837, stationed at York, Pinjarra, Busselton and Williams. His diaries were published by Bunbury and Morrell (1930).

Grey. George Grey (1812–1898) explored parts of south-west WA in 1838–39, and was Government Resident at Albany from August 1839 to March 1840. In his book (Grey 1840) he states that the word-list was compiled from as far as 100 miles north of Perth [i.e. to the south of Cervantes], Murray, Vasse and King George Sound. This list was stated to include words submitted by J. Hutt, G.F. Moore, F.F. Armstrong and the Bussells of the Vasse district.

Stokes. John Lort Stokes (1812–1855) several times visited south-west WA (Swan River, Australind and Albany) as part of a British naval survey of Australian waters (Stokes 1846). In his book he provides a list of Swan River words (pp. 217–220) gathered in October 1840.

Symmons. Charles Symmons (1804–1887) arrived at Perth in December 1839 and was appointed protector of

Aborigines. His book (Symmons 1841) consists of names gathered at Swan River by himself, J. Hutt and F.F. Armstrong (Whittell 1949, 1954a).

Moore. George Fletcher Moore (1798–1886) arrived in WA in October 1829 and departed in 1852. His book (Moore 1842, revised 1884) contains one of the most significant Noongar word-lists, which he acknowledged was contributed to by C. Symmons and 'a friend whose name I am not at liberty to mention'.

Brady. John Brady (1800–1871) was a Roman Catholic priest, then bishop, in WA from 1843–44, 1846–50, and 1851–52. Brady (1845) lists only a few Aboriginal words relevant to this paper.

Drummond. James Drummond (1784–1863) arrived in WA in June 1829, finally settling in the Toodyay district in 1836. He was an active collector of botanical specimens throughout the south-west in the period 1836–1851. Relevant words have been extracted from Anon (nd); only a few of the original documents have been sighted. Drummond usually capitalized Aboriginal words.

Smyth. Robert Smyth (1830–1889) settled in Victoria in 1852 and from about 1860 collated material about Aborigines from many published and other sources around Australia. Most of the information presented about south-west WA Aborigines (Smyth 1878, pp. 221–284) was written by Philip Chauncey (1816–1880), an assistant surveyor in WA in the period 1841–1853. However, no comprehensive word-list is included.

Salvado. Rosendo Salvado (1814–1900) arrived in WA in 1847 and founded the Benedictine Monastery at New Norcia in 1848. See Salvado (1851) and Stormon (1977). It is likely that Aboriginal words recorded from east and north of New Norcia refer to the out-stations Wyening (25 miles [40 km] distant) and Marah (40 miles [64 km]) respectively (Russo 1980, p. 169). The records from Salvado in Curr (1886) refer to New Norcia and Leschenault Bay.

Austin. Robert Austin (1825–1905) came to WA in 1840 and later led the so-called Settlers' Expedition to the north-east of the Avon Valley settlements in 1854 (Austin 1855). This party included one Noongar.

Oldfield. Augustus Oldfield (1821–1887) recorded valuable information about Aborigines when botanizing in 1858–59 near Murchison River and Shark Bay. His paper (Oldfield 1865) includes mammal names used by the 'Watchandie' [? = Nanda of Tindale 1974] and the 'Champion Bay tribe' [provided by R.J. Foley]. Oldfield (1865, p. 297) states that the 'Watchandie' tribe is located 180 miles [c. 290 km] north of the headquarters of the Champion Bay [Geraldton] tribe. This would place the provenance of his word-list as on the eastern shore of Shark Bay, near the Wooramel River.

Millett. Janet Millett resided at York with her husband (Anglican chaplain) from December 1863 to January 1869, and later published a book intended to serve as a guide to immigrants (Millett 1872).

Hunt. Charles Hunt (1833–1868) led, between July and November 1864, an expedition east of York in search of pastoral land (Hunt 1864). He was accompanied by one Noongar.

Ranford. Henry Samuel Ranford (1854–1934) was a land surveyor (Ranford 1875).

Forrest. John Forrest (1847–1918), accompanied by several Noongar trackers, explored parts of south-west WA in 1869, 1870 and 1874 (Forrest 1875).

Hassell, E. Ethel Hassell (1857–1933) was born in and lived in Albany until 1878, when she married and moved to Jerramungup. She relocated to Albany in 1886. Her word-list (Hassell 1975) relates to the vocabulary of the Wheelman tribe at Jerramungup.

Bussell. Alfred John Bussell (b. 1865), son of Alfred Bussell, pioneer settler in 1830 of Augusta and later Busselton, recorded Aboriginal names from this region (Bussell nd). According to Buller-Murphy (nd)(MS at Acc. No. 1648A/6 in Battye Library), he spoke the Aboriginal language fluently.

Hammond MS1. Jesse Hammond (b.1856) travelled extensively throughout south-west WA as a stockman/drover in the 1870s and 1880s. See Hammond (nd = MS1).

Hammond MS2. See Hammond (nd = MS2).

Hammond. See Hammond (nd = 1933).

Johnston. In his book, Johnston (1962) cites notes written by his cousin A.F. Clifton (1857–1948). These relate to the Australind area.

Curr. Edward Curr (1820–1899), a squatter who lived in various parts of eastern Australia before finally settling in Victoria in 1862, distributed standardized lists of English words to settlers across Australia and sought the equivalent local Aboriginal words. These lists were published in four volumes (Curr 1886).

Isaacs. Sam Isaacs (1845–1920) had an Aboriginal mother and lived near Margaret River. Frederick Slade Brockman (1857–1917) was a surveyor, who had married Grace Bussell in 1882. See Isaacs (nd).

Haddleton. Job Francis Haddleton (1879–1958) lived near Katanning on a farm selected by his father in 1864. His book (Haddleton 1952) includes valuable notes on the mammal species of the Katanning district.

Helms. Richard Helms (1858–1914). Attached to the Elder Expedition of 1891–92 as naturalist, he collected many Aboriginal words (Helms 1896), of which the only ones relevant to this paper come from Fraser Range and ‘Yaurigabbi’ (=Yoweragabbie, south-west of Mt Magnet). He also provides a word-list of Aborigines ‘living round the south-western coast of Western Australia, mainly obtained through the assistance of C.A. Paterson...at Perth’.

Wells. Lawrence Wells (1860–1938), surveyor for the Elder Expedition, collected a few Aboriginal words (Wells 1893).

Markey. Thomas Markey (1863–1956), farmer of Toodyay, compiled two lists of Aboriginal words (Markey 1942), presumably from the Toodyay area.

Hassell, Ed. See Hassell, Ednie (nd). Edney [Edmund Arthur] Hassell (1881–1950) was a son of Ethel Hassell (Hassell 1975). This list appears to come from the south-west capes region.

Hassell, E.A. The identity of this person is uncertain. It could refer to Edith Annabelle Hassell (b. c. 1872) or Edmund Arthur Hassell (1881–1950), with the latter more likely. The provenance of these words (Hassell, E.A nd) appears to be the Jerramungup region. Note that this list was incorrectly attributed to an A.A. Hassell by Bindon and Chadwick (1992), who tentatively dated it at 1894. The manuscripts are very difficult to decipher, as the words in the lists have not been written carefully. Words in Acc. No. 436A/5a in Battye Library are stated to relate to Gairdner, Fitzgerald and Pallinup Rivers.

Drake-Brockman. Geoffrey Drake-Brockman (1885–1977) mentions in his book (1960) that as a child he stayed with his Bussell aunts at Burnside and Ellenbrook.

Leake. Bruce Leake (1880–1962) lived on part of a pastoral station established by his father in 1868 at Mooranoppin near Kellerberrin, before establishing his own farm at Woolundra, also near Kellerberrin (Leake 1962).

Buller-Murphy. Deborah Buller-Murphy (1887–1965) was descended from the Bussell and Drake-Brockman families, and had acquired words from Noongars at Busselton, Wallcliffe and Burnside. In c. 1957 she compiled a dictionary, which remains unpublished (Buller-Murphy nd). In Acc. No. 1648A/6 in Battye Library, she noted that Aboriginal legends were told to her as a child by her mother. She also acknowledged A.J. Bussell as the source of words in her dictionary.

Colonial Secretary. These lists, evidently prepared by officers (?police) of the WA Government, were published by the Colonial Secretary (1903, 1904). In many cases names listed could not be used here because no provenances are given.

Bates. Daisy Bates (1863–1951) was appointed by the WA Government in 1904 to gather information about Aborigines in WA. She distributed 500 blank vocabularies to postmasters, police, station owners and other settlers across WA (White 1985, Bates nd). She left WA in 1912. In some cases I have listed specific localities instead of the Magisterial District (abbreviated MD in the table); however, many of the localities cannot now be traced (G. Hoare<sup>1</sup>, personal communication). I have gleaned the following information from Bates' records: Bwokunbup Hill and Boogerup [Kendenup] are within the Albany MD; Korrlup is 50 miles [80 km] NW of Jerramungup, Karadup is in Pinjarra MD; Wergejan [Beverley] is in York MD; Woorurdup is in Swan MD; and Wilgahmala [Berkshire Valley] and Nyerrgoo [30 miles [48 km] NE of Mogumber] are in Victoria Plains MD. Caution needs to be exercised in interpreting her lists, as by the early 1900s many full-blood Aborigines had relocated away from their tribal areas. Thus some words supplied by them may have related to their previous tribal areas rather than their location in 1904.

The blank 97-page vocabulary booklet (*Instructions for filling in particulars concerning the language, customs, and habits of the Aboriginal natives of Western Australia*) was issued under the Authority of M.A.C. Fraser, Government Statistician, and published by the Government Printer. In a two-page introduction it requested, opposite each English word listed, 'the equivalent word or words in the dialect spoken by the Aboriginal Natives of the immediate neighbourhood'. Pages 11–13 consist of a list of names of mammals, among which those relevant to this paper are: ant-eater (marsupial), bandicoot, cat (native), dingo, dormouse, hedgehog, kangaroo (blue), kangaroo (brush), kangaroo rat, kangaroo rat (brush-tailed), kangaroo (red), kangaroo (rock), mouse (pouched), opossum, opossum (ring-tailed), porcupine, rat (water), squirrel (grey), wallaby (banded), wallaby (rock) and wallaby (speckled-hair). For several widespread species I have included names from outside the south-west in order to provide context.

Bates 1913 and 1914. See Bates (1913) and Bates (1914) respectively.

Rac. William John Rac (?1872–1917) arrived in WA in the late 1890s and was a surveyor at Geraldton and later at Albany. The provenance of the names collected by him (Rac 1913) appears to be the Albany region.

Muir, A.G. This presumably refers to Andrew Gordon Muir (1867–1943), farmer at Mordalup. S.W. Jackson obtained Aboriginal words from him after a chance meeting at Deep River in 1912 (Abbott 1998).

Davis. Jack Leonard Davis (1917–2000) was a Noongar poet (Davis nd).

Le Soeuf and Burrell. Le Soeuf and Burrell (1926) attempted to summarize information about the mammals of Australia and New Guinea.

Anon (1928). See Anon (1928).

Scott. Lew Scott (personal communication 1999) was born in 1920 and lived and farmed near the lower Donnelly River.

Roberts. Vic Roberts (personal communication 1999) was born in 1920 and has lived and farmed at Scott River and the lower Blackwood River.

Atkins. W.H. Atkins (1918–1988) was a cleric who lived at Gnowangerup but travelled widely in the south-west of WA (Douglas 1991).

Troughton. Troughton (1967) was the last of many editions of a popular book (first published 1941) about mammals in Australia. In this book (p. 190) he mentions visiting the celebrated collector John Tunney in 1921, possibly the source of some of his Noongar words.

Spencer. See Spencer (1966).

Schorer. See Schorer (1968).

Ride. Ride (1970) was an important book synthesizing old and new information about the mammals of Australia.

Erickson. The Noongar names cited by Erickson (1974) appear to have been taken from otherwise unpublished diaries of early colonists of the Toodyay district.

de Burgh. See de Burgh (1976).

Coyne. Coyne (1980) provides a list of words from the Albany region.

Udell. See Udell (1980).

Gray. See Gray (nd).

Ramson. See Ramson (1988).

Whitehurst. See Whitehurst (1992).

Brooks and Ritchie. See Brooks and Ritchie (1994).

Winmar. See Winmar (1996).

## SPELLING, CAPITALIZATION AND PRONUNCIATION OF NOONGAR NAMES

After analysis and grouping of these records, I have spelt the resulting names on the basis of the rules given by Whitehurst (1992). More esoteric and sophisticated

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phonetic systems have been employed by the linguists Douglas (1976, 1991) and Von Brandenstein (1988). In order to encourage mammalogists to pronounce Noongar words correctly, I include in Table 1 information from Whitehurst (1992). The use of retroflex sounds has generally been avoided, as the simpler spelling and pronunciation should encourage wider use of Noongar names.

All of the names listed (Table 2) adhere to the spelling, syllables (if marked) and capitalization given in the original. Bates was not always consistent in capitalizing words, so I have capitalized all words provided by her. In Tables 2 and 3, KGS refers to the region around King George Sound, centred on Albany. Where several Noongar names are available, the one preferred by me is listed first (right column). This preference is based on a combination of criteria, *viz.* widespread use by Aborigines in south-west WA, few syllables, euphony and sonority, and ease of pronunciation. Clearly, it is not possible to maximize these attributes simultaneously. The selected name is offered as a basis for consideration by Noongars, mammalogists, and others. In the left column of Table 2 are current Latin and common names taken from a list maintained by A.A. Burbidge of the Department of Conservation and Land Management. Aboriginal names that do not appear to be Noongar are enclosed in braces.

## RESULTS

Approximately 1100 records of Noongar names for native mammal species were discovered (Table 2). Reliable names, based on those recorded by Gilbert and Shortridge, were found for 39 species. I tentatively attributed names to three other species (*Sminthopsis granulipes*, *S. crassicaudata*, *Rattus tunneyi*) on the basis of geographic range (in the case of *Sminthopsis* in which *S. murina* has been subdivided into three species [Kitchener *et al.* 1984]). For eight other species (*Dasyercus cristicauda*, *Antechinomys laniger*, *Macropus rufus*, *Leporillus apicalis*, *Notomys alexis*, *Pseudomys hermannsburgensis*, *P. occidentalis* and *P. shortridgei*), no Noongar names were discovered in the sources searched. This is not surprising, as all but *P. occidentalis* and *P. shortridgei* occur marginally in the geographic range of Noongars as indicated in Figure 1.

The few names discovered of non-terrestrial mammals are listed in Table 3.

## DISCUSSION

For most mammal species present in south-west WA, ample records of Noongar names exist. Which of the names presented in this paper should be adopted for general use is left for the appropriate authorities to decide; however, brevity, euphony and practicality are likely to be important factors in making this choice. Whether Noongar names in current use, but spelled differently from the rules provided by Whitehurst (1992), should be altered is an issue requiring discussion. It seems clear that a more

correct orthography would facilitate more accurate pronunciation. Wambenger and Noolbenger should be written *wambenga* and *ngooboongor* so that the *ng* is not voiced, and *noombat* will result in the correct pronunciation and not the erroneous 'Numb-bat' in use at present.

It needs to be emphasized that many of the Noongar names listed for the same species are equally valid, with the various names applicable to different parts of south-west WA. For example, as noted by Moore (1884) and others, many words from King George Sound are shortened by elimination of the final syllable (thus *balat/balawa*, *kwend/kwenda*, *ngoor/ngwayir*, *wol/woli*, *kwa/kwara*, *doot/dooda*). Other species had quite different regional names. Examples include *Dasyurus geoffroii* (Vasse; Albany and southern wheatbelt; Swan Coastal Plain and northern wheatbelt); *Parantechinus apicalis* (Perth area; northern Swan Coastal Plain and northern wheatbelt; southern region); *Antechinus flavipes* (Albany region; rest of south-west); *Phascogale tapoatafa* (Vasse; Perth area; northern wheatbelt; southern wheatbelt; southern region); *Myrmecobius fasciatus* (Kojonup, Albany and Jerramungup; rest of south-west); *Perameles bougainville* (Albany region; rest of south-west); *Cercatetus concinnus* (south-west capes; rest of south-west); *Pseudocheirus occidentalis* (Beverley, East of Katanning, Jerramungup and Bremer Bay; rest of south-west); *Tarsipes rostratus* (Perth area; Albany area); *Macropus eugenii* (Margaret River, Vasse and Scott River; rest of south-west); *Petrogale lateralis* (northern wheatbelt; southern wheatbelt); *Setonix brachyurus* (southern areas; northern areas); *Notomys mitchellii* and *Pseudomys albocinereus* (Perth; Moore River); and *Hydromys chrysogaster* (Perth; Vasse; Albany; Beverley and Jerramungup).

Eight wide-ranging species appear to have had invariant names across the south-west. These names are *nyingarn* [*Tachyglossus aculeatus*], *djakat* [*Macrotis lagotis*], *koomal* [*Trichosurus vulpecula*], *boodi* [*Bettongia lesueur*], *woorap* [*Lagorchestes hirsutus*], *yongka* [*Macropus fuliginosus*], *worong* [*Onychogalea lunata*] and *manang* [*Lagostrophus fasciatus*].

The general conclusion that emerges from the above comparisons is that there is seldom an obvious linkage of names to tribal boundaries, as mapped by Tindale (1974). The clearest is the Wadandi tribe near the south-west capes and Vasse, with a distinct subset of names for several species (*ngooldjant* [*Dasyurus geoffroii*], *wambenga* [*Phascogale* sp. n.], *donat* [*Sminthopsis griseoventer*], *nyeranit* [*Cercatetus concinnus*], *bonin* [*Macropus eugenii*], *ngangaritj* [*Hydromys chrysogaster*]).

The scope for error in recording Aboriginal names is very great (e.g. Hasluck 1977, p. 207; Burbidge and Fuller 1990), with the language barrier the most obvious factor, particularly how the sound heard by Europeans was converted to an anglicized spelling (cf. Tench 1793, pp. 21, 122; Winnecke 1897, p. 40). Next is whether the European asked questions clearly. The Aborigine may have supplied a name for the species, or the part of the animal being pointed at by the European. Third, the Aborigine may not

have distinguished certain small species, e.g. rodents (cf. Tench 1793, p. 10; Oldfield 1865, pp. 255–256). Finally, the Aborigine may have said the equivalent of ‘I don’t know’ or guessed at the name. Scanning the tabulation presented in this paper, particularly those species for which a wealth of Aboriginal names have been recorded, the reader will notice some names which do not resemble the other names listed. Examples include *wyalung*, *nyeranit*, *moilyer*, *wurak*, *beango* and *muritya*. The veracity of such names is thus difficult to confirm.

The names recorded by Gilbert from Moore River and Toodyay districts should be regarded as the most accurate. This is because Gilbert was often accompanied in these localities by Johnston Drummond (1820–1845), whom Gilbert praised thus: ‘This young Man knows almost every production of the colony, most fortunately I have tried him in many instances, & invariably found his descriptions (most minute in particulars) agreeing perfectly with my own observations’ (Wagstaffe and Rutherford 1954). Drummond associated readily with Aborigines and spoke their language fluently (Erickson 1969).

The list is known to contain some errors. Gilbert records *mardo* for *Antechinus flavipes* and *Notomys macrotis*, presumably on the basis of different species concepts of, or possibly an error in identification by, his Noongar aides. Some names published by Gould (1863) are based on inaccurate deciphering of Gilbert’s generally clearly-written notes. Many erroneous spellings published by Wagstaffe and Rutherford (1954, 1955) are based on inaccurate copies of Gilbert’s letters apparently made by Lord Derby’s amanuensis.

Names collected in the 1830s, 1840s, and 1850s are least likely to have been contaminated by movement of Aborigines. As European settlement expanded and consolidated in the 1860s, Aboriginal society rapidly disintegrated, and many displaced Aborigines associated with shepherds and became casually involved in other farm activities, eventually drifting into Government camps. Some words may then have spread more widely (cf. Oldfield 1865, pp. 289–290; Bates 1992, p.101).

Several ‘left-over’ Noongar names have been tentatively attributed, by a process of elimination, to species on the basis of their geographical range. Brackets have been used to indicate such interpretations. A few names could not be linked to any species with confidence, including N-anip, east of New Norcia, described as ‘Specie piccolo di Kangarù’ (Salvado 1851) and Puri, east of New Norcia, described tersely as ‘Specie di Kangarù’. Note, however, that Moore (1884) defines ‘Ngannip’ as a joey. Hassell, E.A. (nd) also noted Kaibung (‘red rock possum’).

Some of the lists discovered provided names for male and female of the most conspicuous species. Those for *Macropus fuliginosus* show a high degree of consistency between lists. In contrast, the names recorded for male and female *Canis lupus* are frequently contradictory.

Noongar names for some mammal species have persisted in general use as locality names, such as towns, suburbs, pastoral stations or railway sidings. Examples include Ninghan, Quindalup, Gwindinup, Noggerup,

Goomalling, Watheroo, Ongerup, Warriup, Yoongarillup, Quairading, Kwobrup, Kendenup, Bokal, Quagamirup Brook and Spring, Boranup, Dwarda, Twertup, Mokine and Mount Yokine. Hassell, E.A. (nd) lists many localities derived from mammal names; few of these are listed in the DOLA database. The name *dunnart* has been generalized by mammalogists as a common name for all species in the genus *Sminthopsis*.

The northern and eastern boundaries of the Noongar language have been vaguely described in the anthropological literature. Bates (1914) stated that the approximate northern and eastern limits were Gingin and Esperance respectively. In her newspaper articles the northern boundary was given as between Dongara and Geraldton or near Jurien Bay, and the eastern limit was stated as east of Esperance (Bates 1992). Douglas (1976) treated the northern boundary (at least at the time of his research) as approximating a line joining Geraldton – Mt Magnet – Kalgoorlie – Esperance, whereas Thieberger (1987) set the limits closer to Jurien – north of Southern Cross – east of Esperance. Some of the names of widespread mammal species recorded here may help define these limits more precisely. Some Aboriginal names from the deserts of WA for *Trichosurus vulpecula* and *Canis lupus* (Burbidge *et al.* 1988) indicate a close resemblance with names recorded in this paper from near Geraldton and Carnamah. Names recorded for *Macropus fuliginosus* from Geraldton and Bremer Bay–Esperance seem to represent a penetration of non-Noongar names from Murchison, Northampton and the Goldfields into the south-west. Caution is necessary, however, as one Noongar name of *Dasyurus geoffroii* bears a close similarity with one name for this species widely used in the WA deserts (see Burbidge *et al.* 1988).

Attitudes of mammalogists to using Aboriginal names do not appear to demonstrate consistency in usage. Anon (1928) made extensive use of Noongar names, but retained the following English names: Pig-footed Bandicoot, Grey Kangaroo, Brush, Rock Wallaby, Ring-tail, Fat-tailed Dunnart, Echidna, Honey Mouse and Possum. Troughton (1967, pp. 31, 44) thought that the Noongar names *chuditch* and *wambenger* were unsuitable for species with such broad geographical ranges. Ride (1970) preferred the use of Noongar names, perhaps following Anon (1928), for 10 species. Strahan (1981) regarded efforts to popularize Aboriginal names as an attempt to resurrect forgotten names. This perspective is incorrect when applied to south-west WA, where there is remarkable continuity in use of many Noongar names for native mammal species. Subsequently, Strahan (1983) appeared to adhere to the view that only one correct common name exists, attributing confusion to ‘ignorance and local loyalties’. Only four Noongar names were approved as common names, and two of these were given in bastardized form (Strahan 1995). My view is that the quest for one vernacular name for each species is an unnecessary duplication of the role of Latin binomials. In Europe, for example, each nation has its own vernacular name for each species of mammal, and no one common name is regarded as more correct or fundamental than another.

Providing Noongar names for mammal species as accurately as possible is only the first stage in facilitating their general use. The next step is learning to pronounce the names as correctly as possible.

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TABLE 1

Pronunciation and spelling of Noongar words (after Whitehurst 1992).

Air stream from lungs:	Labial: Lip sounds	Dental: Tip of tongue placed against teeth	Alveolar: Tip of tongue placed on hard palate	Retroflex: Tip of tongue placed towards rear of hard palate	Velar: Back of tongue placed on soft palate
Stopped by lips or tongue	<b>b-</b> <b>-b-</b> <b>-p</b>	<b>dj-</b> <b>-dj-</b> <b>-tj</b>	<b>d-</b> <b>-d-</b> <b>-t</b>	<b>-rd-</b> <b>-rt</b>	<b>k-</b> <b>-k</b>
By-passed through nose	<b>m</b>	<b>ny</b>	<b>n</b>	<b>-rn-</b> <b>-rn</b>	<b>ng</b>
Escapes over the sides of tongue		<b>-ly-</b> <b>-ly</b>	<b>l</b>	<b>-rl-</b> <b>-rl</b>	
Passes over centre of tongue			<b>-rr-</b> <b>-rr</b>	<b>r</b>	
Passes freely through mouth	<b>w</b>		<b>y</b>		
Not stopped (vowels)	<b>i</b>	<b>e</b>	<b>a</b>	<b>o</b>	<b>oo</b>

Notes: A letter followed by a hyphen signifies that the letter is used only to begin a word; a letter preceded by a hyphen signifies that the letter is used only to end a word; and a letter preceded and followed by a hyphen signifies that the letter is used only in the middle of a word.

Consonants and vowels are generally pronounced as in English; but note particularly: *a* (as in media); *b* (spit); *d* (stall); *dj* (dew); *i* (hit); *k* (skill); *ng* (singer, not finger); *ny* (onion); *o* (law); *oo* (book); *p* (spill); *r* (rake); *rr* (sporrán).

Emphasis is on the first syllable.

TABLE 2

List of Noongar names for mammal species.

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
<b>TACHYGLOSSIDAE</b>		
<b><i>Tachyglossus aculeatus</i></b> Echidna	Gilbert MS: Dun-ung-er-de (Guildford, Toodyay), Ngoong-arn (York). MS2 has the variant: Dun-ung-er-de (Toodyay district)  Gilbert in Gould: Dun-ung-erde (Toodyay, Guildford districts), Nyoong-arn (York district)  Shortridge: Ningan  Bates: Gwing'un (Murchison area), Ning na an (New Norcia), Nyeeng-arn (Wilgahmala), Nyingarn (Carnamah, Nyerrgoo, York MD, Meckering, Mardangoora, East of Katanning, Coolgardie MD, West of Menzies); Nyingan, Nyingain (Dandaragan)  Bates 1913: Eelyingarra (Dongara)  Davis: Nyingarn  Markey: Ninghan  Whitehurst: nyingarn  Winmar: ningarn	nyingarn [ny'ing'arn]  donongerde [don'ong'er'de]
<b>DASYURIDAE</b>		
<b><i>Dasyurus cristicauda</i></b> Mulgara		
Threatened		
Species occurred outside the itinerary of Gilbert		
<b><i>Dasyurus geoffroi</i></b> Chuditch	Gilbert MS: Bur-jad-da (Perth), Bar-ra-jit (mountain districts), Ngoor-ja-na (Vasse). MS2 has the variants: Bar-ra-jit (York	djooditj [djoo'ditj]  ngooldjangit [ngool'djang'it]
Threatened		

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
Newly endemic to WA through extinction in other parts of its geographic range in Australia	and Toodyay district); Dju-tytch (KGS)	badjada [ba'dja'da]
	Gilbert in Gould: Bur-jad-da (Perth), Bar-ra-jit (York and Toodyay districts), Ngoor-ja-na (Vasse), Dju-tytch (KGS)	
	Gilbert in Whittell: Dju-tytche (KGS)	
	Shortridge: Chuditch (Beverley), Gnuljargneet (Beverley), Barry-git (Moore R), Chudich	
	Moore: Barjadda, Barrajit	
	Oldfield: {Tin-do-kat}	
	Hassell, E.: chudic	
	Bussell: Ngoolarngeat	
	Isaacs: Ngwool-jarn-ee, Ngwool-jarn-eet	
	Hassell, Ed.: ngoolgarngeat	
	Hassell, E.A.: chutic	
	Buller-Murphy: Ngoolgarngeat	
	Colonial Secretary: Cuttish (Beverley sub-district)	
	Bates: Bajarda (East of Laverton), Bajjarda (Murrum MD), Bajjat (Norseman MD), Balgart, Baljeerda (Murchison area), Barjert (Guildford & Perth area); Baljerda (Dandaragan), Balyart (Woorurdup); Barajeert (Nyerrgoo), Barjot (Northam), Barrjat, Barrjet (Gingin); Barjeerde (Pinjarra MD), Barjerda (Carnamah), Barrjeet (Wonnerup & Capel Districts), Barrjerda (Wilgahmala, Mardangoora), Chudich (Jerramungup), Jooteetch (Bridgetown MD, Kojonup,	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	<p>East of Katanning, Korrlup, Bremer Bay – Esperance), Joodeetch (Williams MD, Albany MD), Jootitch (Meckering, Wergejan, Albany MD), Ner-gup (Busselton), Ngoorjangin (Vasse MD), Ngoorjangit (Wonnerup &amp; Capel Districts), {Parjerda (West of Menzies)}</p> <p>Rae: Chutikk</p> <p>Davis: Choorditch</p> <p>Anon 1928: Chuditch</p> <p>Roberts: Chuditch</p> <p>Atkins: tjunik, djunik, djudik</p> <p>Troughton: Chuditch</p> <p>Ride: Chuditch</p> <p>de Burgh: barrajuck</p> <p>Gray: Choodich</p> <p>Brooks &amp; Ritchie: chuditch, judij</p> <p>Winmar: choorditch</p>	
<p><b><i>Parantechinus apicalis</i></b> Dibbler</p> <p>Threatened</p> <p>Endemic to WA</p>	<p>Gilbert MS: Marn-dern (Moore R), Wy-a-lung (Perth), Dib-bler (KGS)</p> <p>Gilbert in Gould: Marn-dern (Moore R), Wy-a-lung (Perth), Dib-bler (KGS)</p> <p>Gilbert in Wagstaffe &amp; Rutherford: Mara-dera (Moore R)</p> <p>Grey: Ma-doon</p> <p>Moore: Madun</p> <p>Bates: Matoon (Gingin), Matoon (Gingin), Mordurn (Wergejan, Meckering)</p>	<p>dibla [dib'la]</p> <p>madoon [mad'oon]</p>

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]	
<b><i>Antechinus flavipes</i></b> Mardo	Anon 1928: Dibbler		
	Troughton: Dibbler		
	Ride: Dibbler		
	Brooks & Ritchie: dibala?, dibbler		
	Gilbert MS: Mar-do (Moore R), Man-durt (Perth), Tum-mart (KGS)	mado [ma'do]	domat [dom'at]
	Gilbert in Wagstaffe & Rutherford: Mar-do (Moore R)		
	Shortridge: Mordar (Margaret R)		
	Grey: Mar-do		
	Symmons: Mar-do		
	Moore: Mardo		
	Bussell: Morder		
	Isaacs: Moor-da		
	Buller-Murphy: Morder		
	Colonial Secretary: Mardo (York sub-district)		
	Bates: Marda (Nyerrgoo), Mardoo (Gingin, Pinjarra MD), Morda (Nyerrgoo, Woorurdup, Guildford & Perth area, Vasse MD), Mardoor (Wonnerup & Capel Districts), Moerda (Busselton), Moorda (Busselton), Mora (New Norcia), Mota (New Norcia), Tamart (Plantagenet area), Tammart (Denmark), Tumart (Bwokunbup Hill)		
	Anon 1928: Mardo		
	Ride: Mardo		
Brooks & Ritchie: mardo			

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
<p><b><i>Phascogale calura</i></b> Red-tailed phascogale</p> <p>Threatened</p> <p>Newly endemic to WA through extinction in other parts of its geographic range in Australia</p>	<p>Gilbert MS: King-goor (Williams district). MS2 has the variant: King-goor (Williams R)</p> <p>Gilbert in Gould: King-goor (Williams R)</p>	<p>kingo [king'o]</p>
<p><b><i>Phascogale sp. nov.</i></b> Wambenger, Brush-tailed phascogale</p> <p>Newly endemic to WA because molecular techniques demonstrate that this taxon is a full species. This will necessitate a new species epithet (P. Spencer, personal communication)</p>	<p>Gilbert MS: Bul-loo-wa (York), Bal-la-ga (Perth), Bal-la-wa-ra (south of Perth), Bal-lard (KGS). MS2 has the variant: Bal-la-wa-ra (north of Perth)</p> <p>Gilbert in Gould: Bal-lard (KGS), Bul-loo-wa (York district), Bal-a-ga (Perth), Bal-la-wa-ra (north of Perth)</p> <p>Shortridge: Coming-coming (Beverley), Wambenger (Busselton)</p> <p>Grey: Bal-la-ga-ra; Bal-lard (KGS)</p> <p>Moore: Ballagar (north of Perth), Ballard (KGS), Ballawara (Perth), Bellogar</p> <p>Salvado: Moton</p> <p>Isaacs: Wam-bing-ga</p> <p>Hassell E.A.: Coming Coming</p> <p>Bates: Balagur (Woorurdup), Ballart (Bridgetown MD, Kojonup, East of Katanning), Balowaree (Pinjarra MD), Biljart (Korrlup), Guming-guming (East of Katanning), Paalgurt (Korrlup), Palatt (New Norcia), Pawallat (New Norcia), Wamburuga (Wonnerup &amp; Capel Districts), Wamburnong (Vasse MD), Wer-um-berra (Busselton)</p> <p>Rae: Kumining, Palikk</p>	<p>wambenga [wam'beng'a]</p> <p>balat [bal'at]</p> <p>balawa [bal'aw'a]</p> <p>koming koming [kom'ing kom'ing]</p>

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Anon 1928: Wambenger	
	Roberts: Wambenger	
	Troughton: Wambenger	
	Ramson: wambanong	
	Brooks & Ritchie: wambanang?, wambenger	
<b><i>Antechinomys laniger</i></b>		
Kultarr		
Species occurred outside the itinerary of Gilbert		
<b><i>Sminthopsis crassicaudata</i></b> Fat-tailed dunnart	Hassell, E.A.: Gnudar [Note: name attributed tentatively to this species. Hassell called it the fat-tailed mouse]	ngooda [ngoo'da]
No Noongar name was recorded by Gilbert – the only specimen obtained was captured by a domestic cat		
<b><i>Sminthopsis dolichura</i></b> Little long-tailed dunnart		
<b><i>Sminthopsis gilberti</i></b> Gilbert's dunnart		
Endemic to WA		
<b><i>Sminthopsis granulipes</i></b> White-tailed dunnart	Gilbert MS: Twoor-dong (KGS) [Note: name attributed tentatively to this species]	djoordong [djoor'dong]
Endemic to WA		
	Gilbert in Gould: Twoor-dong (KGS) [Note: name attributed tentatively to this species]	
<b><i>Sminthopsis griseoventer</i></b> Grey-bellied dunnart	Gilbert MS: Dtam-in (Perth) [Note: name attributed tentatively to this species]	donat [don'at] djamin [djam'in]
Endemic to WA		
	Gilbert in Gould: Otam-in (Perth) [Note: name attributed tentatively to this species]	
	Shortridge: Dunnart (Margaret R)	
	Isaacs: Dun-nart	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Bates: Danart (Wonnerup & Capel Districts), Danarda (Wonnerup & Capel Districts), Dannart (Vasse MD)	
	Anon 1928: Dunnart	
	Ramson: danart	
<b>MYRMECOBIIDAE</b>		
<b><i>Myrmecobius fasciatus</i></b>		
Numbat	Gilbert MS: Noom-bat (York districts), Wai-hoo (KGS). MS2 has the variant: Noom-bat (York and Toodyay districts)	noombat [noom'bat] wioo [wi'oo]
Threatened		
Newly endemic to WA through extinction in other parts of its geographic range in Australia	Gilbert in Gould: Noom-bat (York and Toodyay districts), Wai-haw (KGS)	
	Gilbert in Wagstaffe & Rutherford: Wombat	
	Shortridge: Numbat	
	Moore: Numbat (York)	
	Millett: Noombat	
	Hassell, E.: weeoo	
	Haddleton: numbat	
	Hassell, E.A.: Weeou, Wee-u	
	Leake: Numbat	
	Bates: Nombat (Jerramungup), Noombat (Bridgetown MD, East of Katanning, Kojonup), Nyoombot (Gingin), Weeoo (Kojonup, Albany MD, Korrlup), Wi-u (East of Katanning)	
	Rae: wiu	
	Anon 1928: Numbat	
	Roberts: Noombart	
	Troughton: Numbat	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Spencer: nambat	
	Ride: Numbat	
	Gray: Weeu	
	Ramson: numbat	
	Whitehurst: noombat	
	Brooks & Ritchie: numbada, numbat	
<b>PERAMELIDAE</b>		
<b><i>Chaeropus ecaudatus</i></b> Kandjilpa, Pig-footed bandicoot	Gilbert MS: Bur-da (Walyemara), Wot-da (inland from York district)	boda [bo'da] woda [wo'da]
Extinct	Gilbert in Gould: Bur-da (Walzemara district), Wot-da (interior from York)	boodal [boo'dal]
	Shortridge: Buddile (Beverley)	
	Leake: Bertie	
<b><i>Isoodon obesulus</i></b> Quenda	Gilbert MS: Gwen-dee (Perth), Quoint (KGS)	kwenda [kwen'da]
	Gilbert in Gould: Gwen-dee (Perth), Quoint (KGS)	
	Shortridge: Quaint or Wait (Beverley), Queenda (Margaret R)	
	Nind: Quernd	
	Anon 1834: quoint	
	Grey: Dyin-da; Gwinda (Vasse); Koon-de; Kwendt (KGS)	
	Stokes: Condee	
	Symmons: Gwen-di	
	Moore: D-yinda, Gwende (mountain dialect), Kudi (1884), Kundi (1842)	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Salvado: Cueinde (east of New Norcia), Queinde, Quiende	
	Oldfield: {Oon-die; Woo-die (Champion Bay)}	
	Bussell: Queander	
	Hammond MS1: Kwin,der	
	Hammond MS2: Kwin-der	
	Hammond: Kwinder	
	Isaacs: Queen-da	
	Hassell, Ed.: Kwent	
	Hassell, E.A.: Quaint	
	Leake: Quenda	
	Buller-Murphy: Queander, Queender	
	Bates: Cueinde (New Norcia), Gweenda (Woorurdup, Wonnerup & Capel Districts), Gwenda (Guildford & Perth area, Woorurdup), Koondee (Carnamah, Dandaragan), Koorndee (Gingin, Pinjarra MD), Kuendy (New Norcia), Kweenda (Woorurdup, Vasse MD, Wonnerup & Capel Districts), Kwend (Denmark), Kwenda (Nyerrgoo, Meckering, Wergejan), Kwent (Williams MD, Kojonup, East of Katanning, Bridgetown MD, Plantagenet area, Denmark, Bwokunbup Hill, Albany & Denmark, Korrlup, Bremer Bay – Esperance, Esperance MD), Kwernt (East of Katanning, Boogerup), Quaint (Jerramungup), Quenda (Northam), Quinda (New Norcia), Qunadah (Blackwood), Wainda (Meckering), Weendaroo (Mardangoora), Woondie	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	(Victoria District)	
	Muir: Quaint	
	Anon 1928: Quenda	
	Roberts: Quenda	
	Ride: Quenda	
	Coyne: Quarnt	
	Gray: Querrnt	
	Whitehurst: kwenda, kwernt, kwinda	
	Brooks & Ritchie: gwernda, gwerndi, quenda	
	Winmar: kwernt	
<p><b><i>Perameles bougainville</i></b> Western barred bandicoot</p> <p>Threatened</p> <p>Newly endemic to WA through extinction in other parts of its geographic range in Australia</p>	<p>Gilbert MS: Mal-a (York districts), Mala. MS2 includes the variants: Mal-a (York and Toodyay districts), Nyem-mel (KGS)</p> <p>Gilbert in Gould: Mala, Mal-a (York, Toodyay districts); Nyem-mel (KGS)</p> <p>Gilbert in Whittell: Nyem-mel (KGS)</p> <p>Shortridge: Marl (Beverley)</p> <p>Moore: Mala</p> <p>Hassell, E. A.: Marl ('a small black animal belonging to the mole family')</p> <p>Bates: Mal (Bridgetown MD, East of Katanning), Maal (Korrlup), Marl (Kojonup)</p> <p>Anon 1928: Marl</p> <p>Troughton: Marl</p> <p>Ride: Marl</p>	<p>mal</p> <p>nymal [ny'mal]</p>

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
<b><i>Macrotis lagotis</i></b> Dalgyte, Bilby Threatened	<p>Ramson: maal</p> <p>Gilbert MS: Dal-goitch (York districts), Dalgyte. MS2 has the variant: Dol-goitch (Aborigines generally)</p> <p>Gilbert in Gould: Dol-goitch, Dal-gyte, Dal-goitch</p> <p>Gilbert in Wagstaffe &amp; Rutherford: Dalgyte</p> <p>Gould: Dalgyte</p> <p>Shortridge: Dalgyte</p> <p>Grey: Dal-gyte</p> <p>Moore: Dol-gyt</p> <p>Drummond: Dolgitch</p> <p>Austin: dalgite</p> <p>Millett: dolghite</p> <p>Forrest: dulgate</p> <p>Haddleton: dalyite</p> <p>Hassell E.A.: Yerning</p> <p>Leake: Dalgite</p> <p>Colonial Secretary: Dalges (York sub-district)</p> <p>Bates: Dalgait (Denmark, Albany &amp; Denmark), Dalgaitch (Meckering, East of Katanning)</p> <p>Anon 1928: Dalgite</p> <p>Troughton: Dalgheite, Dalgite, Dulgite</p> <p>Ride: Dalgyte</p> <p>Erickson: dalgyte</p> <p>de Burgh: dalgite</p>	djalkat [djal'kat]

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Ramson: dalgite, dalgyte	
	Whitehurst: djalkat	
	Brooks & Ritchie: dalgaj, dalgite	
<b>BURRAMYIDAE</b>		
<b><i>Cercatetus concinnus</i></b>		
Western pygmy possum	Gilbert MS: Man-dur-da (Perth)	mandada [man'dad'a] nyeranit [nyer'an'it]
	Gilbert in Gould: Man-dur-da	
	Shortridge: Nyeranit (Margaret R)	
	Grey: Mun-dar-da	
	Moore: Mandarda	
	Anon 1928: Mundarda	
	Troughton: Mundarda	
	Ride: Mundarda	
	Brooks & Ritchie: mandarda?, mundarda	
<b>PSEUDOCHIERIDAE</b>		
<b><i>Pseudocheirus occidentalis</i></b>		
Western ringtail possum	Gilbert MS: Ngo-ra (Perth), Ngorh (KGS)	ngwayir [ngway'ir] womp
Threatened	Gilbert in Gould: Ngo-ra (Perth), Ngork (KGS)	woder [wod'er]
Endemic to WA	Shortridge: Wormp (Beverley), Moilyer or Ngnuara (Margaret R)	ngoor ngoolangit [ngool'ang'it]
	Nind: Nworra	
	Grey: Ngo-ra	
	Stokes: Gnoorah	
	Moore: Ngo-ra	
	Oldfield: {G'na-cu-lu}	
	Bussell: Ngwarer	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Curr: warder (KGS)	
	Isaacs: Ngwar-ra	
	Hassell, Ed.: ngwarer	
	Hassell, E.A.: Gnoou? [illeg.]; Wamp (Pallinup R & branches)	
	Buller-Murphy: Ngwarer	
	Colonial Secretary: Ngea (Esperance Station)	
	Bates: Gnar (Albany), Gnwurr reh (New Norcia), Gwarra (Northam), Ngoora (Carnamah, Wilgahmala, Pinjarra MD, Wonnerup & Capel Districts, East of Katanning, Korrlup), Ngoora (East of Katanning), Ngoora mooarn (Pinjarra MD), Ngoorra (Dandaragan), Ngwar (Plantagenet area), Ngwarr (Bridgetown MD, East of Katanning, Denmark, Bwokunbup Hill), Ngwaar wamp (Bwokunbup Hill), Ngwarra (Nyerrgoo, Woorurdup, Mardangoora, Meckering, Wergejan, Williams MD, Vasse MD), Ngwarra moorn (Guildford & Perth), Ngworra (Woorurdup), Nuarra (Blackwood), N'warra (Busselton), Nyoorndee (Gingin), Waamp (Korrlup), Waamp (Bremer Bay – Esperance), Wamp (East of Katanning, Boogerup, Bwokunbup Hill, Plantagenet area), Wardar (Boogerup, Bremer Bay – Esperance), Warder (Boogerup)	
	Rae: Wawding?	
	Davis: Ngwirr	
	Roberts: Worra	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Whitehurst: ngwayir	
<b>TARSIPEDIDAE</b>		
<b><i>Tarsipes rostratus</i></b>	Gilbert MS: Jee-pin (Perth), Ngool-boon-goor (KGS)	ngoolboongoor [ngool'boong'oor]
Honey-possum		
Endemic to WA	Gilbert in Gould: Jee-pin (Perth), Ngool-boon-goor (KGS)	djebin [dje'bin] dat
	Grey: Ngool-boon-goor (KGS)	
	Moore: Ngul-bungar, Ngulbungur, Ngulbun-gur (KGS)	
	Drummond: Noorbanger, Tate	
	Hassell E.A.: Teat ('brown barred mouse')	
	Troughton: Ait, Deed, Noolbenger	
	Ride: Noolbenger	
	Brooks & Ritchie: ngulbungur?, noolbenger	
<b>PHALANGERIDAE</b>		
<b><i>Trichosurus vulpecula</i></b>	Gilbert MS: Goo-mal (Aborigines generally)	koomal [koo'mal]
Wayoota, Brushtail possum		
	Gilbert in Gould: Goo-mal	
	Shortridge: Koomaal, Coomul	
	Nind: Comal	
	Lyon: Goomal	
	Bunbury: Goomal	
	Grey: Ko-mal (Vasse); Koo-mal, Koor-nal	
	Stokes: Goomal	
	Symmons: Ku-mal	
	Moore: Gumal, Kumal	
	Smyth: koomal	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Salvado: Kumal	
	Salvado in Curr: cumal (male); cular (female)	
	Oldfield: {We-urda, We-zue- da}	
	Ranford: Coomal	
	Hassell, E.: coomal	
	Bussell: Coomarl	
	Hammond MS1: Koomahl	
	Hammond MS2: Koom-mahl	
	Hammond: Koomahl	
	Johnston: goomall	
	Curr: coomal (York); goomal (Perth, Lower Blackwood); goomul (Harvey); gumell (Blackwood); koomal (Victoria Plains, Toodyay, Pinjarra, Kojonup & Etipup, Bunbury, Geographe Bay & Vasse, Blackwood, Mt Stirling, KGS, Kent); kommale (Northampton); koomul (York), {yoorda (Shark Bay), weurda (mouth of Murchison R), waiada (Champion Bay), widdra (Irwin and Murchison Rivers)}	
	Isaccs: Ku-marl; Ku-marl- Mouarn [black]	
	Helms: Gumal	
	Wells: {Waiadu (Yarragabbie Station)}	
	Hassell, Ed.: coomarl	
	Hassell, E.A.: Comel, Comil (Pallinup R & branches); Mouin Comel [black]	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Buller-Murphy: Coomarl, Koomarl	
	Colonial Secretary: Coomal (Wagin), Coomel (Esperance Station), Cumnel (Beverley sub-district)	
	Bates: Comal (Blackwood), Cular (female) (New Norcia); Cumal (male) (New Norcia); Goomal (Murchison MD, Carnamah, Dandaragan, Wilgahmala, Nyerrgoo, Gingin, Guildford & Perth, Woorurdup, Pinjarra MD, Mardangoora, Wergejan, Meckering, Williams MD, Bridgetown MD, East of Katanning, Vasse MD, Wonnerup & Capel Districts, Denmark, Bwokunbup Hill, Boogerup, Ravensthorpe MD, Bremer Bay – Esperance, Eucla MD), Goomal mowern (black, Gingin), Goomul (Albany MD), Gumal (Albany, Albany & Denmark, Plantagenet area), Gwoom-mall (Northam), Kaimal (Korrlup), Komil (Jerramungup), Koomal (Murchison area, Korrlup), Koom-arl (Busselton), Kumull (New Norcia), {Waiooraa (Victoria District), Waiooraa (Carnamah, Dongara MD), Waloorda (Northampton MD)}	
	Davis: Coomal	
	Scott: Koomal	
	Roberts: Worrán (male), Koomarl (female)	
	Atkins: kawmriil	
	Schorer: Kumarl	
	Erickson: kumarl	
	Gray: Coomal	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Whitehurst: kelang (male); koomal, koomool (female)	
	Brooks & Ritchie: gumal, kumarl	
	Winmar: coomarl	
<b>POTOROIDAE</b>		
<b><i>Bettongia lesueur</i></b>		
Boodie	Gilbert MS: Boor-dee (interior). MS2 has the variant: (mountain districts)	boo'di
Threatened		
Newly endemic to WA through extinction in other parts of its geographic range in Australia	Gilbert in Gould: Boor-dee, Boordee	
	Gilbert in Wagstaffe & Rutherford: Boor-da, Boor-dea	
	Gould: Boodee	
	Shortridge: Boodee	
	Moore: Burdi	
	Drummond: Boordi, Burdit	
	Millett: boody	
	Hassell, E.: boodie	
	Haddleton: boodie	
	Hassell, E.A.: Boudie	
	Leake: Boodie	
	Bates: Boodee (Wergejan), Boordee (Nyerrgoo), Burdaree (Korrlup), Burdia (Israelite Bay MD, Eucla MD)	
	Anon 1928: Boodie	
	Roberts: Boodie	
	Ride: Boodie	
	Erickson: boordie, boordy	
	Ramson: boodie, boody	
	Brooks & Ritchie: boodie,	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
<p><b><i>Bettongia penicillata</i></b> Woylie</p> <p>Newly endemic to WA through extinction in other parts of its geographic range in Australia</p>	burdi	woli [wo'li]
	Gilbert MS: Wal-ya (Perth, mountain districts), Woile (KGS)	wol
	Gilbert in Gould: Wal-ya (Perth, mountain district), Woile (KGS)	
	Gilbert in Wagstaffe & Rutherford: Wal-ga	
	Shortridge: Woylyer, Woyre	
	Nind: Wahl	
	Anon 1834: wo-ail	
	Bunbury: Wullioo	
	Grey: Wal-li-ow; Woile (KGS); Wol-lya (Vasse)	
	Stokes: Wallyo	
	Symmons: Wal-yo	
	Moore: Wal-yo; Woi-le? (KGS)	
	Salvado: uaglio (east of New Norcia)	
	Oldfield: {Wath-u; Wat-tho (Champion Bay)}	
	Hassell, E.: waige	
	Bussell: Walyer	
	Hammond MS1: Wahl,ya	
	Hammond MS2: Wah-lya	
	Hammond: Wahlya	
	Isaacs: Wol-ya	
Helms: Wallin		
Hassell, Ed.: walyer		
Hassell, E.A.: Woyil		

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	(Fitzgerald R & branches), Woyle	
	Leake: Woilie	
	Buller-Murphy: Walyer	
	Colonial Secretary: Walye (Toodyay sub-district)	
	Bates: {Waadhoo (Dandaragan), Wadhoo (Carnamah, Wilgahmala)}, Wail (Kojonup), Wal (Plantagenet area, Bwokunbup Hill, Korrlup, Bremer Bay – Esperance), {Waldhoo (near Balladonia)}, Wal'u (Israelite Bay MD), Walya (Guildford & Perth, Woorurdup, Meckering, Mardangoora, Williams MD, Blackwood, Vasse MD, Wonnerup & Capel Districts), Walye (Wergejan, Williams MD), Wal-yer (Busselton), Walyoo (Gingin, Pinjarra MD), {Warhoo (Mardangoora)}, Wawilyu (New Norcia), Wohle (Jerramungup), Woil (Bridgetown MD, Plantagenet area), Wo'il (East of Katanning, Boogerup), Wol (Bridgetown MD, East of Katanning), Wollue (Northam), Wol-yer (Busselton), Woolil (Kojonup)	
	Rae: Woil?	
	Anon 1928: Woile	
	Roberts: Wolya	
	Atkins: wawly	
	Schorer: Dwolg	
	Troughton: Woile, Woyre	
	Ride: Woylie	
	Ramson: woylie, woilie	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Brooks & Ritchie: walyu, woylie	
	Winmar: woylj	
<b><i>Potorous platyops</i></b> Broad-faced potoroo	Gilbert MS: Mor-da (interior)	moda [mo'da]
Extinct	Drummond: Mort	
Endemic to WA	Hassell E.A.: Mort ('kind of kangaroo rat')	
	Colonial Secretary: mort (Toodyay sub-district)	
<b><i>Potorous gilbertii</i></b> Gilbert's potoroo	Gilbert MS: Ngil-gyte (KGS)	ngilkat [ngil'kat]
Threatened	Gilbert in Gould: Ngil-gyte (KGS)	
Endemic to WA	Nind: Nailoit	
	Moore: Garlgyte	
	Bates 1913: Ngilgaitch	
	Roberts: Nilgyte	
MACROPODIDAE		
<b><i>Lagorchestes hirsutus</i></b> Rufous hare-wallaby, Mala	Gilbert MS: Woo-rup (interior)	woorap [woo'rap]
Threatened	Gilbert in Gould: Woo-rup	
Newly endemic to WA through extinction (in the wild) in other parts of its geographic range in Australia	Gilbert in Wagstaffe & Rutherford: Woorap (York District)	
	Shortridge: Wurrup	
	Moore: Wurak [Note: name attributed tentatively to this species. Moore in error called it <i>Macropus elegans</i> , now called <i>Lagostrophus fasciatus</i> , and described it as a species of kangaroo]	
	Hunt: Wurup	
	Forrest: wirrup	
	Bussell: Woorark [Note: name	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
<b><i>Macropus eugenii</i></b> Tammar wallaby	attributed tentatively to this species. Bussell described it as a very scarce, small brown wallaby]	
	Leake: Wurrup	
	Buller-Murphy: Woorark [Note: name attributed tentatively to this species. She described it as a very scarce, small brown wallaby]	
	Bates: Woorark (Woorurdup), Wooraik (Wonnerup & Capel Districts) [Note: names attributed tentatively to this species]; Woorup (Woorurdup)	
	Anon 1928: Wurrup	
	Ride: Wurrup	
	Gilbert MS: Dam-a (interior)	dama [da'ma]
	Gilbert in Gould: Dama (Moore R)	bonin [bo'nin]
	Gilbert in Wagstaffe & Rutherford: Dama (Moore R)	
	Shortridge: Tammar; Bonnan (Margaret R)	
	Nind: Taamur	
	Drummond: Damar	
	Bussell: Bonnin	
	Haddleton: tommer	
	Hassell, Ed.: bonnin	
Hassell E.A.: Tama, Tamar		
Leake: Tamma		
Buller-Murphy: Bonnin		
Colonial Secretary: tamar (Northam sub-district)		

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
<b><i>Macropus fuliginosus</i></b> Western grey kangaroo	<p>Bates: Bonnin (Vasse MD), Dammur (Murchison MD), Tamar (Plantagenet area), Tammar (Guildford &amp; Perth, Wegejan, Denmark, Bwokunbup Hill, Bremer Bay – Esperance),</p> <p>Rae: Tamma</p> <p>Le Soeuf &amp; Burrell: Dama</p> <p>Anon 1928: Tammar</p> <p>Roberts: Bonin</p> <p>Atkins: tamar</p> <p>Spencer: tamar</p> <p>Troughton: Tammar</p> <p>Ride: Tammar</p> <p>Coyne: Tarmer [male or female]</p> <p>Ramson: tammar, tamar; formerly dama, damar, tamma</p> <p>Brooks &amp; Ritchie: damar, tammar</p> <p>Gilbert MS: Yoon-gur (male), Work (female) (Aborigines generally)</p> <p>Gilbert in Gould: Yoon-gur (male), Work (female)</p> <p>Gilbert in Wagstaffe &amp; Rutherford: Yoon-gaw (male), Work (female)</p> <p>Shortridge: Eonga (male), Woyre (female), Eowit (Moore R), Yongure (male)</p> <p>King: Be-ango</p> <p>Nind: Yungur (male), Warre (female)</p>	<p>yongka [yong'ka]</p> <p>(yongka – male; wok or wor – female)</p>

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Wilson: Worr	
	Lyon: Yawart (male), Waroo	
	Bunbury: Yowert (male), Waroo (female)	
	Grey: Yun-gore; Yow-art (male), War-roo (female); Woor-ra (female) (Vasse); Worr (female) (KGS)	
	Stokes: Yewart; Waroo (female)	
	Moore: Yangor (kangaroo species in general; male in mountain dialect); Yowart (male); Kubit (male, Murray and Serpentine Rivers)	
	Yangornanga (female, Murray and Serpentine Rivers); Warru (female)	
	Symmons: Yun-gor; Yow-art (male); War-ru (female)	
	Brady: Yangor	
	Salvado: longor (male) (east of New Norcia); Uoro (female) (east of New Norcia); Uaro (female) (north of New Norcia)	
	Salvado in Curr: yongar (male); wora (female)	
	Oldfield: {Yow-aa-da; Jim-aa (male), Yo-e-do-bat (female); Yow-ad-do (Champion Bay)}	
	Ranford: Yonker	
	Hassell, E.: yongah, youngar, younger	
	Bussell: Yongher	
	Hammond MS1: N,yong,er	
	Hammond MS2: N-yon-ger	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Hammond: N-yonger	
	<p>Curr: yonga (Pinjarra), yongar (male) (New Norcia, Perth); yonger (male) (Kojonup &amp; Etipup, Bunbury, Geographe Bay &amp; Vasse, Lower Blackwood, Blackwood); yongor (male) (Mt Stirling); {yooada (Champion Bay), yoorda (Northampton)}; youngar (York), younger (male) (KGS); {yowada (mouth of Murchison R), yowardoo (Irwin &amp; Murchison Rivers)}; yowart (Perth), yowdar (Doubtful Island Bay to Israelite Bay); {yowerda (Shark Bay)}; yungar (Toodyay, Harvey; (male) York); yungur (Kent District), yunkera (Victoria Plains)</p>	
	<p>waar (Geographe Bay, Blackwood); wooiar (female) (Geographe Bay &amp; Vasse, Blackwood); waark (female) (KGS); wora (female) (New Norcia); wore (Blackwood); war (female) (Mt Stirling); warr (female) (York)</p>	
	<p>Isaacs: Yonga (male); Woo-ra (female)</p>	
	<p>Helms: Yauart (male), Warru (female)</p>	
	<p>Markey: Yonka (male)</p>	
	<p>Hassell, Ed.: yongher</p>	
	<p>Hassell E.A.: Yonger (Gairdner &amp; Pallinup Rivers); Wore (female)</p>	
	<p>Buller-Murphy: Yongher, Yonker</p>	
	<p>Colonial Secretary: Yonger (Toodyay &amp; Beverley sub-districts)</p>	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	<p>Bates: Yonga (Northam); Yongar (male) (New Norcia, Nyergoo, Guildford &amp; Perth, Woorurdup, Meckering, Wergejan, Williams MD, Bridgetown MD, Vasse MD, Denmark, East of Katanning, Korrlup, Bremer Bay – Esperance, Esperance MD); Yonger (Jerramungup); Yongera (Busselton); Yonggar (male) (Plantagenet); Yongur (male) (Bwokunbup Hill, Boogerup); {Yowada (Kookynie), Yow'ada (Murchison MD), Yowarda (Nyawardee near Canegrass, Carnamah, Wilgamahmala, Mardangoora, Victoria Plains); Yowardoo (Murchison area)), Yowart (male) (Gingin, Pinjarra MD); Yowdar (Doubtful Island Bay – Israelite Bay); {Yowera (Northampton MD)}, Yowerda (male) (Murchison MD, Dandaragan, Victoria District, Wonnerup &amp; Capel Districts); Yungar (Kojonup, Albany); Yungoora (Norseman District), Yungurr (Ravensthorpe MD, Israelite Bay MD)</p>	
	<p>Waaroo (Victoria Plains), War (Plantagenet area), Warhoo (Murchison MD), Warr (female) (Guildford &amp; Perth, Bridgetown MD, Denmark, Bwokunbup Hill, Boogerup, East of Katanning, Korrlup, Bremer Bay – Esperance Bay, Esperance MD); Waroo (female) (Gingin, Pinjarra MD); Warr (Kojonup); Warra (female) (Nyerrgoo, Woorurdup, Meckering, Wonnerup &amp; Capel Districts); Waroo (female) Wilgahmala; Worr (female) (Vasse MD); Worra (female) (New Norcia); Wurr (female) (Williams MD);</p>	
	<p>Bates 1913: Yongar (male)</p>	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Bates 1914: Yongar (male), Wara (female)	
	Rae: Yonga (male); Waw (female)	
	Muir: Yonger	
	Davis: Yonga	
	Scott: Yangora	
	Roberts: Yonga	
	Atkins: yangar (male); wawrr (female)	
	Coyne: Yongar marm (male), Yonger narnk (female)	
	Gray: Yongar	
	Whitehurst: yongka	
	Winmar: yonger	
<b><i>Macropus irma</i></b> Western brush wallaby	Gilbert MS: Goorh-a (Perth), Quar-ra (interior)	kwara [kwa'ra]
Endemic to WA	Gilbert in Gould: Goorh-a (Perth), Quar-ra (interior)	koora [koo'ra]
	Gilbert in Wagstaffe & Rutherford: Goork-a (Perth), Quorira (interior)	
	Shortridge: Quoyrer, Quoirer	
	Grey: Go-ra, Gwoor-a	
	Stokes: Goora	
	Moore: Gurh-ra, Quarra	
	Oldfield: {Wee-ra; Wee-ar-rch (Champion Bay)}	
	Hassell, E.: omer	
	Bussell: Quarra	
	Hammond MS1: Ing,wahra	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Hammond MS2: Ing-wahra	
	Hammond: Ing-wahra	
	Isaacs: Qwoo-ra	
	Markey: Quera	
	Hassell E.A.: Quer (Gairdner R), Quir	
	Buller-Murphy: Quarra	
	Colonial Secretary: Quarra (Toodyay sub-district), Queer (Esperance Station)	
	Bates: Goora (Dandaragan, Wilgahmala, Gingin, Pinjarra MD, Wonnerup & Capel Districts), Gwarra (Woorurdup), Gwerr (Norseman MD), Gwerra (Guildford & Perth), Gwurra (Woorurdup), Koorra (Gingin, Wonnerup & Capel Districts), Koorra (Carnamah), Kwar (Plantagenet area, Denmark, Albany & Denmark), Kwarl (Denmark, Albany & Denmark), Kwerr (Mardangoora, Plantagenet area, Bwokunbup Hill, Boogerup, Korrlup), Kwerra (Murchison MD, Nyerrgoo, Meckering, Wergejan, Williams MD, Vasse MD), Kwirra (Guildford & Perth), Kwurr (Bridgetown MD, Kojonup, East of Katanning, Bremer Bay – Esperance), Kwurra (Murchison MD), Quayrar (New Norcia), Querra (Busselton), Quore (Jerramungup), Qurra (Northam), Weeara (Murchison MD, Northampton MD, Victoria District, Victoria Plains, Murrum MD), Weearra (Murchison MD), Wee'arra (Murchison MD)	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Rae: Kwarr, Kwirr	
	Davis: Kwirr	
	Roberts: Quarra	
	Atkins: kwaur, kwawr	
	de Burgh: koora	
	Gray: Ouoorr	
	Whitehurst: kwer, kwoora	
	Winmar: quara	
<b>Macropus robustus</b> Euro	Shortridge: {Bigodar (Gascoyne R), Bigoder}	bikada [bik'ad'a]
	Hunt: Grinadah	
	Helms: {Pigurla (Fraser Range)}	
	Wells: {Pirkuda (Fraser Range)}	
	Bates: {Beegoorda (Murchison MD, Murrum MD, Norseman MD), Beegoordoo (Dongara MD, Southern Cross MD), Beegurdo (Coolgardie MD)}, Bigart (East of Katanning), {Biggoorda (near Balladonia)}, Bigurda (Israelite Bay MD), Boonoy (Karadup), {Booyunoo (Dongara MD), Peegoordo (Norseman MD)}	
	Anon 1928: Biggada	
<b>Macropus rufus</b>	Shortridge: {Marlo (Gascoyne area)}	
Marloo, Red kangaroo		
Species occurred outside the itinerary of Gilbert		
<b>Onychogalea lunata</b> Djawalpa, Crescent nailtail wallaby	Gilbert MS: Wau-rong (York; interior). MS2 has the variants: Wa-rang (York), Wau-rong (interior)	worong [wo'rong]
Extinct		

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Gilbert in Gould: Waurong	
	Drummond: Warrong	
	Shortridge: Wurrine, Wurrung	
	Austin: worrang, worrung	
	Hunt: Woorong	
	Forrest: wurung	
	Haddleton: wurrung	
	Hassell Ed.: Wurrung	
	Hassell E.A.: Wurrung ('red tammar...but long fur like a brush')	
	Leake: Wurrung	
	Bates: Warong (Woorurdup), Warrong (Korriup), Werong (Woorurdup)	
	Anon 1928: Wurrung	
	Troughton: Wurrung	
	Ride: Wurrung	
	Ramson: wurrung	
	Brooks & Ritchie: waran?, wurrung	
<b><i>Petrogale lateralis</i></b> Warru, Black-flanked rock-wallaby	Gilbert MS: Moo-ro-rong (mountain districts). MS2 has the variant: (York and Toodyay districts)	moororong [moo'ror'ong] bokal [bok'al]
	Gilbert in Gould: Moo-roo-rong (Toodyay district)	
	Shortridge: Boggile [York and Beverley?]	
	Stokes: Mooroo [Note: name attributed tentatively to this species]	
	Moore: Muroorong	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Drummond: Murarong	
	Austin: mouraring, mourarung	
	Oldfield: {Wil-lo-ba}	
	Bates: Baggolya (Mardangoora), Baggool (Peak Hill MD), Baggooldharra (Murrum MD), Baggoolyarra (Dongara MD), Boggal (Meckering), Boggool (Morarie, Nannine), Bogulara (Lake Way District), Boguldara (Lake Way), Boymenong (Jerramungup), Moorerung (Woorurdup, Pinjarra MD, Meckering, Wergejan, Vasse MD, Wonnerup & Capel Districts), Mororong (Guildford & Perth), Murraran (New Norcia), Murrerung (Nyergoo)	
	Bates 1913: Moorerung (Meckering District)	
<b><i>Setonix brachyurus</i></b> Quokka	Gilbert MS: Ban-gup (Perth), Quok-a (Augusta, KGS)	kwoka [kwo'ka]
Threatened	Gilbert in Gould: Bangap (Perth), Quak-a (KGS)	bangop [bang'op]
Endemic to WA	Shortridge: Bangeup, Quokka	
	Nind: Quakur	
	Lyon: Bangup	
	Grey: Ban-gup; Kwa-kur	
	Moore: Ban-gap, Bang-gap; Kwakar (KGS); Quogga (southern districts)	
	Brady: kwa-kur	
	Hassell, E.: quacka	
	Bussell: Quagger	
	Hammond MS1: Kwogger	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Hammond MS2: Kwag-ger	
	Hammond: Kwogger	
	Isaacs: Quag-ga	
	Helms: Burngup	
	Hassell, Ed.: quagger	
	Hassell E.A.: quocker	
	Drake-Brockman: quogga	
	Buller-Murphy: Quagger	
	Bates: Burncup (New Norcia), Burngap (Woorurdup, Pinjarra MD), Burngup (Guildford & Perth), Gwaggur (Bwokunbup Hill), Gwagur (Plantagenet area), Gwoggur (Denmark), Gwogur (Denmark), Kwaggur (Boogerup, Korrlup)	
	Bates 1913: Burngup	
	Rae: Kwokka	
	Muir: Quocker	
	Anon 1928: Quo[k]ka	
	Scott: Quokka	
	Roberts: Quokka	
	Troughton: Quokka	
	Ride: Quokka	
	de Burgh: bunkup	
	Coyne: Quacker (male or female)	
	Udell: bunkup	
	Ramson: quokka, quagga, kwaka	
	Whitehurst: kwoka	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Brooks & Ritchie: gwaga?, quokka	
<b><i>Lagostrophus fasciatus</i></b> Banded hare-wallaby	Gilbert MS: Mar-nine (interior)	maning [man'ing]
Threatened	Gilbert in Gould: Marnine	
Newly endemic to WA through extinction in other parts of its geographic range in Australia	Gilbert in Wagstaffe & Rutherford: Mar-nine	
	Shortridge: Merrnine, Munning, Munnine	
	Drummond: manang, Marnine, Marmine	
	Hassell E.A.: Murning ('barred tammar')	
	Leake: Mernine	
	Colonial Secretary: murning (Esperance Station)	
	Bates: Murndain (Eucla MD), Murnain (Kojonup), Murning (Korrlup),	
	Anon 1928: Munning	
	Ride: Munning	
<b>MURIDAE</b>		
<b><i>Leporillus apicalis</i></b>		
Djooyalpi, Lesser stick-nest rat		
Species occurred outside the itinerary of Gilbert		
<b><i>Notomys alexis</i></b>		
Tarrkawarra, Spinifex hopping-mouse		
Species occurred outside the itinerary of Gilbert		
<b><i>Notomys longicaudatus</i></b>		
Koolawa, Long-tailed hopping-mouse		
Extinct	Gilbert MS: Kor-tung and Goola-wa (Moore R). MS2 has the variant: Gool-a-wa	koolawa [kool'a'wa] kodong [kod'ong]
	Gilbert in Gould: Kor-tung and Gool-a-wa (Moore R)	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Gilbert in Wagstaffe & Rutherford: Kar-tung and Goot-a-ra (Interior)	
	Grey: Dtor-dung	
<b><i>Notomys macrotis</i></b> Noompa, Large-eared hopping-mouse	Gilbert MS: Bul-long (Moore R), Mar-do (Perth)	bolong [bo'long]
Extinct	Gilbert in Wagstaffe & Rutherford: Bat-tong (Moore R)	
Endemic to WA		
<b><i>Notomys mitchellii</i></b> Pankot, Mitchell's hopping-mouse	Gilbert MS: Djyr-dowin (Perth), Mat-ter-geetch (Moore R). MS2 has the variant: Djyr-dow-in (Perth)	djirdon [djird'on] matakitj [ma'ta'kitj]
	Gilbert in Gould: Djyr-dow-in (Perth), Mat-tee-getch (Moore R)	
	Shortridge: Gunding	
	Moore: Djirdowin	
	Hassell, E.A.: yungil ['Jibra rat']	
<b><i>Pseudomys albocinereus</i></b> Noodji, Ash-grey mouse	Gilbert MS: Noo-jee (Perth), Jup-pert (Moore R)	noodji [noodj'i]
Endemic to WA	Gilbert in Gould: Noo-jee (Perth), Jup-pert (Moore R)	
	Gilbert in Wagstaffe & Rutherford: Nea-jee (Perth)	
	Grey: Nu-jee	
	Moore: Nuji; N-yuti (Upper Swan)	
	Bates: Ngooje (Guildford & Perth)	
<b><i>Pseudomys fieldi</i></b> Djoongari, Shark Bay mouse	Gilbert MS: Kurn-dyne (Moore R)	konding [kond'ing]
Threatened	Gilbert in Gould: Kurn-dyne (Moore R)	
Newly endemic to WA through		

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
extinction in other parts of its geographic range in Australia	Gilbert in Wagstaffe & Rutherford: Kura-agae (Moore R)	
	Salvado: Candagn (east of New Norcia), Pico (north of New Norcia)	
	Hassell, Ed.: Kanding	
	Bates: Karndain (Korrlup), Karndin (Wergejan), Candan (New Norcia)	
<p><b><i>Pseudomys hermannsburgensis</i></b> Mingkiri, Sandy inland mouse</p>		
<p>Species occurred outside the itinerary of Gilbert</p>		
<p><b><i>Pseudomys nanus</i></b> Moolpoo, Western chestnut mouse</p>	Gilbert MS: Jil-beetch (Moore R)	djilbitj [djil'bitj]
	Gilbert in Gould: Jib-beetch (Moore R)	
	Gilbert in Wagstaffe & Rutherford: Jeit-Vitch (Moore R)	
<p><b><i>Pseudomys occidentalis</i></b> Walyadi, Western mouse</p>		
<p>Threatened</p>		
<p>Newly endemic to WA through extinction in other parts of its geographic range in Australia</p>		
<p>Species occurred outside the itinerary of Gilbert</p>		
<p><b><i>Pseudomys shortridgei</i></b> Dayang, Heath rat</p>		
<p>Threatened</p>		
<p>Species occurred outside the itinerary of Gilbert</p>		
<p><b><i>Hydromys chrysogaster</i></b> Rakali, Water-rat</p>	Gilbert MS: Ngoor-joo (Perth), Ngwir-ri-jin (KGS)	ngoodjo [ngoodj'o]

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Gilbert in Gould: Ngoor-joo (Perth), Ngwir-ri-gin (KGS)	ngwirdjin [ng'wir'idj'in] wamp wamp
	Shortridge: Wamp-Wamp (Beverley), Mamgericht (Busselton)	ngangaritj [ngang'ar'itj]
	Moore: Murit-ya, Ngurju	
	Hassell, E.A.: Wanip Wanip	
	Bates: Daaram (Wonnerup & Capel Districts), Ngangareetch (Wonnerup & Capel Districts), Ngarngariten (Vasse MD), Ngoorja (Guildford & Perth), Ngooreeja (Woorurdup), Ngoorjoo (Pinjarra MD)	
	Bates 1914: daran (Vasse)	
<b><i>Rattus fuscipes</i></b> Mootit, Southern bush rat  Type locality is in WA (for species also occurring outside WA)	Gilbert MS: Mur-deet (KGS). MS2 has the variant: Moor-deat (KGS)  Hassell, E.A.: Mordit  Bates: Moordut (Denmark), Moort (Bridgetown MD, East of Katanning), Mordi-tcha (Guildford & Perth), Moreetch (Wonnerup & Capel Districts), Mort (Williams MD), Murdit (East of Katanning)  Whitehurst: moyitj	modit [mod'it]
<b><i>Rattus tunneyi</i></b> Djini, Pale field-rat	Grey: Djil-yoor [Note: name attributed tentatively to this species]  Moore: Djil-yur [Note: name attributed tentatively to this species]	
CANIDAE <b><i>Canis lupus</i></b> Dingo	Gilbert MS: Dwer-da (Aborigines generally)  Gilbert in Gould: Dwer-da	doot

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Shortridge: Duada, Dwert, Euckine, Yarging	
	Nind: Toort, Yaccan toort	
	Wilson: To-ort	
	Lyon: Doora	
	Bunbury: Dora, Doodi	
	Grey: Bore-ang (male dog) (KGS); Door-da (dog), Tdoor-da (dog), Doorda Mo-kine (wild dog); Nank (female dog) (KGS); Toor-ta (dog), Yek-kain (wild dog), Yiee-kain (wild dog)	
	Stokes: Dudah	
	Symmons: Dar-da (dog); Dur-da-mo-kyn	
	Moore: Borang (male dog); Durda (dog), Durda Mokyn (wild, untamed dog); Yekyn (wild dog); Mokyn (wild dog) (Upper Swan)	
	Brady: Durda, ldoor-da	
	Salvado: Duora (east of New Norcia), Durda (east of New Norcia), Tutto (north of New Norcia); Duora n-anga (female) (east of New Norcia); Tuttumimbi (female) (north of New Norcia)	
	Salvado in Curr: dura waiwe	
	Oldfield: {G'no-ban-o (wild); Ot-tho (domesticated)}	
	Hassell, E.: twert	
	Bussell: Dorder (dog); Dorder Yockine (Dingo)	
	Hammond MS1: Dwerda	
	Hammond MS2: Dyi-erda-yug-gnyr [illeg.]	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Hammond: Dwerda, Dwerda-yuggyn	
	<p>Curr: [Note: * = tame dog, assumed by me to indicate tame Dingo] dooda* (Perth, York, Mt Stirling), dooda mokyne (Perth), {doodoo (Eyre's sand patch, Eucla), doodoota (Shark Bay)}, dorda yakkino (Toodyay), dura waiwe (New Norcia), dwarda* (Pinjarra), dwardar* (Lower Blackwood), dwoda* (Harvey), dwodda* (Geographe Bay), dwert* (Geographe Bay), {hotther* (Champion Bay)}, moakin (Kojonup &amp; Etipup), moking (KGS), mookine (Kent District), {newbana (Northampton), ngobano (mouth of Murchison R), nuban (Natingero), ngupine* (Doubtful Island Bay to Israelite Bay), toothoo* (Irwin &amp; Murchison Rivers)}, twart* (Kent), twert (KGS), twurt* (Kojonup &amp; Etipup), yakkine dooda (Perth), yakkine (Victoria Plains, Pinjarra, Blackwood, Harvey, Geographe Bay &amp; Vasse), yarkine (Geographe Bay, Blackwood), yeekine (York), yockine (York), yackine (Lower Blackwood), yokkine (Mt Stirling)</p>	
	Helms: {Muban (Yaurigabba)}; Dwarda (dog); Yokkain (Dingo)	
	Wells: {Doychu (dog) (Fraser Range); Dudu (dog) (Yarragabie Station)}	
	Markey: Yakine	
	Hassell, Ed.: dorder, dorder yockine	
	Hassell E.A.: Moiler; Twert	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	(Fitzgerald R & branches); Twirt (tame dog); Yuckine	
	Buller-Murphy: Dorder, Dorder Yockine	
	Colonial Secretary: Yokine (Beverley sub-district)	
	Bates: {Dhoodhoo (Mardangoora), Dhoothoo (Dandaragan, Carnamah, Wilgahmala), Doojoo (Norseman MD)}, Doowert (Korrlup), Dorda (Wergejan), Dura (New Norcia), Dwarda (Blackwood), Dwerda (Esperance MD), Dwerda yeegain (Meckering), Dwert (Albany, Boogerup), Dworda (Wergejan), {Joojoo Coolgardie MD, Southern Cross MD}}, Moggain (East of Katanning), Mokin (Kojonup, Plantagenet area), Mokkain (Korrlup), Mwoggain (Bridgetown MD, East of Katanning), {Ngoobanoo (Carnamah), Ngoobanoo (Northampton MD)}, Nwogin (Plantagenet area), {Ngupine [tame dog] (Doubtful Island Bay – Israelite Bay), O-tha (Victoria District)}, Twert (Plantagenet District, Albany, Esperance MD), Yaggain (Bridgetown MD, East of Katanning), Yagginyung (Karadup),	
	Burung (male) (Albany); Dooja jerdara (male) (Wonnerup & Capel District); Dorda mamman (male) (Vasse MD); Dwerda mamma (male) (Woorurdup); Dwerda yaggain maam (male) (Guildford & Perth); Dwert (male) (Albany & Denmark); Dworda mamma (male) (Nyergoo); iya-kain mangar (male) (New Norcia); Joorda mamma (male) (Gingin); Mooyelur (male)	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	<p>(Bremer Bay – Esperance);                      Towitemla-mam (male)                      (Jerramungup); Twert borong                      (male) (Bwokunbup Hill,                      Plantagenet area); Yackine                      mamma (male) (Northam);                      Yakkain (male) (Williams MD);                      Yokine mool-kut (male)                      (Busselton);</p>	
	<p>Dooja ngaia/nganga (female)                      (Wonnerup &amp; Capel Districts);                      Dorda yaggain (female)                      (Vasse MD); Dwerda nganga                      (female) (Woorurdup); Dwerda                      yaggain nganga (female)                      (Guildford &amp; Perth); Dwerda                      yog (female) (Nyerrgoo);                      Dwert mokkin (female)                      (Denmark), Dwert ngaank                      (female) (Boogerup); Dwert                      ngank (female) (Denmark);                      Dwert yakkain (female)                      (Williams R); Dworda yog                      (female) (Nyergoo); iya-kain                      tuwia (female) (New Norcia);                      Joorda nganga (female)                      (Gingin); Mokin (female)                      (Albany &amp; Denmark); Mokkin                      (female) (Bwokunbup Hill);                      Mwoggin (female)                      (Bwokunbup Hill); Ngaank                      twert (female) (Bwokunbup                      Hill); Ngaiam (female) (Bremer                      Bay – Esperance); Puank                      (female) (Albany); Towitmela-                      yanch (female)                      (Jerramungup); Twert ngank                      (female) (Plantagenet area);                      Yackine yorga (female)                      (Northam); Yokine yaw-ka                      (female) (Busselton); Yukkain                      (female) (Boogerup);</p>	
	<p>Bates 1914: dwerda</p>	
	<p>Rae: Mokien, Twert, Yukien;                      Mam (male); Gnunk (female)</p>	
	<p>Muir: Yerkine</p>	
	<p>Davis: Dwirt (dog)</p>	

Species, current vernacular name and current status	Name(s) recorded	Recommended name(s), with corrected orthography and [suggested syllables]
	Scott: Yokine	
	Roberts: Mokine (male), Yokine (female)	
	Atkins: twaurt	
	Gray: Toorrit	
	Whitehurst: dwert mokiny, mokiny	
	Winmar: dwert	

TABLE 3

Noongar names recorded for non-terrestrial mammal species.

Species or higher taxon, and comment	Name(s) recorded
<p><b>Bats</b> Ten species, excluding vagrants, occur in south-west WA. Shortridge (1936) implies that the names listed by him apply to all insectivorous species of bats (cf. Burbidge <i>et al.</i> 1988, p. 13).</p>	<p>Gilbert MS: <i>Nyctophilus</i> sp. Bam-be (Perth); <i>Nyctophilus</i> sp. Bam-be (Perth), Bar-ba-lon (KGS); <i>Scotophilus</i> sp. [= <i>Chalinolobus morio</i>] Bam-be (Perth)</p> <p>Gilbert MS2: <i>Nyctophilus Geoffroyii</i> [= <i>N. geoffroyi</i>] Bam-be (Perth &amp; vicinity); <i>Nyctophilus</i> sp. Bam-be (Perth &amp; vicinity), Bar-ba-lon; <i>Scotophilus morio</i> [= <i>Chalinolobus morio</i>] Bam-be (Perth &amp; vicinity)</p> <p>Gilbert in Gould: <i>Nyctophilus geoffroyi</i> Bambe (Perth), Bar-ba-lon (KGS); <i>N. timoriensis</i> Bam-ba (Perth)</p> <p>Shortridge: <i>Chalinolobus morio</i> Tarding (Beverley), Babainit (Busselton)</p> <p>Grey: Bam-bee, Ba-bil-gun</p> <p>Symmons: Bam-bi</p> <p>Moore: Bambi, Babilgun</p> <p>Rae: Ba-bill</p> <p>Whitehurst: babitj</p>
<p><b><i>Neophoca cinerea</i></b> Australian sea-lion</p> <p>It appears that this species had a different name at Swan River and KGS.</p>	<p>Gilbert: Man-ye-ne (Perth). MS2 has the variant Perth &amp; vicinity</p> <p>Nind: Barlard</p> <p>Lyon: Manyeen</p> <p>Grey: Man-yin-ee</p> <p>Symmons: Man-yin-ni</p> <p>Moore: Man-yini, Man-yi-ni</p> <p>Hassell, E.A.: Dalgart</p> <p>Rae: Balkut</p>
<p><b>Whale</b> Based on recent stranding recoveries, it appears that the many species present in</p>	<p>Nind: Mammang</p> <p>Grey: Me-marng</p>

Species or higher taxon, and comment	Name(s) recorded
south-west waters of WA were not distinguished by Noongars.	Symmons: Mi-man-ga Moore: Mimang-a, Mi-mang-a Oldfield: {Moo-long-ar-do} Isaacs: Mum-mung Hassell, E.A.: Mumong Buller-Murphy: Mamung Rae: Mamong Atkins: mamang Gray: Mumung
<b>Porpoise</b> Presumed to refer to <i>Tursiops truncatus</i> Bottlenose Dolphin	Lyon: Waraneen Grey: Wa-ran-ung; Twoort-a-bang-ul (KGS) Symmons: War-ran-ang Moore: Warran (1842); Warranang; Worran-ang (1884) Hammond MS1: Kwillen,ah Hammond MS2, 1933: Kwillen-ah Isaacs: Kear-la Hassell, Ed.: Twertawaning Bates 1913: Warranung Bates 1914: Kela (Vasse) Atkins: twardamonit Whitehurst: kwilena

# Wood basic density surveys of pedigreed Maritime Pine in Gnangara, Pinjar and Yanchep plantations

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The survey results indicated that pedigreed maritime pine material has acceptable basic density for a range of uses, e.g. sawlogs, MDF or LVL production.

## SUMMARY

Maritime pine (*Pinus pinaster*) growing in Gnangara, Pinjar and Yanchep plantations north of Perth was assessed to compare the basic density of wood from genetically improved (pedigreed) trees, planted routinely from 1972 to 1987 (P72 to P87), with that of older unimproved trees. Over 500 trees were sampled initially, with the minimum sample of 20 trees (5 plots x 4 trees) in each planting year of the pedigreed material. An additional 20 trees from each of P82 to P87 plantings were sampled because these would be harvested soon. Smaller samples of older material, and 30 trees from research trials established from 1965 to 1972, were included. A bark-to-pith core was extracted at breast height (1.3 m), and basic density of each 35 mm section from the pith assessed. Basic density (unextracted) increased from pith to bark and decreased with decreasing age. Mean basic density in 70–105 mm sections of P72 to P80 plantings was about 500 kg m<sup>-3</sup>.

Effects of height in tree on basic density of five pedigreed maritime pine trees from each of P72 to P87 plantings were assessed. Mean basic density of cores from 1.3 m, 3 m, 6 m and 9 m decreased with decreasing age and with increasing height in the tree. Sample cores from edge and internal trees of P80, P82 and P84 stands showed that edge trees had basic density about 30 kg m<sup>-3</sup> less than that of internal trees.

The initial survey indicated that resin content continued to increase with age, and a further study compared mean basic density of cores from trees planted in 1957 and 1984. Matched cores from either P57 or P84 were either left unextracted or extracted with an acetone : ethanol : toluene solution (4:1:1 ratio) for 48 hours before measuring basic density. The results showed that 0–35 mm sections of cores from P57 trees had 13.9 per cent resin content compared with 3.7 per cent in cores from 1984 plantings, and there was a decreasing trend of resin content with increasing distance from the pith.

Comparative basic density data from previous assessments of Western Australian-grown maritime pine are given.

## INTRODUCTION

Maritime pine (*Pinus pinaster*) is one of the major plantation species in Western Australia, with a current area of about 27 000 ha. This species will become significantly more important with planned establishment of 150 000 ha in the semi-arid areas of the Wheatbelt to reduce salinity effects while providing a commercial crop.

The current major areas of maritime pine are Gnangara, Pinjar and Yanchep plantations, about 35 km north of Perth, with a combined area of about 20 000 ha. All plantings since 1972 have been improved or pedigree stock resulting from an intensive tree-breeding program initiated by the then Forests Department. The areas will be thinned and clear-felled progressively over the next 20 years and the area converted to a State park.

Maritime pine industrial wood is used by Wesfi Ltd for medium density fibreboard (MDF) production in Kewdale, and by Pinetec Pty Ltd, who mill mainly pallet timber. There is a current proposal for a Japanese and a local company to use part of the maritime pine resource to manufacture laminated veneer lumber (LVL) for either structural or non-structural purposes. Most of the product would be exported.

Efficient utilisation requires detailed information on the wood properties of the species, particularly the pedigreed resource planted since 1972, because thinnings from these compartments are providing an increasing resource to Wesfi and Pinetec and would be used in LVL production. Wood density is an important predictor of strength properties, and an initial survey was to obtain a better understanding of wood density variation with age of maritime pine.

The initial survey was based on systematic sampling at breast height (1.3 m) of trees in areas planted with pedigreed pine each year from 1972 to 1980 (P72 to P80), with comparisons made with unimproved material from P69 to P71. Some younger (P81 to P87) and older (P51 and P57) material was also included. The data from this survey confirmed the trend of decreasing basic density with

decreasing age in the juvenile and adjacent wood. Wesfi were concerned about this trend (and that of decreasing density with increasing height in the tree), particularly as it affected the basic density of trees from P82 to P87: they requested additional sampling.

A subsequent survey with destructive sampling was required to quantify the basic density variation with increasing height in the tree, with a single compartment selected as being representative of a specific planting year (P72 to P87).

Another Wesfi concern was the lower density of veneers produced from P82 logs sent to Japan for LVL trials, compared with the density data from the initial survey. Further core samples were collected from the P82 to P87 areas, and taken from immediately adjacent to plots sampled for the LVL logs for Japan. In the wood density assessments, sampling was carried out a minimum of 20 m from the edge of the stand, so sample trees provided data representative of that particular resource. However, when sampling of the resource was required for the LVL pilot trial, the specification included a minimum diameter limit that could only be achieved by sampling the open-grown edge trees. The Department of Conservation and Land Management (CALM) postulated that the lower density resulted from edge trees being sampled in these young plantations to make the minimum diameter specification, and that lower basic density subsequently measured in LVL produced from edge trees was not representative of that age stand. It was necessary to quantify the basic density differences between edge trees within the compartment, and the next sampling was done in three specific stands (P80, P82, and P84).

The systematic sampling of maritime pine planted in these plantations showed a consistent increasing trend with age in unextracted basic density of cores. Koch (1972) indicated that resin continued to be produced in the southern pines of the United States (e.g. *P. elliotii* var *elliotii*, *P. taeda*) after the initial heartwood formation, and it was postulated that this situation also occurred in Western Australian-grown maritime pine. Resin content increases wood density, but has negligible effect on strength. A small pilot study used paired cores from 1957 (P57) and 1984 (P84) plantings, with unextracted basic density of one core compared with basic density of the other core after the resin was extracted at the Western Australian Chemistry Centre.

The major objective of the comprehensive survey and studies was to assess wood basic density of Western Australian-grown maritime pine of a wide range of ages as an indication of its potential uses. The effects of increasing height in the tree on wood density, the differences between edge and internal trees in the compartment, and the comparative resin content in juvenile wood of P57 and P84 trees were also assessed.

## METHODS

### Survey of basic density at breast height

The sampling pattern used to assess basic density variation in the pedigreed resource was based on the area established annually from 1972 to 1987 (P72 to P87). A smaller sample of unimproved resource (P51, P57, P69, P70 and P71) was included for comparative purposes. The number of plots sampled was proportional to the area planted, and stratification was done based on silvicultural and site variations. A bark-to-pith core at breast height was taken from each of four trees in the selected plot, and basic density of each 35 mm section measured. The location of five temporary plots (each with four trees) was nominated by a CALM forester with intensive knowledge of Gngangara, Pinjar and Yanchep plantations (Table 1).

Each tree had a core sample removed at breast height, using a 'Trecor'® Wood Corer with a 'Tanaka'® petrol motor drill. The position was modified if within 15 cm of a whorl of branches. After the diameter at breast height over bark was measured, a mark was made on the corer to ensure that the core being drilled went past the pith in each tree. Only one radial core was used from each tree, to reduce the damage to the stem. The corer was sharpened at the start of the survey, and proved very effective in producing a clean uniform core with good definition of the growth rings. Immediately after removal the cores were wrapped in a marked plastic bag to minimize moisture loss. A pilot trial had shown that overnight moisture loss in the core could be compensated for with a 20-minute soaking in water before cutting the core into sections and measuring green volume.

The procedure in the laboratory was to break off the bark at the cambium, cut the core to length through the pith with a Stanley knife, and then measure and record the length from pith to cambium. The core was divided into 35 mm sections, commencing at the pith. This length is based on the radius of the residual 70 mm diameter cylinder left after peeling veneers, and is not directly related to number of growth rings. Each 35 mm section was cut with the knife, and any residual length less than 5 mm included with the previous section because of the difficulty in obtaining an accurate density estimate when earlywood/latewood proportions are affected. Year, tree and height in tree were marked on the core section with a 'Lumochrom' pencil, which provides a waterproof marking.

Basic density is the oven dry mass divided by the green volume. The volume was estimated using the displacement method. A clamp stand was placed beside a set of electronic scales with a beaker of water. The scales were tared to read zero, and a length of sharpened wire inserted at right angles into the core section, which was then submerged below the surface of the water. The reading on the scales is an accurate estimate of the displacement of water and therefore of core volume.

The cores were then dried using the oven-dried method, which requires drying at 103°C to constant weight, when all moisture has been removed from the sample. The

TABLE 1

Planting years (P51 = planted in 1951) and compartments sampled for wood density survey of maritime pine (*Pinus pinaster*) in Gnangara, Pinjar and Yanchep plantations.

STRATUM	COMPARTMENT	TRIAL No.	No. of PLOTS
<b>NON-PEDIGREED</b>			
P51	Gnangara 13,18,127	-	3
P57	Gnangara 46,49,52	-	3
P69	Yanchep 1,2: Pinjar 1,2: Gnangara 20,23	-	6
P70	Yanchep 1,2,8,9	-	4
P71	Pinjar 4	-	2
<b>PEDIGREED</b>			
P72	Pinjar 3,6,7,8	-	5
P73	Yanchep 13,15,16,20	-	5
P74	Gnangara 28,29,30,31	-	5
P75	Pinjar 2,3,5,6,11,12,13,15	-	10
P76	Pinjar 21,28,29,30,31,33,34,35,36	-	10
P77	Pinjar 25,26,27,41,42,45,46,47	-	10
P78	Pinjar 39,40,48	-	5
P79	Pinjar 6,7,9,10	-	5
P80	Pinjar 9,20,22	-	5
P81	Pinjar C 12, 13,15	-	5
P82	Pinjar C 14, 18	-	5+5
P83	Yanchep C 1,2,3	-	5+5
P84	Pinjar 4,5,10,16,17	-	5+5
P85	Pinjar H 6,9,15	-	5+5
P86	Pinjar 8,13	-	5+5
P87	Yanchep 11B,13, 14A	-	5+5
<b>RESEARCH (TREE BREEDING)</b>			<b>No. OF TREES</b>
P65	Gnangara 7	YS1	2
P66	Gnangara 7, Yanchep 46A	YS3, 07	4
P67	Yanchep 37A,46A	YS12	6
P68	Gnangara 13, Yanchep 60	YS11B,12, 13B	6
P69	Yanchep 60, Gnangara 109A	YS19,20	8
P72	Pinjar 2	YS43	4

measurements were done on unextracted cores that contained varying amounts of resin, because extraction facilities were not available without incurring considerable costs.

The mean basic density values and standard deviations were calculated, excluding a few results where resin content was unacceptably higher than average. Standard deviation was not calculated for fewer than five samples.

The supplementary sample taken following the request by Wesfi was four trees per plot from each of the five plots in each year P82 to P87, in the same compartments as the original samples. The additional sampling increased sample size from 20 to 40 trees in those years of planting. The supplementary sampling is shown with details of the initial survey for the P82 to P87 planting years in Table 1.

### Effect of height in tree on basic density

In a survey with destructive sampling to quantify variation in basic density with increasing height up the stem one of the original compartments (P72 to P87) was randomly selected and trees adjacent to those in the first sample selected (Table 2). Five trees were sampled from each compartment, and felling was required to allow coring in the upper sections of the stem, at breast height, 3 m, 6 m and 9 m. The whole core was used for the survey of effect of height in tree on basic density, without cutting into 35 mm long sections. The cores were handled similarly to samples from the previous survey to obtain basic density estimates. This survey was necessarily destructive to enable coring at 3 m intervals up the tree, and the trees were felled.

TABLE 2

Compartments sampled for survey of basic density at different heights in maritime pine trees in Pinjar and Yanchep plantations.

PLANTING YEAR	COMPARTMENT
P72 <sup>a</sup>	Pinjar 3
P73	Yanchep 20
P74	Gnangara 22
P75	Pinjar 17
P76	Pinjar 30
P77	Pinjar 27
P78	Pinjar 40
P79	Pinjar 6
P80	Pinjar 22
P81	Pinjar C 23
P82	Pinjar C 14
P83	Yanchep C 4
P84	Pinjar 5
P85	Pinjar H 9
P86	Pinjar 8
P87	Yanchep 11B

<sup>a</sup> P72 = planted in 1972

### Basic density of edge trees

To compare basic density of edge and interior trees, sample trees were selected randomly from immediately adjacent to the P80, P82 and P84 areas harvested for LVL trials in Japan. Five trees were selected from the edge of the stand, five from 10 m from the edge, and five from 30 m from the edge, in each of the three age classes.

A 12 mm diameter core was drilled at breast height with a 'Trecor'® borer, as described previously. The method for measuring basic density in 35 mm sections of each core, commencing at the pith, was also described. Mean unextracted basic density was calculated for each 35 mm segment in each treatment. Weighted mean basic density for the cross-section was estimated for the 105 mm radius (i.e. 210 mm diameter) in both edge and internal logs, with density data from each 35 mm section and using the difference in the area of circles of 35 mm, 70 mm and 105 mm radius.

### Effect of age on resin content

Sample trees for basic density comparisons were selected randomly from P57 and P84 areas used in the previous assessments. Five trees were randomly selected from each of two different areas in each planting year, to give ten trees in each treatment.

Two 12 mm diameter cores were drilled at breast height with a 'Trecor' borer, as described previously, taking paired cores in the same vertical plane and 30 mm apart. One core had basic density measured unextracted, and the other after resin extraction. Resin extraction was done by the Western Australian Chemistry Centre over 48 hours, using a Soxhlet apparatus and acetone : ethanol : toluene in a 4:1:1 ratio.

Cores were divided into 35 mm sections commencing at the pith, and the basic density assessment done. Resin-extracted cores were soaked for 24 hours before measurement to replace moisture removed during the resin extraction. Mean basic density was calculated for each 35 mm segment in each treatment, and the percentage resin content was estimated by dividing unextracted basic density by extracted basic density.

## RESULTS AND DISCUSSION

### Survey of basic density at breast height

The mean unextracted basic density and standard deviation of the 35 mm sections in each planting year are given in Table 3.

The 35 mm sections were based on the likelihood of some maritime pine resource being peeled and then used for LVL manufacture. The residual core after peeling on modern equipment is about 70 mm diameter, and therefore peeled veneer would be produced from the wood outside that diameter. That is, the basic density of the second and subsequent 35 mm sections indicates the likely wood density of veneers from that resource.

Table 3 shows definite trends with the mean unextracted basic density increasing with increasing distance from the pith, and decreasing from the older-aged to the younger plantations. Juvenile wood or crown-formed wood produced in the first ten years has lower density than mature wood, but the resin production associated with formation and development of heartwood with increasing age will reduce that difference, owing to the weight of the resinous deposits laid down in the heartwood (Koch 1972). The standard deviation values in the first 35 mm sections tended to be higher than those in the second and subsequent sections, and reflected the variation in resin production in that first section. Inspection showed no obvious variation in ring width or earlywood to latewood proportions that would result in large wood density differences. In screening candidate trees for tree-breeding purposes, it would be an advantage to extract resin to give more accurate comparisons.

As might be expected, the oldest sample trees (P51) had very high resin content. In one tree resin flowed freely from near the pith as the core was being extracted. Drilling was very difficult with the corer binding continually. The trees became progressively easier to drill with decreasing plantation age.

One industry requirement was a minimum air-dry density of 550 kg m<sup>-3</sup> for veneers for LVL production, to ensure that stiffness of the product would meet US requirements for structural material, according to a consultant to local industry who carried out LVL trials in 1995. Air-dry density of maritime pine is approximately 1.22 times greater than basic density, based on air-dry density having 12 per cent greater mass than basic density, but only 92 per cent of the volume, using shrinkage data from Kingston and Risdon (1961). Consequently, any unextracted basic density greater than 450 kg m<sup>-3</sup> should be

TABLE 3.

Basic density ( $\text{kg m}^{-3}$ ) at breast height of pedigreed maritime pine compared with that of older unimproved trees (35 mm sections).

STRATUM	PLANTATION	No. PLOTS	CORE LENGTHS (mm)	MEAN BASIC DENSITY (standard deviation in parentheses)					
				0–35mm	35–70mm	70–105mm	105–140mm	140–175mm	175–210mm
UNIMPROVED									
P51	Gnangara	3	160–210	502 (31)	562 (37)	564 (29)	547 (29)	565 (50)	534 (53)
P57	Gnangara	3	93–180	502 (55)	497 (40)	516 (50)	501 (48)	497 (-)	
P69	Yanchep, Pinjar, Gnangara	2 each	82–160	489 (46)	485 (37)	523 (57)	538 (50)	574 (-)	
P70	Yanchep D, E	4	82–130	482 (43)	491 (32)	527 (39)	545 (47)		
P71	Pinjar	2	92–140	508 (56)	469 (40)	514 (37)	537 (47)		
PEDIGREE									
P72	Pinjar	5	83–135	521 (63)	511 (36)	525 (41)	513 (29)		
P73	Yanchep C	5	105–150	471 (47)	503 (35)	540 (30)	551 (34)		
P74	Gnangara	5	100–155	461 (35)	469 (29)	502 (28)	520 (40)	515 (-)	
P75	Pinjar	10	85–140	466 (40)	478 (35)	503 (38)	491 (31)		
P76	Pinjar	10	90–140	473 (56)	461 (39)	508 (43)	496 (42)		
P77	Pinjar	10	80–140	449 (38)	464 (41)	508 (49)	504 (62)		
P78	Pinjar	5	85–130	460 (35)	468 (39)	506 (44)	498 (52)		
P79	Pinjar	5	86–135	466 (54)	459 (25)	496 (34)	487 (29)		
P80	Pinjar	5	70–125	464 (57)	466 (46)	490 (39)	488 (59)		
P81	Pinjar	5	75–110	433 (35)	440 (37)	466 (31)			
P82	Pinjar	5+5 <sup>b</sup>	80–110	449 (43)	456 (37)	490 (49)			
P83	Yanchep H	5+5	68–110	432 (39)	448 (36)	476 (43)			
P84	Yanchep H	5+5	53–105	411 (29)	453 (38)	494 (49)			
P85	Yanchep H	5+5	65–105	416 (29)	451 (39)	463 (48)			
P86	Yanchep H	5+5	60–90	393 (27)	434 (38)	462 (40)			
P87	Yanchep H	5+5	60–100	388 (26)	438 (28)	442 (49)			
RESEARCH									
P65–P72	Yanchep, Pinjar, Gnangara	30 trees	110–215	481 (41)	501 (41)	503 (34)	527 (35)	530 (47)	503 (34)

<sup>a</sup> P51 = planted in 1951<sup>b</sup> Including supplementary sampling

satisfactory for structural material, but lining and other products could have lower density.

The pedigreed material planted from P76 to P95 came from the Mullaloo seed orchard, and consequently the same genetic material was planted (Hopkins and Butcher 1994). Some culling over the years had removed some of the poorer parents, including those with lower than average basic density. Silvicultural systems have not changed, and the range of sites over Gngangara, Pinjar and Yanchep plantations is similar.

Comparison of matched routine and pedigreed trees growing adjacent to each other in a P73 stand showed that basic density in both treatments was similar, although the pedigreed trees had produced about 30 per cent greater volume (Hill 1999). The cores taken from seven different heights in the tree (1.3 m, 2.4 m, 4.8 m, 7.2 m, 9.6 m, 12.0 m and 14.4 m) were measured in five ring sections (0-5, 6-10, 11-15, 15+) allowing the comparison.

This basic density survey in Gngangara, Pinjar and Yanchep, which compared pedigreed material from P72 to P87 showed definite trends of increasing unextracted density with increasing age, using breast height samples (Fig. 1). The trend was most pronounced in the first 35 mm core sections, and can be explained by the resin content increasing with time. A similar trend in the southern pines of the United States (e.g. *P. elliottii* var *elliottii*, *P. taeda*) was reported by Koch (1972).

### Effect of height in tree on basic density

An additional survey confirmed the uniform trend of decreasing average basic density with increasing height in the tree (Table 4).

Mean basic densities and standard deviations of cores from each height in each of five trees from each planting year are given in the Table, showing definite trends with the mean basic density decreasing with increasing height in the trees, and decreasing with decreasing age. Juvenile wood or crown-formed wood produced in the first ten years has lower density than mature wood, and the mean density of the cross-section will increase with increasing age. Inspection showed no obvious variation in ring width or earlywood to latewood proportions that would result in wood density differences. The trees became progressively easier to drill with decreasing plantation age.

The data in Table 4 show the expected trends, with occasional anomalies in those trends because of the smaller sample size (of five trees) than that used when sampling at breast height only. However, with 80 trees sampled overall, and generally four cores per tree, the survey provides considerable information. The trends in basic density with increasing height in the tree are shown in Figure 2.

### Basic density of edge trees

There was apparently low basic density of younger samples in the batches of logs from P72 to P84 which were sent to Japan for an LVL trial. When sampling additional trees adjacent to the areas logged, it appeared likely that the low

densities of logs from the younger stands (P80, P82 and P84) compared with the data from the comprehensive survey, was the result of felling edge trees to achieve the minimum log diameter requirement for LVL production. Edge trees grow faster and generally have lower wood density than trees inside the compartment, and it was necessary to quantify the differences.

The results of this study, showing mean basic density and standard deviations of edge trees compared with internal trees in P80, P82 and P84 stands, with values given for each 35 mm section are presented in Table 5.

### Edge vs internal trees

The data in Table 5 and the weighted mean values show that the mean basic density of the edge trees is less than that of the internal trees. The exception is the 0-35 mm core section, where the results are similar because in the first few years of growth there are no competition effects. Once crown competition commences, the edge trees have more light, water and nutrients available. They consequently grow considerably faster but with lower wood density than dominant internal trees.

The 35-70 mm and 70-105 mm sections show an increasing difference in basic density between edge and internal trees, because different aged rings are involved, e.g. sections from 35-70 mm in edge trees contain more juvenile wood than the same sections from internal trees. As age increases, the edge trees have wider growth rings than internal trees, and the lower density values indicate lower percentage latewood. The greatest differences were found in the 70-105 mm sections, with mean basic density varying from 30 kg m<sup>-3</sup> in P80 to 64 kg m<sup>-3</sup> in P82 stands.

The estimates of weighted mean basic density to 105 mm radius (210 mm diameter) under bark, based on the areas of each 35 mm in the cross-section were as follows:

P80 - Edge trees 467 kg m <sup>-3</sup>	Internal trees 497 kg m <sup>-3</sup>
P82 - Edge trees 443 kg m <sup>-3</sup>	Internal trees 481 kg m <sup>-3</sup>
P84 - Edge trees 459 kg m <sup>-3</sup>	Internal trees 487 kg m <sup>-3</sup>

The differences between weighted mean basic density of edge and internal trees were therefore 30 kg m<sup>-3</sup> for P80, 38 kg m<sup>-3</sup> for P82, and 28 kg m<sup>-3</sup> for P84. This variation between edge and internal tree density would explain the apparent anomaly when the LVL trial produced material of lower density than found in the initial survey.

Overall, the study reached the major objective of quantifying the differences in mean basic density and weighted density of edge compared with internal trees, showing that edge trees were of lower wood density.

### Age effects

Table 5 shows the general trend of decreasing mean basic density with decreasing age, similar to the results reported by Hill (1999). There were some minor anomalies with the smaller sample size than that used in the previous intensive studies. For example, mean basic density in the

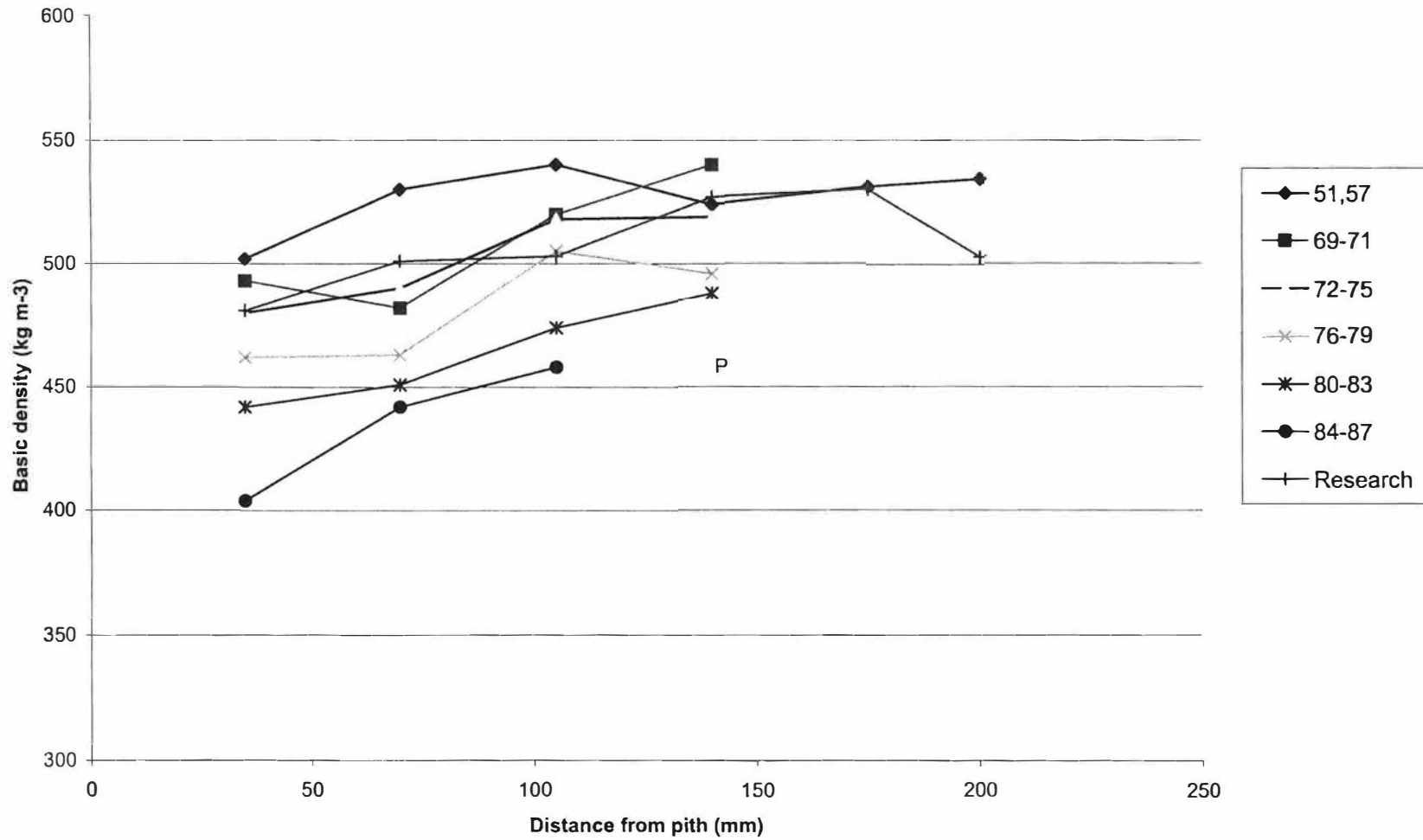


Figure 1. Breast height basic density of maritime pine from Gwangara, Pinjar and Yanchep Plantations by grouped planting years.

TABLE 4

Effects of age and height in tree on wood basic density ( $\text{kg m}^{-3}$ ) of pedigreed maritime pine.

PLANTING YEAR	MEAN BASIC DENSITY (SD in parentheses)			
	1.3 m	3 m	6 m	9 m
P72 <sup>a</sup>	477 (29)	452 (29)	440 (42)	418 (-) <sup>b</sup>
P73	484 (24)	460 (35)	450 (41)	439 (44)
P74	499 (16)	468 (33)	464 (19)	432 (4)
P75	468 (30)	466 (21)	439 (17)	415 (28)
P76	489 (18)	473 (28)	455 (32)	422 (29)
P77	457 (20)	445 (18)	433 (21)	408 (17)
P78	469 (23)	456 (11)	443 (22)	421 (-)
P79	479 (31)	433 (36)	446 (37)	433 (42)
P80	474 (24)	430 (28)	423 (15)	419 (-)
P81	438 (19)	430 (28)	423 (15)	398 (-)
P82	470 (15)	463 (24)	442 (26)	
P83	444 (27)	418 (22)	408 (-)	
P84	436 (7)	418 (14)	407 (-)	
P85	419 (24)	411 (21)	412 (-)	
P86	427 (30)	395 (24)	395 (-)	
P87	408 (17)	412 (29)	390 (14)	

<sup>a</sup> P72 = planted in 1972<sup>b</sup> Standard deviation was not calculated for fewer than five samples.

70–105 mm section in P84 was similar to the P80 value, and greater than the P82, but fewer than five trees reached this dimension.

### Effect of age on resin content

Table 6 shows the mean basic density and standard deviations of extracted and unextracted cores from trees in P57 and P84 stands, with values given for each 35 mm section. The percentage resin is based on extracted density.

Table 6 indicates that mean basic density of older trees continues to increase with increasing age. As expected, the effect was most pronounced in the 0–35 mm core section, with 13.9 per cent resin in P57 compared with 3.7 per cent in cores from P84 trees. The unextracted basic density values in that core section were similar to those shown in Table 3, i.e.  $502 \text{ kg m}^{-3}$  for P57 and  $411 \text{ kg m}^{-3}$  for P84.

However, CALM considered that the trend resulted from continuing resin production after the initial heartwood formation. Similar trends have been reported in the southern pines of the United States (Koch 1972), and in South Africa (South African Department of Forestry 1964).

According to Koch (1972), the extraction process removes most of the extractives, which are generally referred to as resins. They may require extraction with a range of chemicals, but Koch quotes alcohol/benzene as removing the greatest amount of extractives. Acetone : ethanol : toluene is now recommended because of the possible carcinogenic effects of benzene, but it is possible

that residual amounts of the extractives remained after the Soxhlet extraction.

In commercial use such as LVL or plywood production where pine is used with the normal resin content, it is likely that some volatile components of the resins will be given off during the veneer drying process with drying temperatures probably about  $160^\circ\text{C}$ . The highest resin content is in the 70 mm diameter core discarded after peeling. The thin veneers peeled outside this diameter should not be adversely affected by resin content, particularly with the high quality gluelines achievable from modern adhesives and technology.

Table 6 shows the general trend of decreasing mean basic density with decreasing age, similar to the results reported by Hill (2000). There were some minor anomalies with the smaller sample size than that used in the previous intensive studies. Overall, the study indicated that the resin or extractives content continued to increase with increasing age, with the greatest effect found in the 0–35 mm section of the core.

### Comparison with other Western Australian wood density data

Table 7 gives other data relating to the wood density of maritime pine grown in Western Australia. The 85 superior trees of maritime pine selected by Perry in Leiria, Portugal, in 1965 were the basis for the Forests

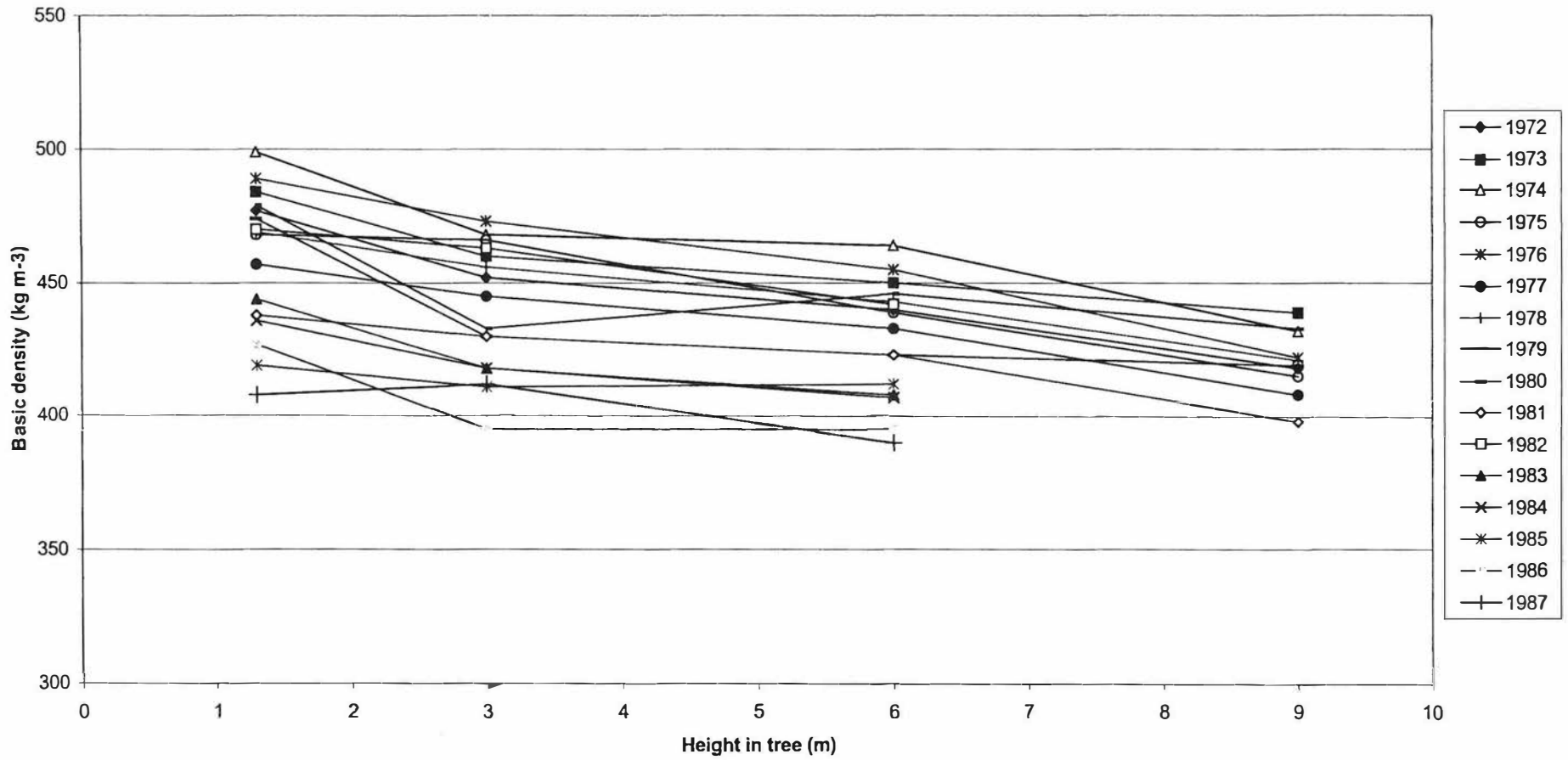


Figure 2. Basic density of maritime pine with increasing height in tree-planting years 1972 to 1987 (P72 to P87).

TABLE 5

Mean basic density ( $\text{kg m}^{-3}$ ) and standard deviations (in parentheses) of edge and internal maritime pine trees (35 mm sections).

YEAR	SAMPLE LOCATION	0–35 mm	35–70 mm	70–105 mm	>105 mm
P80 <sup>a</sup>	Edge	441 (71)	448 (48)	483 (29)	520 (-) <sup>b</sup>
	Internal	453 (69)	485 (30)	513 (36)	
P82	Edge	423 (71)	440 (37)	449 (-)	513 (-)
	Internal	415 (31)	450 (47)	513 (-)	
P84	Edge	387 (30)	443 (36)	484 (-)	520 (-)
	Internal	410 (35)	458 (31)	520 (-)	

<sup>a</sup> P80 = planted in 1980

<sup>b</sup> Standard deviation is not given for fewer than five sections.

TABLE 6

Mean basic density ( $\text{kg m}^{-3}$ ) and standard deviations (in parentheses) of unextracted and resin-extracted cores from maritime pine trees (35 mm sections), and estimated resin contents.

YEAR	SAMPLE	0–35 mm	35–70 mm	70–105 mm	>105 mm
P57 <sup>a</sup>	Unextracted	517 (68)	512 (45)	554 (32)	566 (-) <sup>b</sup>
	Extracted	454 (48)	485 (39)	534 (43)	576 (-)
	Resin (%)	13.9	5.6	3.7	-
P84	Unextracted	419 (22)	465 (52)	495 (-)	
	Extracted	404 (23)	450 (40)	486 (-)	
	Resin (%)	3.7	3.3	1.9	

<sup>a</sup> P57 = planted in 1957

<sup>b</sup> Standard deviation is not given for fewer than five sections.

Department's intensive tree breeding program. Perry and Hopkins (1967) gave basic density data for each selected tree (age range 30 to 138 years), with a mean of  $500 \text{ kg m}^{-3}$ . The major traits for improvement in the program were stem straightness and vigour, with consideration also given to branch size and angle.

The CSIRO Division of Forest Products completed a major survey of density and shrinkage of native and exotic species grown in Australia (Kingston and Risdon 1963). They assessed samples of unimproved maritime pine from Western Australia, which had mean air-dry density of  $596 \text{ kg m}^{-3}$  and basic density of  $490 \text{ kg m}^{-3}$ .

Nicholls *et al.* (1963) assessed wood properties of the four major provenances of maritime pine, i.e. Leiria, Corsica, Esterel and Landes, and concluded that the Leirian provenance had higher basic density, good fibre length and superior vigour and form compared with the others (Table 7). Mean values were not given, but a graph in the report indicated that a basic density of  $500 \text{ kg m}^{-3}$  was achieved by ten years.

The tree-breeding program progressed with its concentration on phenotype, and wood density was given

minor consideration until a screening of parents for the breeding population for the next generation was done to confirm that juvenile wood (defined as the first eight rings) was of acceptable density (Hopkins and Butcher 1994). They reported mean basic density of  $430 \text{ kg m}^{-3}$  for juvenile wood (first eight rings) and  $480 \text{ kg m}^{-3}$  for mature wood (ninth to twelfth rings).

Air-dry density was measured as part of an assessment of the strength properties of Western Australian-grown maritime pine by Siemon (1983), with treatments ranging from P36 to P66. The 16-year-old material reported in the study as 'pedigree', and which came from the Flinn's agroforestry trial near Mundaring, had air-dried density as low as  $474 \text{ kg m}^{-3}$ . This material was actually unimproved. The mean air-dry density for all samples in the study was  $559 \text{ kg m}^{-3}$ . A later assessment of Donnybrook Sunkland trial plots and 13 and 14-year-old maritime pine showed a mean air-dry density of  $570 \text{ kg m}^{-3}$ .

Wespine Industries Pty Ltd carried out a sawmilling trial of maritime pine in which graded recoveries and knot sizes from older resource was compared with those of pedigreed material and unimproved planted in 1971

TABLE 7

Air-dry and basic density (kg m<sup>-3</sup>) from previous assessments of Western Australian-grown maritime pine.

RESOURCE	SAMPLE SIZE	AIR-DRY DENSITY		BASIC DENSITY		REFERENCES
		MEAN	SD	MEAN	SD	
Leirian trees selected by Perry in 1965 (age 30–138)	85			500	33	Perry & Hopkins (1967)
Mature wood from the Sommerville plantation (1960s)				550		Nicholls (1966)
Screening of breeding population (age 8–12)	336			430(Juv)		
				480(Mat)	30	Hopkins and Butcher (1994)
					40	
Wespine sawmilling trial: P71 pedigreed	36	588	37			Meachem <sup>a</sup> (pers.comm)
31-year-old Yanchep plantation	10	569	53			Meachem (pers.comm)
47-year-old Gnangara plantation	10	611	54			Meachem (pers.comm)
WA resource: overall mean		559				Siemon (1983)
" 16-year-old (Agroforestry)	5	474				Siemon (1983)
Donnybrook Sunkland trial plots (13, 14 year old)		570	85			Siemon (1995)
CALM Timber Technology assessment of P73 orchard stock (Yanchep C23): 25 years old	11	557	80	458	55	CTT (1998)
Routine stock	(x 7 discs) 11	550	81	454	63	
CSIRO data	10	596	36	490	28	Kingston & Risdon (1961)

<sup>a</sup> Mr G. Meachem, Wespine Pty Ltd, Moore Rd, Dardanup WA 6236.

(Meachem,<sup>1</sup> personal communication). Air-dry density was also measured, and mean value was 588 kg m<sup>-3</sup>. Other data collected by Wespine were air-dry density of 569 kg m<sup>-3</sup> for 31-year-old unimproved and 611 kg m<sup>-3</sup> for 47-year-old pines.

CALM Timber Technology had completed a wood density assessment of eleven maritime pine trees (P73) of seed orchard origin, which included a comparison with adjacent unimproved trees in the Yanchep trial (Hill 2000). Although there was a significant improvement in stem straightness and increase in vigour (and therefore size) in the pedigreed trees, the air-dry densities and basic densities were similar in the two treatments. Air-dry densities of pedigreed and unimproved trees were 557 kg m<sup>-3</sup> and 550 kg m<sup>-3</sup> respectively, and basic densities were 458 kg m<sup>-3</sup> and 454 kg m<sup>-3</sup> respectively. The mean ring width of the pedigreed specimens was greater than for unimproved, but obviously the latewood percentage was similar in both, resulting in similar density.

## CONCLUSION

The first survey of basic density compared wood of pedigreed maritime pine planted in Yanchep, Pinjar or Gnangara plantations from 1972 to 1987 with some older unimproved material (P51, P57, and P69 to P71). There was a trend of decreasing basic density as stand age decreased, which would be explained by the higher resin contents in the older trees. Further assessments of basic density of pedigreed maritime pine will continue, with plots planted in semi-arid areas scheduled for survey in 2000.

The second survey assessed effect of height in tree on wood basic density of pedigreed maritime pine planted in Pinjar and Yanchep plantations from 1972 to 1987. There was a trend of decreasing basic density as stand age decreased, which would be explained by the higher resin contents in the older trees. The trend of decreasing mean basic density with increasing height in the tree was confirmed.

In commercial use such as LVL or plywood production where pine is used with the normal resin content, it is likely that some volatile components of the resins will be given off during the veneer drying process with drying temperatures probably about 160°C. The highest resin content is in the 70 mm diameter core discarded after peeling. The thin veneers peeled outside this diameter should not be adversely affected by resin content, particularly with the high quality gluelines achievable from modern adhesives and technology.

## ACKNOWLEDGEMENTS

The first survey was organized in consultation with Ian Knobel of Wesfi Ltd, and Barry McCombe, a consultant to Wesfi. Clayton Sanders of CALM's Plantation Group nominated sampling areas in the routine plantations, and Trevor Butcher permitted sampling of research trials. Ernie Jordan provided technical assistance in the fieldwork.

In the second survey to assess the effect of height in tree on basic density, Tony Dehnel and Brian Halcy provided technical assistance in the fieldwork.

Yumiko Bonnardeaux provided assistance with the fieldwork for the resin content assessment, and David Harris of the WA Chemistry Centre organized the resin extraction from the cores.

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