

Birds of the southern Carnarvon Basin, Western Australia: distribution, status and historical changes

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Abstract – Geographic range and status is documented for the 279 bird species known to occur in the southern Carnarvon Basin, Western Australia. The 162 breeding species are mapped, and each was assessed for possible changes in abundance during the last century. No species is known to have become extinct. For about 75% of breeding species we could not detect a change, but about 13% have increased in abundance, and 10–15% have decreased in abundance. These changes are comparable to those reported for a nearby arid area (the Murchison catchment), but are less than those reported for an eastern Australian arid area (western New South Wales).

INTRODUCTION

The north-west coast was the first part of Australia discovered by Europeans, and some of the earliest references to Australian birds, made by early Dutch and English navigators, come from the Carnarvon Basin (see, for example, Burbidge, McKenzie and Harvey, 2000). This was followed up during early settlement in the late 19th and early 20th centuries by field notes from Thomas Carter, a competent field observer resident in the area from 1887 (Carter, 1887–89, 1910, 1917, 1920, 1921, 1923). Whitlock (1921) was another early field worker who provided valuable observations from the Shark Bay area early this century. After that, there were very few detailed sets of observations until the last few decades. However, during that time, as in other parts of the Australian arid zone, there were major changes in land use, particularly with the introduction of domestic stock. These circumstances would be expected to bring about a number of changes in the avifauna of the region (e.g. Reid and Fleming, 1992). Despite this, apart from the regional overview of the Gascoyne District provided by Storr (1985) there has been no attempt to review the avifauna of the Carnarvon Basin and document details of the distribution of individual species and any changes that may have occurred. Contemporary patterns of occurrence are documented by Burbidge, Johnstone, Fuller and Stone (2000), but

these authors did not examine historical changes. The present paper is therefore an attempt to do this.

MATERIALS AND METHODS

This paper is based mainly on information held in the 'Storr, Western Australian Bird Data Bank'. This data bank was compiled by G.M. Storr and R.E. Johnstone between 1970 and 1996 and formed the basis for a series of eight regional avifaunas covering Western Australia (e.g. Storr, 1985). It contains details of specimens held in museum and private collections, extracts from the literature and the unpublished data of many naturalists. Names and taxonomy follow Johnstone (2001).

The scope of the present work is to summarise for each species and subspecies our knowledge of local distribution, ecological status, relative abundance, habitat preferences, breeding season, movements and taxonomy. Range is usually given in broad terms, for example coasts and coastal plains, or eastern zone, and a distribution map is given for each species recorded breeding in the region. Breeding and wintering ranges, when different from total range, are outlined in the species accounts. Status refers primarily to a bird's ecological status, i.e. whether it is a resident or a breeding or non-breeding visitor, sedentary, nomadic or migratory, and very common, common, moderately common, uncommon, scarce or rare. Habitat preferences are defined in terms of vegetation and breeding seasons are defined by months in which eggs are laid. Season of occurrence of regular non-breeding visitors is indicated by

This paper is dedicated to the memory of Robert Lance Pink (1941–1993) who contributed a great deal to our knowledge of the ornithology of the region.

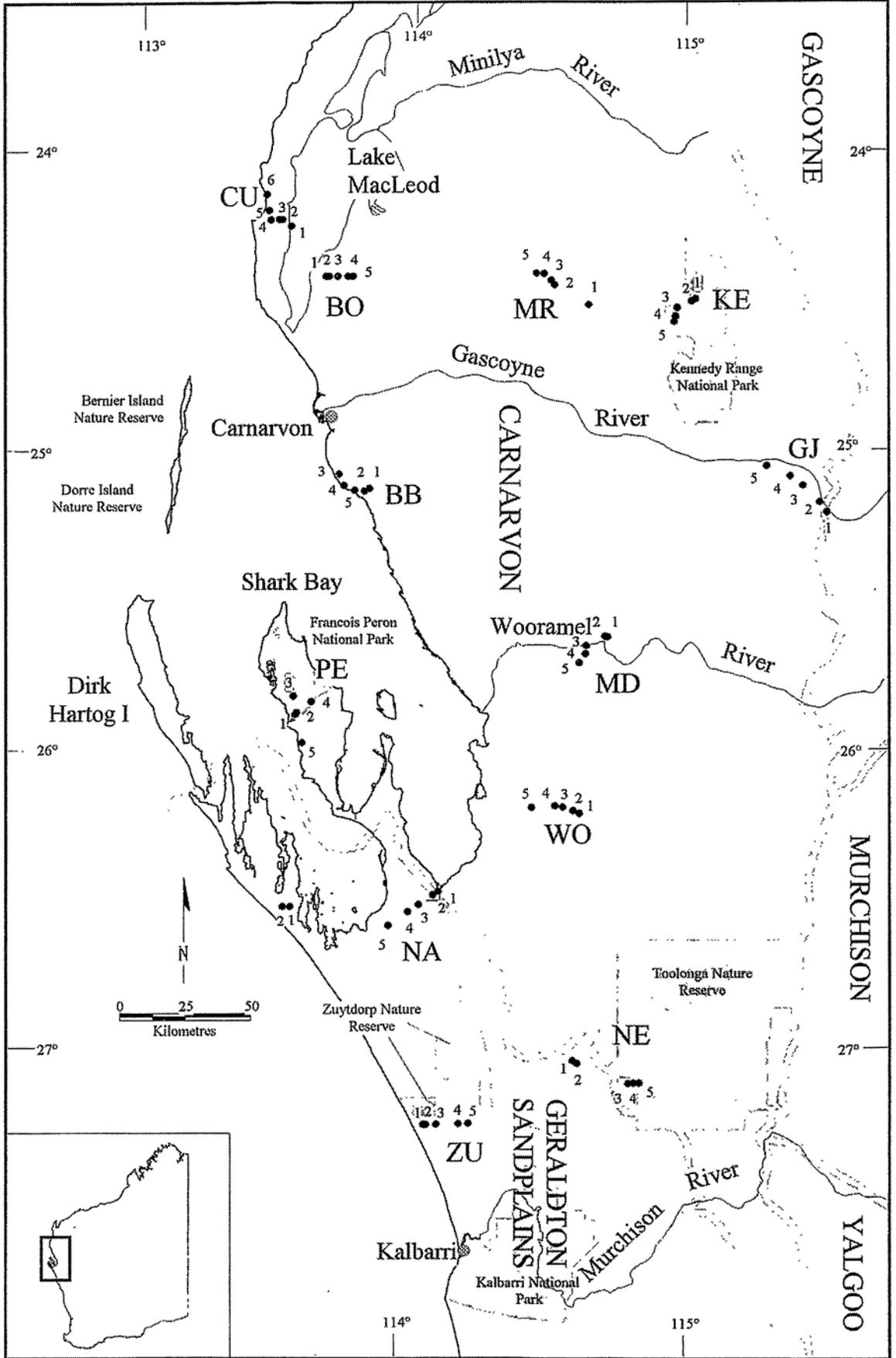


Figure 1 Location of biogeographic boundaries (Thackway and Cresswell, 1995) and detailed study sites (Burbidge, Johnstone, Fuller and Stone, 2000) in the Southern Carnarvon Basin.

months of earliest and latest records. For vagrants and rare visitors, records are individually cited. If no comment is made in any of the above categories (e.g. breeding) then there are no data known to us.

The region covered by this paper is that part of the Carnarvon Basin lying between latitude 24°S and the State Vermin Fence at 27°16'S and bounded by longitude 115°40'E (Figures 1, 2) [see Burbidge, McKenzie and Harvey (2000) for further detail]. The maps provided by us for individual species (Figure 2) extend from 23°30'S to 28°S, but it is only within the above limits (i.e. 24° to 27°16'S) that we have exhaustively searched for all available records (up to October 1998). Mean annual rainfall ranges from 35 cm in the far south to 18 cm in the far north-east. In the south most of the rain falls from April to October and in the north-east from December to June (Wyrwoll *et al.*, 2000).

Most of the region lies north of the mulga-eucalypt line (Serventy and Whittell, 1967) which marks the boundary between acacia dominated vegetation in the north and eucalypt dominated vegetation in the south [this corresponds with the boundary between the Carnarvon and Geraldton Sandplains Biogeographic Regions of Thackway and Cresswell (1995); see Figure 1]. In the arid northern three-quarters of the region the prevailing plant formations are woodlands, scrubs and thickets of *Acacia* spp., mainly mulga *Acacia aneura* in the north and east and bowgada *Acacia ramulosa* and *A. linophylla* in the south. Watercourses are lined with river gums *Eucalyptus victrix* and occasionally *Casuarina obesa* and *Melaleuca* spp.

Coastal flats and saltlakes are dominated by the chenopod genera *Halosarcia*, *Atriplex* and *Maireana*. Blocks of mangroves *Avicennia marina* occur along the coast between the Gascoyne and Wooramel Rivers and small stands also occur on Lake MacLeod and far north of Peron Peninsula. The extensive red sand dunes on the Kennedy Range are vegetated with *Eucalyptus*, *Banksia* and *Acacia* over *Triodia*. To the south of the mulga-eucalypt line, i.e. south of Hamelin and Nerren Nerren, the prevailing plant formations are eucalypt woodlands growing mainly on the heavier soils and thickets, and heaths on sands.

Pastoralists occupy nearly all of the region, and the vegetation has been slightly to severely degraded by the grazing of sheep, goats and cattle, and in the far south rabbits.

Although the region was visited by European navigators since early in the seventeenth century, little was known of the birds before the beginning of European settlement in the 1850s to 1890s. Even today there are still extensive areas east of Woodleigh and south of Coburn that are poorly sampled. This paper is based mainly on the collections of the Western Australian Museum

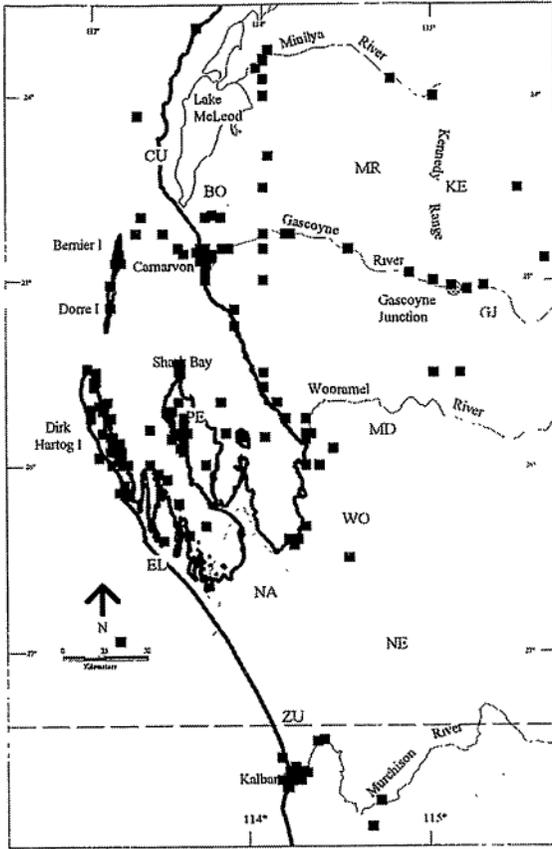
(going back to 1892), the literature (especially papers by T. Carter, F.L. Whitlock, A.A. Burbidge *et al.*, M.G. Brooker *et al.*, M. Howard and R.E. Johnstone) and the unpublished observations of many naturalists notably R.L. Pink, J.R. Ford, G.M. Storr, P. Stone, N. Kolichis, P.J. Fuller, L.A. Smith, J.A. Smith, T.A. Barnes, R.P. Jaensch, G.B. Pearson, R.E. Johnstone, A.H. Burbidge and M. Howard.

Historical changes for breeding species were assessed in part by comparison of the reports of early observers, particularly Carter and Whitlock, with reports by more recent observers and our own knowledge and experience. The second method of assessing changes was by comparing reporting rate between different historical periods (Peters, 1979; McGowan *et al.*, 1998). We compared the number of records for a given species for different time periods using χ^2 (chi-square) contingency tables. The time periods chosen were pre-1951 and post-1950. An examination of all available data showed that there were few records prior to 1950, which marked the point where the reporting rate for all birds increased markedly due to the numbers and efforts of field observers. This point in time is conveniently at about the middle of the period during which European settlement of the region has been widespread (Burbidge, McKenzie and Harvey, 2000). A comparison such as we have attempted makes a number of assumptions (Franklin, 1999), with the main one being that the reporting rate for a species will remain constant if the bird does not change in abundance. This condition may not be met if observations come from different geographic areas in different time periods, or if observers change in skill levels, the way in which they detect birds or the consistency with which they record their observations and the length of observation period for each report. Some of these factors cannot be controlled for but we took two steps to minimise the possible effects of such factors on our data. Since virtually all the pre-1951 records for the study area were from north of the southern end of Hamelin Pool (Figures 1, 2), we made our statistical comparisons using only data gathered from north of 26.5 degrees latitude. We further divided the species into those with predominantly coastal distributions (i.e. west of 114.2° longitude) and those with 'inland' or widespread distributions. Sample sizes for the various categories are shown in Table 1.

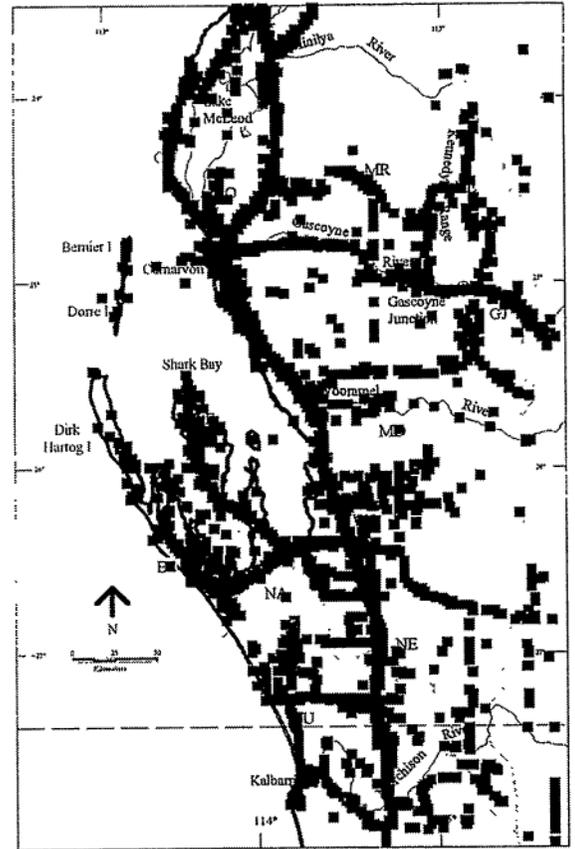
Environment

The region is divisible into eight major habitat types.

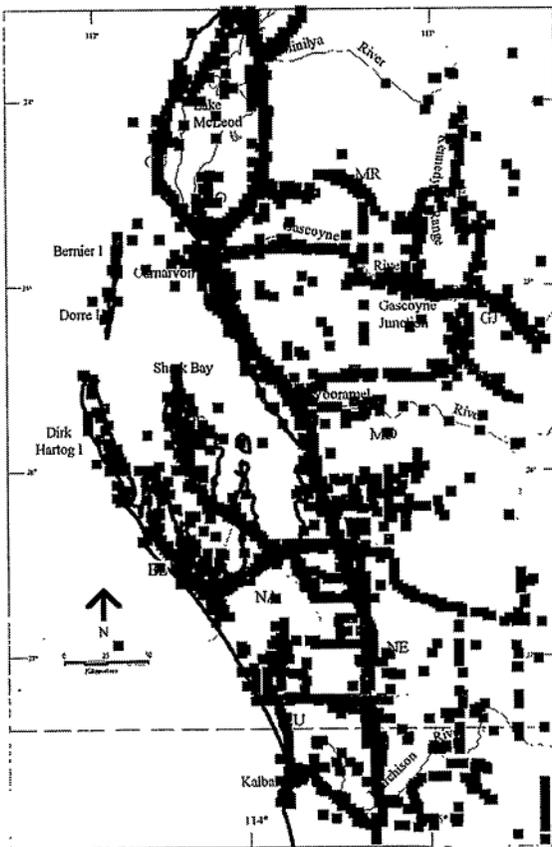
1. **Coastal.** Inshore seas, tidal mudflats, beaches and coastal cliffs.
2. **Islands.** Includes the large islands namely, Bernier, Dorre and Dirk Hartog and many small islands in Freycinet Estuary. Soils are mainly



a, Pre-1951



b, Post-1950



c, All

Figure 2 Locations of (a) pre-1951 records, (b) post-1950 records and (c) all records of breeding bird species in the southern Carnarvon Basin. Coverage of records from south of the dashed line at about latitude 27.25°S is incomplete.

white sands over limestone. Mean annual rainfall about 30 cm, most of it falling in winter.

3. Mangal. Blocks of mangal occur on Lake MacLeod and on coast between Miaboolia Beach and Long Point, also northern Peron Peninsula. Only one species of mangrove *Avicennia marina* occurs in the region and stands vary from woodland to stunted shrubland.
4. Coastal Plains. Extending from Cape Cuvier south to Shark Bay; includes coastal flats (sapphire-saltbush flats), saltlakes, coastal

Table 1 Records of breeding bird species (bird species by location by year), for coastal and inland distribution patterns, for the pre-1951 and post-1950 periods.

	No of taxa	Pre-1951	Post-1950	Totals
coastal	32	353	1243	1596
'inland'	130	603	9573	10176
Totals	162	956	10816	11772

dunes and white calcareous sands of coastal dunes. Generally extends inland for about 10 km.

5. **Eastern Acacia Zone.** This occupies nearly all of the eastern part of the region from Booloogoro and Mardathuna south to the mulga - eucalypt line. It consists mainly of red-soil plains (red clays and sandy loams predominate) with some areas of red sand dunes e.g. on Booloogoro, Mardathuna and Meedo. The prevailing vegetation is *Acacia* scrub, mainly mulga *Acacia aneura* in the north and bowgada *Acacia ramulosa* and *A. linophylla* in the south. Mean annual rainfall ranges from 20 to 28 cm.
6. **Kennedy Range.** A steep escarpment with an extensive tableland about 80 km long, covered with deep red sand dunes. The vegetation on the sand dunes is mainly *Grevillea*, *Acacia* and *Banksia* over *Triodia* and the interdune sandplain is mainly scattered mallee (*Eucalyptus*) over *Triodia*.
7. **Southern Eucalypt Zone.** Comprising the Shark Bay sand plains (Edel Land, base of Peron Peninsula, Tamala and the southern part of the region north to the mulga-eucalypt line. Soils grading from white sands over limestone to reddish sands and loams. Vegetation is highly varied assemblage of shrubs and low trees mainly *Eucalyptus*, *Banksia*, *Melaleuca*, *Hakea* and *Grevillea* spp. In the far south of the region there are extensive eucalypt woodlands including tracts of York Gum *Eucalyptus loxophleba*.
8. **Watercourses.** Comprising the Gascoyne and Wooramel rivers and other minor watercourses. Vegetation consists mainly of river gums *Eucalyptus victrix*, *Casuarina*, *Acacia* and *Melaleuca* spp.

LIST OF BIRDS

See Appendix 1 for distribution maps of individual species known or suspected to breed in the Carnarvon Basin.

Casuariidae

Dromaius novaehollandiae (Latham, 1790) Emu

Found throughout the region including Faure I. (but not Dirk Hartog, Bernier and Dorre Is). Moderately common, usually in ones, twos, family parties or small flocks (up to 50) and larger aggregations in south-west of region where movements impeded by state vermin fence. Favours lightly wooded flats and riverine and coastal plains with good grass and herbage. Breeding late April-early June. Has increased in abundance during the last century (Table 2). Emus have also increased in pastoral country elsewhere, apparently due to the provision of artificial water sources (e.g. Davies, 1969).

Megapodiidae

Leipoa ocellata Gould, 1840 Malleefowl

North to Tamala, and the southern quarter of Peron Peninsula, and the southern boundary of Woodleigh and Talisker Stations. Formerly further north on northern Peron Peninsula, east coast of Hamelin Pool, on Boolathana and between Lake MacLeod and the sea. Recently re-introduced by the Western Australian Department of Conservation and Land Management to northern parts of Peron Peninsula. The northern limit of this species in Western Australia. Originally common and widespread, now uncommon and patchily distributed. Mainly in mallee and tea-tree scrub on Tamala and Peron Peninsula and mainly in acacia thickets on Woodleigh and Talisker. Breeding in August-December.

Phasianidae

Coturnix pectoralis Gould, 1837 Stubble Quail

Mainly western part of region, including Dirk Hartog, Baudin and Salutation Islands. Uncommon visitor from south-western Australia (mainly April-November), in ones, twos or small parties (up to 15). Favours lightly wooded grasslands and lakeside flats with samphire and *Nitraria*. Breeding recorded in April and August.

Coturnix ypsilophora australis (Latham, 1802) Brown Quail

One (unconfirmed) record from near Carnarvon on 19 September 1984 in rank grass and low trees beside a swamp.

Anatidae

Anseranas semipalmata (Latham, 1798) Magpie Goose

Rare vagrant visitor probably from Kimberley-eight at Carnarvon in July 1952 (Storr, 1985).

Dendrocygna eytoni (Eyton, 1838) Plumed Whistling Duck

Infrequent and very rare visitor, recorded on Boolathana Station in August 1984 at Carnarvon sewage ponds in May 1982 and on the Lyons River in October 1986.

Dendrocygna arcuata (Horsfield, 1824) Wandering Whistling Duck

Rare visitor probably from Kimberley. Two at McNeill Claypan on 17 September 1996 (D. James personal communication).

Stictonetta naevosa (Gould, 1841) Freckled Duck

Rare visitor from south-west of State. Several shot on a pool on the lower Gascoyne by Tom Carter in September 1913. Also recorded just outside of region on the Lyons River near Mt Augustus in October 1983.

Cygnus atratus (Latham, 1790) Black Swan

Greater part of region, north to Lake MacLeod and the Minilya River and inland to Gascoyne Junction, but absent from waterless country in south-west. Mainly a scarce (in dry years) to moderately common (in wet years) visitor from south-west of State, in pairs or small flocks (up to 25). Favours inundated saltlakes, claypans, swamps, river pools, artesian bore overflows and saltwork ponds. Breeding reported just outside the region in March-May and October-November.

Tadorna tadornoides (Jardine and Selby, 1828) Australian Shelduck

Throughout the region, including Dirk Hartog I. and Freycinet Estuary. Uncommon visitor from south-west Australia, usually in ones, twos or small parties, occasionally flocks (up to 40). Sheltered seas, tidal pools, flooded saltlakes, claypans, swamps, river pools and artesian bore overflows. Breeding just outside the region in July-August.

Chenonetta jubata (Latham, 1802) Australian Wood Duck

Greater part of the region. Uncommon to moderately common visitor from south-west of State, usually in ones, twos or small parties (up to 7). River pools, flooded claypans and other ephemeral waters. No breeding records for Carnarvon Basin.

Anas gracilis Buller, 1869 Grey Teal

Greater part of region, including Dirk Hartog I., but less frequent in waterless south-west. Nomadic. Moderately common to common often breeding, in ones, twos, small parties or flocks (up to 200). Flooded saltlakes and claypans, swamps, floodwaters, artesian bore overflows and saltwork ponds. Breeding recorded in March-August.

Anas castanea (Eyton, 1838) Chestnut Teal

Formerly occurring in mangrove creeks near Carnarvon. In 1916 T. Carter (1920) was told that green-headed teal were often seen and shot in large and deep mangrove creeks some miles north of Carnarvon.

Anas superciliosa Gmelin, 1789 Pacific Black Duck

Throughout the region. Uncommon visitor, probably mainly from the south-west, occasionally breeding, usually in ones, twos or small parties, occasionally flocks (up to 100). Fresh and brackish waters including river and tidal pools, flooded claypans, swamps and artesian bore overflows. Dated breeding records from just outside the region March-May.

Anas rhynchotis rhynchotis Latham, 1802 Australasian Shoveler

Mainly western zone (coastal plains), north to Minilya and east to Boolathana and Callagiddy.

Scarce visitor from south-west, in ones, twos or small flocks. Flooded swamps, saltlakes and claypans, also river pools and artesian bore overflows (especially Hamelin Pool).

Malacorhynchus membranaceus (Latham, 1802) Pink-eared Duck

Uncommon visitor, probably mainly from the south-west, to many parts of region, usually in pairs or small parties, sometimes flocks (up to 8). Mainly flooded saltlakes, claypans, swamps and billabongs, also river pools and artesian bore overflows.

Aythya australis (Eyton, 1838) Hardhead.

Throughout the region. Scarce visitor from south-west of State, single or in small flocks (up to 5). Swamps, river pools and saltwork ponds.

Podicipedidae*Tachybaptus novaehollandiae novaehollandiae* (Stephens, 1826) Australasian Grebe

Uncommon visitor (all months) to greater part of region. Usually in ones or twos, occasionally flocks (up to 100). River pools, ephemeral waters (flooded claypans, swamps and gravel pits) and artesian bore overflows.

Poliiocephalus poliocephalus (Jardine and Selby, 1827) Hoary-headed Grebe

Mainly a non-breeding visitor (all months) to greater part of region (but mostly on the Gascoyne and absent from waterless south-western corner). Scarce or uncommon, usually in ones or twos but occasionally small flocks (up to 44). Flooded claypans and swamps, also river pools and artesian bore overflows. One breeding report (August). Has apparently increased in abundance (first record in 1962).

Podiceps cristatus australis Gould, 1844 Great Crested Grebe

Two records, both on northern Lake MacLeod: flocks of 4 and 20 observed by J.A.K. Lane on 13 and 14 May 1977, and 3 birds observed by S. Halse in 1994.

Spheniscidae*Eudyptula minor novaehollandiae* (Stephens, 1826) Little Penguin

Vagrant, reported as far north as False Entrance (Edel Land) (Serventy and Whittell, 1976: 71).

Procellariidae*Macronectes giganteus* (Gmelin, 1789) Southern Giant Petrel

Scarce winter visitor (June-July) to open seas. All specimens found with bands were birds of the year, banded on Anvers I., Signy I. and Bird I. (South Georgia).

Macronectes halli Mathews, 1912 Northern Giant Petrel

Rare visitor. A nestling banded on Macquarie I. in February 1970, recovered off Cape Cuvier in July 1970.

Daption capense (Linnaeus, 1758) Cape Petrel

Scarce winter visitor from subantarctic to open seas, in ones or twos.

Pterodroma lessonii (Garnot, 1826) White-headed Petrel

Rare winter visitor from subantarctic to seas well offshore.

Pterodroma mollis (Gould, 1844) Soft-plumaged Petrel

Common winter visitor (May–July) from subantarctic to seas well offshore.

Halobaena caerulea (Gmelin, 1789) Blue Petrel

One record: a bird tentatively identified by E.W. Ferguson well offshore on 26 May 1919.

Calonectris leucomelas (Temminck, 1835) Streaked Shearwater

Summer visitor from northern hemisphere to open seas.

Puffinus pacificus (Gmelin, 1789) Wedge-tailed Shearwater

Common to very common breeding visitor to islands in Freycinet Estuary and adjacent seas. Mainly ones and twos also small flocks (up to 100), sometimes close to mainland (Quobba). Breeding mid November–early December on small islands in Freycinet Estuary (Slope (formerly), Friday, Lefebre, Charlie, Freycinet, Double and Baudin). This is the only dimorphic population in Australia with 20% of the birds from these islands being white breasted. Possibly declined in abundance (Table 2), and this may be due to the destruction of Slope Island as a breeding site where about half the population (c. 250 pairs) previously bred.

Puffinus huttoni Mathews, 1912 Hutton's Shearwater

Status uncertain, mainly a winter visitor from New Zealand to well offshore.

Puffinus assimilis assimilis Gould, 1838 Little Shearwater

Rare visitor from the south to open seas.

Diomedidae

Diomedea melanophris Temminck, 1828 Black-browed Albatross

Rare winter visitor (July) from subantarctic to open seas.

Diomedea chrysostoma J.R. Forster, 1785 Grey-headed Albatross

One record: a single bird (possibly this species)

observed by T. Gregory. A few kilometres west of Cape Inscription in July 1938.

Diomedea chlororhynchos bassi Mathews, 1912 Yellow-nosed Albatross

Common visitor (May–November) from the south to open seas.

Hydrobatidae

Oceanites oceanicus (Kuhl, 1820) Wilson's Storm Petrel

Moderately common winter visitor and passage migrant from subantarctic to open seas.

Phaethontidae

Phaethon rubricauda Boddaert, 1783 Red-tailed Tropicbird

One record: a bird probably this species observed south-west of Dirk Hartog I. by E. Ashby in late September 1927.

Sulidae

Sula bassana serratator (G.R. Gray, 1843) Australasian Gannet

Rare visitor (mid May–late August) from the south to open seas.

Anhigidae

Anhinga melanogaster novaehollandiae (Gould, 1847) Darter

Mainly Lake MacLeod and the lower Gascoyne. Uncommon, ones, twos or small parties (up to 10). Permanent pools on Lake MacLeod, Lake Julia and on the Gascoyne. Breeding in September–October.

Phalacrocoracidae

Phalacrocorax carbo novaehollandiae Stephens, 1826 Great Cormorant

Recorded on Lake MacLeod, Miaboolia Beach, at Shark Bay and on large pools on major watercourses. Rare or uncommon visitor in ones, twos and small parties (up to 6). Breeding reported just outside the region in April.

Phalacrocorax varius hypoleucos (Brandt, 1837) Pied Cormorant

Mainland coast from Miaboolia Beach south to Long Point, deep pools on Lake MacLeod, sheltered seas (but not the highly saline Hamelin Pool) and offshore islands, also two records from lower Gascoyne. Very common in Denham Sound, common to moderately common elsewhere. Breeding late April–early September. Possibly declined in abundance (Table 2), but this result may be due to the relatively large number of early observations from Shark Bay.

Phalacrocorax sulcirostris (Brandt, 1837) Little Black Cormorant

Mainly large pools on rivers (especially the Gascoyne) also Lake MacLeod. Breeding on Gascoyne in May–June. Possibly declined over the last century (Table 2).

Phalacrocorax melanoleucos melanoleucos (Vieillot, 1817) Little Pied Cormorant

Greater part of region, mainly the Gascoyne and Lyons Rivers, also Lake MacLeod and Freycinet Estuary. Uncommon, mainly ones and twos. Breeding in mangroves at Lake MacLeod and on islands in Freycinet Estuary in August–September.

Pelecanidae

Pelecanus conspicillatus Temminck, 1824 Australian Pelican

Mainly western part of region. Mainly sheltered seas (Freycinet Estuary and Hamelin Pool), also large pools on Lake MacLeod and the lower Gascoyne (upstream to Gascoyne Junction). Common visitor in ones, twos or small parties, occasionally flocks (up to 600). Breeding reported on Pelican I. in April–May. Possibly declined over the last century (Table 2).

Fregatidae

Fregata ariel (G.R. Gray, 1845) Lesser Frigatebird

Rare vagrant. Reported at Monkey Mia in late August early September 1972.

Ardeidae

Ardea pacifica Latham, 1802 White-necked Heron

Greater part of region, scarce or absent south of Hamelin and Woodleigh. Moderately common, usually single or in small parties. Mainly river pools, bore overflows and floodwaters. Breeding reported just outside region in January, March and August.

Ardea novaehollandiae Latham, 1790 White-faced Heron

Throughout the region including islands. Common to moderately common, usually in ones or twos occasionally small parties (up to 20). River pools, tidal creeks and flats, mangroves, flooded claypans, bore overflows and floodwaters. Breeding reported in February–April and July–August.

Ardea alba modesta J.E. Gray, 1831 Great Egret

Mainly northern part of region, the Gascoyne inland to just east of Gascoyne Junction, also Lake MacLeod. Moderately common visitor; usually single or in small parties (up to 6). River pools, lake and estuarine pools, mangrove creeks, also flooded samphire flats.

Ardea intermedia Wagler, 1829 Intermediate Egret Vagrant. Recorded at Useless Loop saltworks in November 1982.

Ardea garzetta nigripes Temminck, 1840 Little Egret

Moderately common along the coast between Gascoyne and Wooramel Rivers, also casual on northern Lake MacLeod, the Gascoyne (near Gascoyne Junction) and Shark Bay.

Ardea sacra sacra Gmelin, 1789 Eastern Reef Heron

Coasts and islands but not Hamelin Pool. Moderately common resident on Bernier, Dorre and Dirk Hartog Is and on mainland coast between Cape Cuvier and Point Quobba, elsewhere uncommon, usually in ones or twos. Reefs, tidal flats and mangrove creeks. Breeding in August–September.

Butorides striatus stagnatilis (Gould, 1848) Striated Heron

Coasts from Miaboolia Beach south to Long Point and northern Peron Peninsula, also mangroves in northern Lake MacLeod. The southern limit for this species in Western Australia. Common resident usually in ones and twos. Breeding in August to October. Possibly increased in abundance (Table 2).

Nycticorax caledonicus hilli Mathews, 1912 Rufous Night Heron

Moderately common on the lower Gascoyne and in mangroves on northern Lake MacLeod, casual further south (Woodleigh).

Threskiornithidae

Plegadis falcinellus (Linnaeus, 1766) Glossy Ibis

Status uncertain; vagrant or rare visitor. Only recorded at McNeill Claypan, at a bore overflow near Hamelin and 9 km NNE of Minilya Bridge.

Threskiornis molucca (Cuvier, 1829) Australian White Ibis

Vagrant or rare visitor, recorded at Moogooree in 1952, northern Lake MacLeod in 1982 and Carnarvon in 1966.

Threskiornis spinicollis (Jameson, 1835) Straw-necked Ibis

Greater part of region. Highly nomadic. Uncommon to common visitor to coastal and near coastal plains, scarce elsewhere. Mainly ones, twos or small flocks (up to 100) and once a flock of 2,000 at Boologooro. Inundated flats, river pools, bore overflows and dams.

Platalea regia Gould, 1838 Royal Spoonbill

Rare visitor. One observed at Barrabiddy Creek in far north of region on 19 August 1994 (Halse *et al.*, 2000).

Platalea flavipes Gould, 1838 Yellow-billed Spoonbill

Uncommon visitor, single or in small parties (up to 9). River pools (Gascoyne and Wooramel) also flooded claypans and bore overflow (once). Breeding recorded just outside the region at Mt Clare and Breberle Lake.

Accipitridae

Pandion haliaetus cristatus (Vieillot, 1816) Osprey

Common resident on islands, scarce on mainland coast. Breeding in late June-mid September. Possibly decreased in abundance (Table 2), but this result may be due to the relatively high proportion of observations of early observers from islands.

Elanus caeruleus axillaris Latham, 1801 Australian Black-shouldered Kite

Throughout the region. Uncommon to moderately common visitor (mainly in winter). Mostly lightly wooded coastal plains, scarce in interior. Breeding reported at Minilya Bridge in August.

Elanus scriptus Gould, 1842 Letter-winged Kite

Rare and infrequent visitor from the eastern arid zone. Recorded in large numbers about the lower Minilya in October–November 1888, and in ones, twos and small groups at Cape Cuvier, Quobba, Boolathana, Monkey Mia, Useless Loop and Zuytdorp in 1994.

Hamirostra isura (Gould, 1838) Square-tailed Kite

Rare visitor or passage migrant. One observed 12 km ESE of Carnarvon in November 1976, one undated record from Woodleigh and one at Nerren Nerren in 1994.

Hamirostra melanosternon (Gould, 1841) Black-breasted Buzzard

Greater part of region except far south-west corner. Uncommon, usually single, occasionally in twos, one record of four. Mainly lightly wooded country especially river gums along watercourses. One breeding report from Wooramel in September. It was either overlooked by early observers, or has increased in abundance. The first of 26 dated records was in 1961 (near Minilya) and the second in 1975.

Milvus migrans (Boddaert, 1783) Black Kite

Rare visitor to northern half of region south to Woodleigh.

Haliastur sphenurus (Vieillot, 1818) Whistling Kite

Greater part of region including Bernier I., but absent from waterless coastal country south and west of Hamelin. Common in ones, twos or small parties. Wooded country in vicinity of water, also main roads where attracted to dead kangaroos. Breeding April–August.

Haliastur indus girrenera (Vieillot, 1822) Brahminy Kite

Uncommon resident on coast about Carnarvon (Miaboolia Beach south to Oyster Creek), also recorded on northern Lake MacLeod and western edge of Callagiddy and ascending the Gascoyne for a few kilometres. The southern limit for this species in Western Australia. One undated breeding report.

Accipiter fasciatus fasciatus (Vigors and Horsfield, 1827) Brown Goshawk

Throughout the region including Dirk Hartog I., but apparently absent from the far north-west. Uncommon to moderately common in ones and twos. Resident and visitor (influx in autumn-winter by migrants from south-west). Well wooded country, especially about watercourses, also mangroves and tall *Acacia*. Breeding in August–September.

Accipiter cirrocephalus cirrocephalus (Vieillot, 1817) Collared Sparrowhawk

Greater part of region including Dirk Hartog I. but scarce or absent in far north-west and south-east. Uncommon resident, usually single occasionally in twos. Probably a small influx in numbers in autumn-winter with south-west migrants. Breeding July–October. May have declined in abundance (Table 2).

Aquila morphnoides morphnoides Gould, 1841 Little Eagle

Mainly northern and eastern parts of region, south to the Wooramel and upper Murchison, casual further south and west (Hamelin, Tamala) and on Dirk Hartog I. Breeding in July–August.

Aquila audax (Latham, 1802) Wedge-tailed Eagle

Throughout the region including Dorre and Dirk Hartog I. Common to moderately common on sheep stations and about main roads (where attracted to road-kills). Usually in ones or twos, occasionally in small parties (up to 10). Breeding in late May-mid August. Diet and breeding in the Carnarvon area have been documented by Brooker and Ridpath (1980) and Ridpath and Brooker (1986).

Using our measure based on proportions of records we found no statistical evidence for a change in abundance. However, Wedge-tailed Eagles were seen in only 11 of the 42 years before 1951 for which records exist, and in 33 of 45 years after this period, suggesting that they have increased in abundance. The species is believed to have increased in the adjacent Murchison region (Saunders and Curry, 1990) and in other parts of arid Australia (e.g. Smith and Smith, 1994).

Haliaeetus leucogaster (Gmelin, 1788) White-bellied Sea Eagle

Common resident on larger islands less frequent

on mainland coast and northern Lake MacLeod. Islands, coasts and estuaries. Breeding from May to August. Possibly decreased in abundance (Table 2), but this result may be due to the relatively high proportion of observations of early observers from islands.

Circus assimilis Jardine and Selby, 1828 Spotted Harrier

Throughout the region including Dirk Hartog I. Uncommon, usually single. Sparsely wooded country. Breeding in August. May have declined in abundance (Table 2).

Circus approximans Peale, 1848 Swamp Harrier

Rare non-breeding visitor from the south (September–November) to coastal plains. Swamps, bore overflows and flooded grasslands and samphire.

Falconidae

Falco berigora berigora Vigors and Horsfield, 1827 Brown Falcon

Throughout the region including Dirk Hartog I. Common, usually single occasionally in twos. Lightly wooded country, attracted to road kills and grass fires. Breeding in July–August.

Falco cenchroides cenchroides Vigors and Horsfield, 1827 Australian Kestrel

Throughout the region including islands. Common resident and very common autumn-winter visitor, especially to west coast. Usually single, occasionally in twos or small parties (up to 30). Treeless or lightly wooded country, coastal dunes and around saltflakes. Breeding in late July to early October. Has increased in abundance this century (Table 2).

Falco longipennis longipennis Swainson, 1837 Australian Hobby

Throughout the region, including Bernier and Dirk Hartog Is. Moderately common resident and autumn-winter visitor. Numbers augmented by passage migrants and winter visitors from south. Lightly wooded country especially near water. Breeding in August–September.

Falco hypoleucos Gould, 1841 Grey Falcon

Rare visitor to northern part of region south to Gascoyne.

Falco peregrinus macropus Swainson, 1837 Peregrine Falcon

Throughout the region. Scarce visitor (mostly March–August).

Falco subniger G.R. Gray, 1843 Black Falcon

Rare visitor to eastern part of region south to Woodleigh. Open mulga.

Gruidae

Grus rubicunda (Perry, 1810) Brolga

Rare dry season visitor from far north. Several observed near Overlander in 1952, near Minilya Roadhouse in 1987 and recorded just outside the region at Waroora. These are the southernmost records for Western Australia.

Rallidae

Gallirallus philippensis (Linnaeus, 1766) Buff-banded Rail

Mainly coastal areas from Carnarvon south to Hamelin, casual inland, Mardathuna, Woodleigh and on Dirk Hartog I. Nomadic. Rare or uncommon, in ones or twos.

Porzana pusilla palustris Gould, 1843 Baillon's Crake

Rare or uncommon. Recorded at McNeill Claypan in October 1984 and six at Hamelin Pool on 29 August 1994.

Porzana fluminea Gould, 1843 Australian Spotted Crake

Greater part of region. Locally common and probably resident of bore overflows on Hamelin and Yaringa but generally uncommon. Rushes, sedges, low shrubs and samphires around swamps, lakes (fresh or salt) and ephemeral waters.

Porzana tabuensis (Gmelin, 1789) Spotless Crake

Observed at Hamelin bore overflow in November 1982 and late April 1983. Also unconfirmed reports from bore overflows at Yaringa.

Porphyrio porphyrio bellus Gould, 1841 Purple Swamphen

One recorded at bore overflow 25 km SSW of Yaringa on 17 November 1982.

Gallinula ventralis Gould, 1837 Black-tailed Native Hen

Greater part of region but absent in waterless country south and west of Hamelin. Nomadic. Mainly an irregular visitor. Locally common in good years but generally scarce, in ones, twos or small parties, occasionally large flocks (up to 200). Mainly inundated flats and other ephemeral waters, also swamps, claypans, river pools and bore overflows. Breeding reported in March, April, August and October.

Fulica atra australis Gould, 1845 Eurasian Coot

Greater part of region, but absent from waterless country south and west of Hamelin. Uncommon to moderately common (more plentiful on coastal plains than interior). Usually in ones, twos or small parties, occasionally flocks (up to 200). River pools, flooded claypans, swamps, bore overflows and floodwaters. Breeding reported just outside region

in March. Not recorded in the study area north of the Murchison until 1962.

Otididae

Ardeotis australis (J.E. Gray, 1829) Australian Bustard

Throughout the region including Dirk Hartog I. Nomadic. Locally and seasonally varying from rare to moderately common (more plentiful on coastal plains than in interior). Usually in ones, twos or small parties, rarely small flocks (up to 8). Mainly treeless or lightly wooded country, including samphire flats and spinifex plains. Breeding in March and July–August. Apparently declined in abundance.

Turnicidae

Turnix velox (Gould, 1841) Little Button-quail

Greater part of region, no records from south-west and an unconfirmed report from Dirk Hartog I. Common in good seasons, rare or absent in droughts. In ones, twos or small parties. Coastal flats and in interior spinifex (*Triodia* and *Plectrachne*) and other grasses and herbage especially along minor watercourses. Breeding in May–September.

Scolopacidae

Gallinago sp.

A snipe, possibly *G. stenura*, recorded by B. Barrett at Hamelin on 30 January 1991 (*Western Australian Bird Notes* No. 58: 2).

Limosa limosa melanuroides Gould, 1846 Black-tailed Godwit

Rare summer visitor from Palearctic. Recorded at bore overflow near Hamelin, saltwork ponds at Useless Loop and Lake MacLeod, and also at Shark Bay.

Limosa lapponica menzbieri Portenko, 1936 Bar-tailed Godwit

Most coasts including Dirk Hartog I. and shores of Lake MacLeod. Common visitor (August–June) from Palearctic. Usually in small flocks, occasionally hundreds. Mainly tidal mudflats, beaches and saltwork ponds.

Numenius minutus Gould, 1841 Little Curlew

Coasts and coastal plains. Recorded at Lake MacLeod, Carnarvon district, McNeill Claypan, Shark Bay and Peron Peninsula. Rare summer visitor from northern hemisphere. In ones, twos or small flocks (up to 24). Mainly near-coastal samphire and grass flats.

Numenius phaeopus variegatus (Scopoli, 1786) Whimbrel

Most coasts (except Hamelin Pool), also islands and Lake MacLeod. Common visitor (all months)

from northern hemisphere. In ones, twos or small flocks (up to 30). Mainly tidal flats, especially near mangroves, also beaches.

Numenius madagascariensis (Linnaeus, 1766) Eastern Curlew

Most coasts but not Hamelin Pool. Moderately common visitor (all months) from northern hemisphere. In ones, twos, occasionally small parties (up to 8). Mainly tidal mudflats near mangroves.

Tringa totanus (Linnaeus, 1758) Common Redshank

One record of a single bird observed at Carnarvon by R. Garstone on 4 August 1989 (*Western Australian Bird Notes* No. 53:2).

Tringa stagnatilis (Bechstein, 1805) Marsh Sandpiper

Most coasts, also Lake MacLeod, shores of Useless Inlet and Dirk Hartog I. Visitor (August–June) from northern hemisphere. Uncommon to moderately common on coasts and coastal plains, rare in interior. Usually in ones, twos or small parties, occasionally flocks (up to 20). Tidal mudflats, mangrove creeks, flooded samphire flats and bore overflows.

Tringa nebularia (Gunnerus, 1767) Common Greenshank

Most coasts and coastal plains, also Lake MacLeod, shores of Useless Inlet and Dirk Hartog I. One report from Lake Julia, SW of Kennedy Range (Halse *et al.*, 2000).

Visitor (August–June) from northern hemisphere. Uncommon to moderately common on coasts and coastal plains, rare in interior. Usually in ones, twos or small parties, occasionally flocks (up to 70). Tidal mudflats, mangrove creeks, flooded saltlakes and samphire flats, river pools, bore overflows, swamps and saltwork ponds.

Tringa glareola Linnaeus, 1758 Wood Sandpiper

Coastal plain from Gascoyne River south to Hamelin. Summer visitor (October–April) from northern hemisphere. Common at bore overflow near Hamelin in ones, twos or small flocks (up to 80), scarce or rare elsewhere on river pools and claypans.

Tringa cinerea (Guldenstädt, 1774) Terek Sandpiper

Scarce summer visitor from northern hemisphere. Recorded at Lake MacLeod, Carnarvon, Shark Bay and 4 km south of Bush Bay. Tidal mudflats.

Tringa hypoleucos Linnaeus, 1758 Common Sandpiper

Coasts and coastal plains including shores of Lake MacLeod and Useless Inlet, also Dirk Hartog and Salutation Is and along Gascoyne River. Moderately common visitor (late August–early May) from northern hemisphere. Usually in ones or twos. Tidal

flats, beaches, saltwork ponds, river pools and bore overflows.

Tringa brevipes (Vieillot, 1816) Grey-tailed Tattler

Most coasts, including Dirk Hartog I.; also Lake MacLeod. Moderately common visitor (September–June) from northern hemisphere. Usually in ones or twos occasionally small flocks (up to 19). Tidal mud and reef flats also bore overflow at Hamelin.

Arenaria interpres interpres (Linnaeus, 1758) Ruddy Turnstone

All coasts including Lake MacLeod and Bernier and Dirk Hartog Is, but not Hamelin Pool. Common-moderately common visitor (early July–late May) from northern hemisphere. In ones, twos or small flocks (up to 12). Tidal mud and reef flats, beaches, saltwork ponds and rocky coasts.

Limnodromus semipalmatus (Blyth, 1848) Asian Dowitcher

Rare visitor from northern hemisphere. One at Lake MacLeod in late September or early October 1987 (Jaensch and Vervest, 1990).

Calidris canutus (Linnaeus, 1758) Red Knot

Most coasts including shores of Lake MacLeod and Useless Loop also Dirk Hartog I. (but not Hamelin Pool). Uncommon to moderately common summer visitor (late September–May) from northern hemisphere. In ones, twos or small flocks. Mainly tidal flats.

Calidris tenuirostris (Horsfield, 1821) Great Knot

Most coasts including shores of Lake MacLeod (but not Hamelin Pool). Moderately common summer visitor (September–March) from northern hemisphere. In ones, twos or small flocks. Tidal mud and saltflats.

Calidris alba (Pallas, 1764) Sanderling

Coasts including shores of Lake MacLeod. Rare summer visitor from northern hemisphere. In ones, twos or small parties (up to 6). Mainly open beaches, also sandy inlets and saltwork ponds.

Calidris ruficollis (Pallas, 1776) Red-necked Stint

All coasts and coastal plains also Bernier and Dirk Hartog Is. Common visitor (August–June) from northern hemisphere. Mainly in small flocks. Tidal flats, beaches, saltwork ponds, inundated samphire flats and bore overflows.

Calidris minuta (Leisler, 1812) Little Stint

Rare summer visitor from northern hemisphere. Two at Lake MacLeod in November 1999 (T. Kirkby and C. Davis, personal communication).

Calidris subminuta (Middendorff, 1853) Long-toed Stint

Scarce visitor (September–November) from northern hemisphere. In ones, twos or small parties.

Shores of Lake MacLeod, muddy edge of McNeill Claypan, bore overflows and saltwork ponds.

Calidris acuminata (Horsfield, 1821) Sharp-tailed Sandpiper

Most coasts and coastal plains (including Lake MacLeod); also Dirk Hartog I. and Useless Loop saltworks. Moderately common visitor (September–June) from northern hemisphere. Seasonally common on inland waters. Usually in small parties occasionally flocks (up to 200). Flooded samphire flats, bore overflows and tidal flats.

Calidris ferruginea (Pontoppidan, 1763) Curlew Sandpiper

Mainland coast and coastal plains including Lake MacLeod and Useless Loop saltworks. Visitor (September–May) from northern hemisphere. Ordinarily moderately common, in ones, twos or small parties, on passage aggregating in hundreds or thousands (highest numbers 41 000 on Lake MacLeod in September 1987; Jaensch and Vervest, 1990 and 18 392 in November 1999, T. Kirkby and C. Davis, personal communication). Tidal mud and sand flats, saltlakes and bore overflows.

Limicola falcinellus (Pontoppidan, 1763) Broad-billed Sandpiper

Range and status uncertain. Only recorded at Lake MacLeod in September–October 1987. This species breeds in far northern Europe and Asia and winters in southern Europe, southern Asia and northern Australia.

Philomachus pugnax Linnaeus, 1758 Ruff

Rare summer visitor from northern hemisphere. Only reported at Hamelin bore overflow in November 1961.

Rostratulidae

Rostratula benghalensis australis (Gould, 1838) Painted Snipe

A male collected near Carnarvon by G.W. Berry on 21 November 1963.

Burhinidae

Burhinus grallarius (Latham, 1802) Bush Stone-curlew

Greater part of region including Dirk Hartog I. but very few records. Uncommon, in ones or twos. Lightly wooded country near adequate daytime shelter. Breeding July–September. Records are too few to test statistically, but was probably more plentiful before the advent of the feral cat and fox, judging from the remarks of T. Carter (1887). There has certainly been a decline in the number of records, with only three since 1950 (Dirk Hartog, Woodleigh and NE of Kennedy Range).

Haematopodidae

Haematopus longirostris Vieillot, 1817 Pied Oystercatcher

Most coasts, including Bernier, Dorre, Dirk Hartog, Freycinet, Wilds, Mary Anne, Baudin, North Guano, Three Bays and Salutation Is, also Lake MacLeod, but rare or absent in Hamelin Pool. Common on Dirk Hartog I., uncommon to moderately common elsewhere; usually in pairs. Tidal mud and reef flats and sandy beaches. Breeding August–September. Possibly decreased in abundance (Table 2), but this result may be due to the relatively high proportion of observations of early observers from islands, particularly Dirk Hartog.

Haematopus fuliginosus ophthalmicus Castelnau and Ramsay, 1877 Sooty Oystercatcher

Most coasts including Bernier, Dorre and Dirk Hartog Is. Moderately common; usually in pairs or small parties (up to 6). Mainly rocky coasts.

Recurvirostridae

Himantopus himantopus leucocephalus Gould, 1837 Black-winged Stilt

Greater part of region, south to Hamelin. Nomadic. Common and breeding in wet years, but generally uncommon to moderately common in ones, twos or small parties, occasionally flocks (up to 124). Inundated samphire flats, claypans, saltlakes, swamps, bore overflows and river pools. Breeding in June. Apparently increased in abundance (Table 2).

Cladorhynchus leucocephalus (Vieillot, 1816) Banded Stilt

Coastal plains from Lake MacLeod south to Tamala. Uncommon to very common visitor; usually in small flocks, occasionally large flocks (up to c. 50 000). Mainly flooded saltlakes, also saltwork ponds and bore overflows. Breeding reported just outside region.

Recurvirostra novaehollandiae Vieillot, 1816 Red-necked Avocet

Greater part of region south to Hamelin. Nomadic, uncommon visitor, usually in twos or small parties occasionally in aggregations (up to 100). Flooded saltlakes, claypans, brackish coastal lagoons, saltwork ponds, bore overflows and ephemeral pools. Breeding reported just outside region.

Charadriidae

Vanellus tricolor (Vieillot, 1818) Banded Lapwing

Throughout the region, including Dirk Hartog I. Common resident and autumn and winter visitor from south. Usually in pairs or small parties, rarely flocks (up to 15). Sparsely vegetated plains. Breeding June–August and February–April in

north. This species was not recorded in the region by early workers; it colonised Dirk Hartog I. in c. 1915 and the Peron Peninsula a few years later.

Pluvialis squatarola (Linnaeus, 1758) Grey Plover

Most coasts including Bernier and Dirk Hartog Is, also shores of Lake MacLeod. Uncommon mainly summer visitor (August–May) from northern hemisphere. Usually in ones, twos or small parties. Tidal mudflats, beaches and saltwork ponds.

Pluvialis fulva (Gmelin, 1789) Pacific Golden Plover

Most coasts including Bernier I., also Lake MacLeod. Scarce visitor (mainly summer) from northern hemisphere. Usually single, occasionally in small parties (up to 6). Tidal mudflats, saltwork ponds and saltlakes.

Charadrius ruficapillus Temminck, 1822 Red-capped Plover

Most coasts and coastal plains, including larger islands (Bernier and Dirk Hartog), also Lake MacLeod. Common to moderately common resident usually in ones, twos or small parties, occasionally aggregations (up to 100). Beaches, near coastal saltmarshes, saltwork ponds, shores of saltlakes, also edges of river pools and freshwater lagoons. Breeding in July–August.

Charadrius mongolus mongolus Pallas, 1776 Lesser Sand Plover

Rare summer visitor from northern hemisphere. Small flocks recorded near Carnarvon, Denham and at Lake MacLeod.

Charadrius leschenaultii leschenaultii Lesson, 1826 Greater Sand Plover

Most coasts including Bernier and Dirk Hartog Is, also shores of Lake MacLeod. Moderately common visitor (recorded all months) from northern hemisphere. Usually in ones, twos or small parties (up to 12). Tidal flats, saltlakes, saltwork ponds and sandy beaches.

Charadrius melanops Vieillot, 1818 Black-fronted Dotterel

Greater part of region, but not Peron Peninsula or far south-west. Moderately common, usually in ones or twos. Mainly bare margins of fresh waters, occasionally edge of saltlakes. Breeding August–September. In our study area, not recorded north of the Murchison until 1959. Has benefited from the provision of overflows from artesian wells.

Charadrius rubricollis (Gmelin, 1789) Hooded Plover

Vagrant. Four birds on a claypan at Wooramel River crossing, North West Coastal Highway, on 21 June 1977 (J. Masters, personal communication).

Charadrius veredus Gould, 1848 Oriental Plover

Rare summer visitor from northern hemisphere to

north-western coastal plains. Recorded 37 km SSE of Quobba in October 1980 and 30 km E of Carnarvon in October 1927. Also unconfirmed report from Carbla in January 1993 (*Western Australian Bird Notes* No. 65: 3).

Erythrogonys cinctus Gould, 1838 Red-kneed Dotterel

Coastal plains from the Gascoyne River south to Hamelin and inland to Callagiddy and Woodleigh; also interior on larger rivers and at Lake Julia and Lake MacLeod. Nomadic. Generally uncommon, more frequent in wet years. Usually in ones, twos or small parties, occasionally larger aggregations (up to 40). Mainly flooded saltlakes also edges of fresh or brackish swamps, claypans and bore overflows. Breeding reported in February–March and from July to October.

Peltohyas australis (Gould, 1841) Inland Dotterel

Mainly coastal plains and Dirk Hartog I. Uncommon, usually in small parties (up to 8). Sparsely vegetated plains, stony flats and samphire flats. Breeding March–April and July–August. Not recorded in the study area until 1960.

Glareolidae

Stiltia isabella (Vieillot, 1816) Australian Pratincole

Far north of region, lower Minilya River and lower Gascoyne (Brickhouse). Rare visitor from further north, in ones, twos or small flocks. One breeding record from lower Minilya in July.

Glareola maldivarum J.R. Forster, 1795 Oriental Pratincole

Rare summer visitor from northern hemisphere. In ones or twos to coastal plains south to Hamelin.

Laridae

Catharacta antarctica lonnbergi (Mathews, 1912) Brown Skua

Rare winter visitor from the south to sheltered seas.

Larus pacificus georgii King, 1826 Pacific Gull

All coasts and islands, also Lake MacLeod. Moderately common on islands and about towns (Carnarvon, Denham) and saltwork ponds, otherwise scarce. Breeding on islands in August–September.

Larus dominicanus Lichtenstein, 1823 Kelp Gull

Vagrant. One recorded at Carnarvon on 13 March 1981 (*Australasian Seabird Group Newsletter* 17: 3–5).

Larus novaehollandiae novaehollandiae Stephens, 1826 Silver Gull

All coasts including many islands, also Lake MacLeod. Moderately common on islands and around towns (Carnarvon, Denham), elsewhere

scarce or uncommon. In ones, twos or small flocks (up to 100). Breeding on islands from April–September.

Sterna nilotica macrotarsa Gould, 1837 Gull-billed Tern

Coasts and coastal plains from Miaboolia Beach south to Hamelin; also Lake MacLeod. Scarce visitor in ones, twos and small flocks (up to 30). Inundated samphire, tidal creeks, saltlakes, saltwork ponds, river pools, and bore overflows.

Sterna caspia Pallas, 1770 Caspian Tern

Moderately common on islands (except Bernier and Dorre) and in sheltered seas (but not Hamelin Pool), also estuaries, pools and bare shores of Lake MacLeod. Breeding in August–September.

Sterna bengalensis Lesson, 1831 Lesser Crested Tern

Coast and seas south to South Passage. Uncommon, mainly in small flocks (up to 20). Most birds are probably visitors from further north. Breeding in small numbers on Meade I. in June 1998, the southernmost breeding locality for Western Australia. Apparently increasing in numbers (Table 2); this tern may be moving south like some other tropical species (Storr and Johnstone, 1988; Dunlop and Wooller, 1990).

Sterna bergii Lichtenstein, 1823 Crested Tern

Coasts, islands and seas (but not Hamelin Pool); also Lake MacLeod. Common; resting in flocks (up to 300) but usually fishing singly. Mainly sheltered seas. Breeding August–September. Possibly decreasing in abundance (Table 2).

Sterna dougallii Montagu, 1813 Roseate Tern

Coast south to Carnarvon and tip of Peron Peninsula also Dirk Hartog I. Moderately common, usually resting in flocks (up to 200), fishing singly. Breeding on islands off Dirk Hartog in November–December. Possibly increasing; first recorded in the study area in 1959.

Sterna hirundo longipennis Nordmann, 1835 Common Tern

Moderately common summer visitor from northern hemisphere to seas around Carnarvon.

Sterna (albifrons) sinensis Gmelin, 1789 White-shafted Little Tern

Probably a rare summer visitor from Asia (judging from records north and south of region); only one record from Carnarvon.

Sterna nereis nereis (Gould, 1843) Fairy Tern

Coasts and sheltered blue-water seas south to Denham and Useless Inlet; also islands (including those in Freycinet Estuary), and Lake MacLeod. Common summer visitor from the south (September–late February). Breeding on small (mostly rocky) islands; mid September–mid

November. Possibly decreasing in abundance (Table 2).

Sterna anaethetus anaethetus Scopoli, 1786 Bridled Tern

Islands and blue-water seas; but not reported from Bernier and Dorre. Common summer visitor from Asia (September-late February). Breeding on small (mostly rocky) islands; mid September-mid November.

Sterna hybrida javanica Horsfield, 1821 Whiskered Tern

Coastal plains from Boolathana south to Hamelin. Moderately common visitor, numbers varying with extent of floodwaters on coastal plains, usually in ones, twos or small flocks (up to 40), otherwise scarce. Inundated near-coastal samphire flats, saltlakes and claypans, also bore overflows and river pools. Breeding reported just out of region in February–April and August–September. Possibly increasing in abundance (Table 2), but the pattern may be complicated by the irruptive nature of the species.

Sterna leucoptera Temminck, 1815 White-winged Black Tern

Irregular summer visitor from northern hemisphere to coastal plains from Lake MacLeod south to Woodleigh. Usually in ones, twos or small flocks, occasionally in thousands before departure.

Columbidae

Columba livia Gmelin, 1789 Domestic Pigeon

Moderately common around farms and urban areas at Carnarvon, also recorded at Quobba, Denham, Hamelin, Monkey Mia, Nanga, Overlander and Dirk Hartog I.

Streptopelia senegalensis senegalensis (Linnaeus, 1766) Laughing Turtle-Dove

Recorded at Yandoo Creek (24°38'S, 113°50'E), Carnarvon, Babbage I., near mouth of Wooramel, Overlander Roadhouse, Billabong Roadhouse, several sites on Peron Peninsula, Whale Well, Tamala (26°48'S, 113°42'E) and Dirk Hartog Island. The northern limit of this exotic species in Western Australia. Status uncertain. Occasional visitor possibly resident in some areas (including Dirk Hartog Island). Breeding reported near Overlander in November. Has colonised the study area since about 1960 (first record 1963).

Phaps chalcoptera (Latham, 1790) Common Bronzewing

Throughout the region, including Peron Peninsula and Dirk Hartog I. Locally moderately common, but generally uncommon; usually in ones or twos with aggregations at water. Mainly wattle thickets and scrubs. Breeding June–October.

Phaps histrionica (Gould, 1841) Flock Pigeon

Very irregular to coastal plains (Carnarvon district and lower Lyndon River). Appearing (if at all) in small numbers, but in some years e.g. 1887 and 1987 in thousands. These are the southernmost records for Western Australia.

Ocyphaps lophotes (Temminck, 1822) Crested Pigeon

Throughout the region but scarce or rare in waterless areas south of Tamala and west of Coburn and Nerren Nerren. Originally local and uncommon and confined to the lower Gascoyne. Now moderately common to very common in pastoral areas; in ones, twos or small parties, but up to 100 at water. Has probably benefited from the provision of water supplies for domestic stock. Breeding probably all year round, but the egg months cited are February–April, July–November.

Geophaps plumifera Gould, 1842 Spinifex Pigeon

Northern interior of region; upper Gascoyne west to Rocky Pool and Wooramel west to Callytharra Springs. Locally moderately common but generally scarce; usually in ones, twos or small parties, occasionally larger flocks at water. Stony or rocky country in vicinity of water. Breeding reported just outside the region (on the Minilya) in September.

Geopelia cuneata (Latham, 1802) Diamond Dove

Most of region south to Coburn and Nerren Nerren and the Murchison. Moderately common in north of region, uncommon south of the Gascoyne and probably mostly visitors. Usually in ones, twos or small parties. Breeding reported in August.

Geopelia striata placida Gould, 1844 Peaceful Dove

Common on the Gascoyne and about Carnarvon, rare visitor at Hamelin and Woodleigh. Mainly vicinity of permanent pools with river gums. Breeding reported in February. May have declined in abundance (Table 2).

Psittacidae

Calyptorhynchus banksii samueli Mathews, 1917 Red-tailed Black Cockatoo

Range broken and patchy. Southern population confined to south-east interior along the mulga-eucalypt line at Coburn and Nerren Nerren, also patchily distributed in north-east of region on major watercourses (Minilya, upper Gascoyne, Lyons and upper Wooramel). Uncommon resident in pairs or small parties. Breeding reported outside the region from July to November also February to May.

Cacatua roseicapilla roseicapilla Vieillot, 1817 Galah

Throughout the region, vagrant on Dirk Hartog I. Locally uncommon, e.g. on Peron Peninsula, but generally common. Mainly in pairs or small parties, occasionally large flocks (up to 150). Mainly lightly wooded grasslands in vicinity of water and with

trees suitable for nesting and shelter. Breeding July–September. Now much more plentiful and widespread than around the turn of the century, presumably due to the provision of artificial water sources and the introduction of seeding exotic grasses and annuals.

Cacatua sanguinea westralensis (Mathews, 1917) Little Corella

Mainly northern and eastern parts of region south to Woodleigh and Byro, accidental on Dirk Hartog I., Peron Peninsula and at Tamala. Locally common on lower and middle Gascoyne but generally scarce and uncommon and patchily distributed; usually in flocks (up to 350). Mostly along watercourses with pools fringed with river gums, also towns and homesteads. Breeding in August–September.

Cacatua leadbeateri (Vigors, 1831) Major Mitchell's Cockatoo

Rare visitor to Tamala. Formerly occurring on the Wooramel, recorded there in 1887 by T. Carter. Scarce on and near the Murchison.

Nymphicus hollandicus (Kerr, 1792) Cockatiel

Mainly eastern interior of region west to Minilya, Callagiddy, lower Wooramel, Hamelin and Nerren Nerren. Casual further west including Dirk Hartog I. Moderately common in wet years but generally uncommon; usually in pairs or small parties occasionally flocks (up to 60). Mainly lightly wooded grasslands. Breeding reported in September.

Polytelis anthoepus anthoepus (Lear, 1831) Regent Parrot

Rare visitor to southern part of region (below mulga-eucalypt line), north to 23 km ENE of Tamala; vagrant further north to Monkey Mia and Carnarvon. In pairs or small flocks (up to 12). The northern limit of this species in Western Australia.

Platycercus zonarius zonarius (Shaw, 1805) Australian Ringneck

Greater part of region but not Edel Land, and rare or absent on Peron Peninsula and coastal plains between the Gascoyne and the Wooramel. Moderately common, usually in ones, twos or family parties. Well wooded country especially river gums and other eucalypts, also tall mulgas. Breeding recorded in August.

Platycercus varius (Clark, 1910) Mulga Parrot

Greater part of region north to Booloogooro and Kennedy Range but probably only a rare visitor to the waterless country in south-west corner. Uncommon to moderately common in well-wooded country especially mulga and other acacia scrubs and mallee, scarce or absent on coastal plains, usually in pairs or small parties. Breeding recorded in August.

Neophema elegans (Gould, 1837) Elegant Parrot

Southern two-thirds of region, north to the Gascoyne and west to Callagiddy and Yaringa. Scarce autumn visitor presumably from south-western Australia to grassy flats on coastal plains and along water courses.

Neophema petrophila (Gould, 1841) Rock Parrot

Confined to western parts of Shark Bay. The northern limit of this species in Western Australia. Very common in pairs or flocks up to 100 on small islands in Freycinet Estuary, elsewhere scarce. No records from Peron Peninsula or Dirk Hartog I. since 1920. Breeding reported in August–September.

Neophema bourkii (Gould, 1841) Bourke's Parrot

Mainly eastern half of region, west to Mardathuna, Callagiddy, Overlander and Toolonga. Moderately common, in ones twos or small flocks (up to 16). Mainly mulga and other acacia scrubs, also mallees and callitris near drinkable water. Breeding reported in August. May have expanded into the Carnarvon Basin in recent times – the first dated record from the study area is from 1960.

Melopsittacus undulatus (Shaw, 1805) Budgerigar

Mainly eastern part of region west to Minilya, Boolathana, Wooramel, Coburn and Nerren Nerren, casual further west e.g. appearing on Dirk Hartog I. after tropical cyclone of February 1921. Abundance extremely variable, ranging locally from scarce or absent after long dry periods, to very common and breeding in wet years, e.g. 1961, 1972, 1975 and 1982. This variability may explain the statistically significant increase in abundance reported in Table 2. Usually in small flocks, occasionally in hundreds. Lightly wooded grasslands (including *Triodia*), especially in vicinity of water and belts of trees suitable for nesting and shelter including river gums. Breeding reported in April, May, August, September and October.

Cuculidae

Cuculus pallidus (Latham, 1801) Pallid Cuckoo

Throughout the region, including Bernier and Dirk Hartog Is. Visitor and passage migrant (mostly May–September). After breeding in southern part of State adults move north. Moderately common in eastern part of region, uncommon on coastal plains; usually in ones or twos. Most kinds of wooded country. Breeding reported north to lower Gascoyne, August. May have decreased in abundance (Table 2).

Cacomantis flabelliformis flabelliformis (Latham, 1801) Fan-tailed Cuckoo

Five records; an immature collected by P.J. Fuller in dense scrub near Cooloomia on 19 September

1979; also recorded at Nanga in October 1994, Zuytdorp in May 1995 and Gascoyne Junction in October 1994 and June 1995. The south-western population of this species is migratory spending summer in far south and moving north and east from April to June.

Chrysococcyx osculans (Gould, 1847) Black-eared Cuckoo

Throughout the region but absent (or rare) from the far north and the area south of Hamelin and west of Nerren Nerren. Breeding visitor and passage migrant (March–September) from further north. Uncommon or scarce, usually single occasionally in twos. Mainly thickets and scrubs. Breeding reported in August.

Chrysococcyx basalis (Horsfield, 1821) Horsfield's Bronze Cuckoo

Throughout the region including Bernier, Dorre and Dirk Hartog Is. Breeding visitor and passage migrant (March–October). Moderately common, usually single occasionally in twos. Mainly thickets and scrubs of acacia also eucalypt woodlands and mangroves. Breeding reported in July–August.

Chrysococcyx lucidus plagosus (Latham, 1802) Shining Bronze Cuckoo

Normally only recorded in far south of region. Rare passage migrant (to north of State) from the south-west. Specimens collected at Carnarvon in May and August. Recorded at Monkey Mia in September 1994.

Centropodidae

Centropus phasianinus highami (Mathews, 1922) Pheasant Coucal

Formerly occurring on the lower Minilya River; T. Carter collected specimens from thick scrub near a pool at Minilya Station in 1887, but no reports this century.

Strigidae

Ninox novaeseelandiae boobook (Latham, 1802) Boobook Owl

Greater part of region but casual or absent on western coastal plains, Peron Peninsula, Edel Land and Dirk Hartog I. Status uncertain, mainly a winter visitor (from south-western Australia) probably also resident in riverside forests and woodlands also swamps with coolabahs. Usually in ones or twos.

Tytonidae

Tyto alba delicatula (Gould, 1837) Barn Owl

Rare non-breeding visitor to greater part of region, recorded at Quobba (needs confirmation), Carnarvon, 17 km north of Nerren Nerren, Woodleigh and Dorre and Baudin Is.

Podargidae

Podargus strigoides brachypterus Gould, 1840 Tawny Frogmouth

Greater part of region, but scarce on Peron Peninsula and Edel Land. Uncommon to moderately common, usually single occasionally in twos. Most kinds of wooded country. Breeding July–August.

Caprimulgidae

Eurostopodus argus Hartert, 1892 Spotted Nightjar

Greater part of region. Scarce or uncommon and probably mainly only an autumn-winter visitor; casual or accidental on Bernier and Dirk Hartog I. (single breeding record from Dirk Hartog I. in early 1900s).

Aegothelidae

Aegotheles cristatus cristatus (Shaw, 1790) Australian Owllet-nightjar

Greater part of region but not Peron Peninsula or Edel Land. Uncommon on coasts moderately common in eastern part of region. Most wooded habitats. Breeding July to early October. The first record for the study area was in 1961, but it may have been overlooked by early observers (it is more frequent in those parts of the study area least visited by early observers).

Apodidae

Apus pacificus pacificus (Latham, 1801) Fork-tailed Swift

Uncommon non-breeding summer visitor from northern hemisphere in small flocks (up to 20). Recorded near Warroora, south of Carnarvon, Monkey Mia, near Denham and Woodleigh.

Halcyonidae

Dacelo leachii leachii Vigors and Horsfield, 1826 Blue-winged Kookaburra

Largely confined to major watercourses (Minilya, Gascoyne, Lyons and Wooramel), in northern two-thirds of region south to the lower Wooramel. The southern limit of this species in Western Australia. Common to moderately common on Gascoyne and Lyons Rivers, uncommon on Wooramel River. In ones, twos and family parties. Mainly forests of *Eucalyptus victrix* along major watercourses. Breeding in July, August and October. May have declined in abundance (Table 2).

Todiramphus pyrrophygia (Gould, 1841) Red-backed Kingfisher

Greater part of region, but not Peron Peninsula, Edel Land or far south of region. Common to moderately common; usually single occasionally in

twos. Lightly wooded country, especially about minor watercourses with nest sites (exposed banks). Breeding in August–September.

Todiramphus sanctus sanctus (Vigors and Horsfield)
Sacred Kingfisher

Greater part of region but scarce or absent in far south. Uncommon non-breeding winter visitor from south and passage migrant (March–May and August–November). Usually in ones and twos. Mainly river gums in vicinity of water also mangroves.

Meropidae

Merops ornatus Latham, 1801 Rainbow Bee-eater

Greater part of region but absent or accidental on Peron Peninsula and Edel Land and in south-west corner. Breeding visitor from north and passage migrant, mainly arriving in September–October and leaving in February–March. Locally scarce, e.g. in much of coastal plains and on Peron Peninsula and Edel Land, moderately common elsewhere; usually in ones, twos or small parties; occasionally small flocks (up to 50) in passage. Favours lightly wooded country, especially at water. Breeding reported in October–November at Mardathuna, near Carnarvon and at Coburn.

Climacteridae

Climacteris affinis superciliosa North, 1895 White-browed Treecreeper

Mainly eastern part of region. Recorded on lower and middle Gascoyne (between Carnarvon and Gascoyne Junction), Callagiddy, upper Wooramel and Woodleigh. Also near the Elbow of the Murchison. Uncommon. Recorded in open woodlands of mulga and gidgie. Breeding in April.

Climacteris melanura wellsi Ogilvie-Grant, 1909
Black-tailed Treecreeper

Confined to the Minilya and lower Gascoyne from Rocky Pool upstream to Bidgemia. The southern limit for this species in Western Australia. Uncommon to moderately common, in ones, twos or small parties. Mainly river gums. Breeding in August.

Maluridae

Malurus splendens splendens (Quoy and Gaimard, 1830) Splendid Fairy-wren

Greater part of region, west to Carnarvon, Callagiddy, Yaringa, Peron Peninsula, Edel Land, Tamala and north to about 24°50'S including southern end of Kennedy Range. Scarce or absent in south-west corner and far north. Uncommon in north of region, common to very common in south and south east of region; usually in family parties.

Mainly moderately tall and dense shrublands, particularly bowgada *A. linophylla* and other acacia thickets including *A. cuthbertsonii* and *A. victoriae*. Breeding probably in April in north (judging from records just outside the region) and July–August in south. The first dated record north of the Murchison in the study area is 1964, but the species is sparsely distributed in areas visited by early observers.

Malurus lamberti assimilis North, 1901 Variegated Fairy-wren

Throughout the region including Peron Peninsula, Edel Land and Dirk Hartog Island but absent from south-western corner. Common to moderately common; usually in family parties. All kinds of shrubland, thicket and scrub, including mangroves. Breeding from late July to early September. Possibly declined in abundance over the last century (Table 2).

Malurus lamberti bernieri Ogilvie-Grant, 1909

Endemic to Bernier and Dorre Is. Common. The population on Dorre I. is tentatively placed here; its taxonomic status is yet to be resolved.

Malurus pulcherrimus Gould, 1844 Blue-breasted Fairy-wren

Far south-west of region north to Tamala (head of Freycinet Estuary) and east to base of Peron Peninsula, Hamelin Pool and 45 km south of Nerren Nerren. The northern limit of this species in Western Australia. Common to moderately common; in small parties. Mainly sandplain scrubs composed of *Acacia*, *Eucalyptus*, *Banksia*, *Calothamnus* and *Hakea* south of mulga-eucalypt line. Breeding reported just outside the region from late August to early November.

Malurus leucopterus leuconotus Gould, 1865 White-winged Fairy-wren

Moderately common to common on coastal plains and around saltlakes including Lake MacLeod, and also dunes of Kennedy Ranges; less frequent elsewhere. Usually in pairs or small parties. Low vegetation (particularly heaths and chenopod flats), coastal heath and other low shrublands and *Triodia*. Breeding July–September.

Malurus leucopterus leucopterus Vigors and Horsfield, 1827

Common on and endemic to Dirk Hartog I. Breeding in August.

Stipiturus malachurus hartogi Carter, 1916 Southern Emu-wren

Uncommon on and endemic to Dirk Hartog I. Possibly declined in abundance (Table 2). Listed by Storr (1985) as moderately common but local, in pairs or small parties; however, recent workers have reported it as uncommon. Breeding July–August.

Stipiturus ruficeps ruficeps Campbell, 1899 Rufous-crowned Emu-wren

Confined to plateau of Kennedy Range. Moderately common in pairs and family parties. *Triodia* with scattered mallee on sandplains and dunes. One undated breeding report.

Amytornis textilis textilis (Dumont, 1824) Thick-billed Grasswren

Woodleigh, near Overlander and Peron Peninsula (south to near Nanga Homestead); extinct on Dirk Hartog I. Common on Peron Peninsula in open shrubland with *Acacia* and *Triodia*; locally moderately common on Woodleigh Station and around Overlander in piled up deadfall acacia, bowgada thickets and regenerating burnt country. Formerly occurring in dense acacia scrub on Dirk Hartog I. Breeding from July to October (B. Cale, personal communication). Breeding biology has been documented on Peron Peninsula and habitat preferences described in the Shark Bay region by M. Brooker (1988) and B. Brooker (2000).

Pardalotidae

Pardalotus rubricatus Gould, 1838 Red-browed Pardalote

Northern and eastern interior of region south to Wooramel River and west to Carnarvon and Wooramel. Uncommon; in ones or twos. Mainly canopy of eucalypts especially river gums. Breeding reported in September. Has probably declined in abundance over the last century, but numbers of observations are too few to test statistically.

Pardalotus striatus murchisoni Mathews, 1912 Striated Pardalote

Northern part of region, south to upper Wooramel and upper Murchison and west to Bidgemia and Byro. Moderately common in far north, uncommon on the Wooramel and Murchison; in pairs or small parties. Canopy of eucalypts especially river gums. Breeding just outside the region (on the Gascoyne) in May.

Pardalotus striatus westraliensis Mathews, 1912

Southern part of region, north to Coburn, Nerren Nerren and the middle Murchison. Intergrading with *murchisoni* on the upper Murchison River. The northern breeding limit of this subspecies in Western Australia. Moderately common resident in mallee scrubs and eucalypt woodlands south of mulga-eucalypt line and in river gums on Murchison. Scarce winter visitor from south-western Australia to northern parts of region (e.g. Cape Cuvier, September 1994).

Acanthizidae

Sericornis frontalis balstoni Ogilvie-Grant, 1909 White-browed Scrubwren

Coasts and coastal plains, north to Carnarvon including Peron Peninsula and Edel Land and Bernier, Dorre and Dirk Hartog Islands, south to Zuytdorp and Nerren Nerren. The northern limit of this species in Western Australia. Common; usually in pairs or small parties. Dense shrubland especially near-coastal sandplain scrub with *Hakea* and *Acacia* (up to 10 km inland), also dense samphire and mangroves. Breeding reported June–August.

Calamanthus campestris Gould, 1841 Rufous Fieldwren

Coasts and coastal plains including Peron Peninsula and Edel Land and Dorre and Dirk Hartog Is. Uncommon to moderately common; in ones and twos. Heaths and other low scrubs on near-coastal sandplains, also samphire flats and low mangroves. Breeding June–August.

Pyrrholaemus brunneus Gould, 1841 Redthroat

Greater part of region, but not far south-west corner (south of Freycinet Estuary and west of Cooloomia). Moderately common resident in south, scarce to moderately common and patchily distributed in north; usually in pairs or family parties, occasionally accompanying thornbills and fairywrens. Most kinds of scrub, thicket and tall heath. Breeding from June to August.

Smicronis brevirostris (Gould, 1838) Weebill

Northern interior, west to Mooka and the lower Wooramel; also south-west and southern part of region at Tamala, Nanga, Hamelin, Woodleigh and Nerren Nerren but mostly absent from Zuytdorp hinterland. Canopy of eucalypt scrubs and woodlands (mainly river gums in north and mallees in south). Breeding in October.

Gerygone fusca fusca (Gould, 1838) Western Gerygone

Greater part of region west to Mardathuna, Kennedy Range National Park, Callagiddy, Peron Peninsula, Nanga and Zuytdorp. Autumn-winter visitor and passage migrant from south-western Australia. Scarce to moderately common; in ones or twos. Most kinds of well-wooded habitat, e.g. mulga and other acacia thickets and the denser eucalypt woodlands and scrubs.

Gerygone tenebrosa (Hall, 1901) Dusky Gerygone

Northern Lake MacLeod and on mainland coast from Miaboolia Beach south to 8 km NNW of Long Point. The southern limit of this species in Western Australia. Common; in ones or twos. Confined to mangroves *Avicennia marina*. Breeding from October to January.

Acanthiza apicalis Gould, 1847 Broad-tailed Thornbill

Greater part of region, north to Boolathana, Mardathuna and Kennedy Range, also Peron Peninsula and base of Edel Land. Not recorded for

Table 2 Changes in reporting rate for breeding bird species in the central Carnarvon Basin (see text for explanation; see Table 1 for sample sizes). Key: W = inland or widespread, C = predominantly or entirely coastal (in Carnarvon Basin); I = increase, D = decrease, N = indeterminate, not known, or no change; * = $0.01 < P < 0.05$, ** = $0.001 < P < 0.01$, *** = $P < 0.001$, from χ^2 contingency tables – see text for details. Some species are marked I or D but without a probability level – in these cases we believe, based on our knowledge of the bird's biology, there has been a significant change that is not reflected in the data (see text). For coastal species, the data were subset to include only records west of 114° .

Common Name	Distribution pattern	pre-1951		post-1950		Change
		No. of records	Proportion of records	No. of records	Proportion of records	
Emu	W	8	0.0132	279	0.0291	I*
Malleefowl	W	11	0.0182	3	0.0003	D(***)
Stubble Quail	W	2	0.0033	5	0.0005	N
Black Swan	W	4	0.0066	31	0.0032	N
Grey Teal	W	3	0.0050	64	0.0067	N
Pacific Black Duck	W	5	0.0083	55	0.0057	N
Hoary-headed Grebe	W	0	0.0000	28	0.0029	N
Wedge-tailed Shearwater	C	16	0.0453	31	0.0250	D*
Darter	W	1	0.0017	11	0.0011	N
Great Cormorant	W	0	0.0000	7	0.0007	N
Pied Cormorant	C	49	0.1388	81	0.0653	D***
Little Black Cormorant	W	4	0.0066	13	0.0014	D**
Little Pied Cormorant	W	0	0.0000	18	0.0019	N
Australian Pelican	W	24	0.0397	51	0.0053	D***
White-necked Heron	W	3	0.0050	49	0.0051	N
White-faced Heron	W	7	0.0116	106	0.0110	N
Eastern Reef Heron	C	7	0.0198	28	0.0226	N
Striated Heron	C	2	0.0057	33	0.0266	I*
Yellow-billed Spoonbill	W	1	0.0017	6	0.0006	N
Osprey	C	20	0.0567	26	0.0210	D***
Black-shouldered Kite	W	1	0.0017	34	0.0035	N
Black-breasted Buzzard	W	0	0.0000	17	0.0018	N?
Whistling Kite	W	4	0.0066	102	0.0106	N
Brahminy Kite	C	3	0.0085	15	0.0121	N
Brown Goshawk	W	4	0.0066	23	0.0024	N
Collared Sparrowhawk	W	5	0.0083	21	0.0022	D**
Little Eagle	W	2	0.0033	28	0.0029	N
Wedge-tailed Eagle	W	14	0.0232	152	0.0158	N
White-bellied Sea-Eagle	C	17	0.0482	29	0.0234	D*
Spotted Harrier	W	8	0.0132	36	0.0038	D**
Brown Falcon	W	9	0.0149	210	0.0219	N
Australian Kestrel	W	15	0.0248	546	0.0569	I**
Black-tailed Native-hen	W	2	0.0033	23	0.0024	N
Eurasian Coot	W	0	0.0000	20	0.0021	N
Australian Bustard	W	14	0.0232	46	0.0048	D***
Little Button-quail	W	3	0.0050	34	0.0035	N
Bush Stone-curlew	W	8	0.0132	4	0.0004	(D)
Pied Oystercatcher	C	16	0.0453	31	0.0250	D*
Black-winged Stilt	C	1	0.0028	31	0.0250	I**
Banded Lapwing	W	8	0.0132	47	0.0049	I**
Red-capped Plover	C	8	0.0227	54	0.0435	N
Black-fronted Dotterel	W	0	0.0000	45	0.0047	(I)
Red-kneed Dotterel	W	1	0.0017	23	0.0024	N
Inland Dotterel	W	0	0.0000	8	0.0008	(I)
Australian Pratincole	W	2	0.0033	2	0.0002	N
Pacific Gull	C	19	0.0538	41	0.0331	N
Silver Gull	C	24	0.0680	115	0.0927	N
Caspian Tern	C	10	0.0283	42	0.0339	N
Lesser Crested Tern	C	0	0.0000	15	0.0121	I*
Crested Tern	C	25	0.0708	50	0.0403	D*
Roseate Tern	C	0	0.0000	13	0.0105	(I)
Fairy Tern	C	15	0.0425	21	0.0169	D**
Bridled Tern	C	6	0.0170	11	0.0089	N
Whiskered Tern	C	0	0.0000	18	0.0145	I*
Laughing Turtle-Dove	W	0	0.0000	21	0.0022	(I)

Table 2 (cont.)

Common Name	Distribution pattern	pre-1951		post-1950		Change
		No. of records	Proportion of records	No. of records	Proportion of records	
Common Bronzewing	W	1	0.0017	61	0.0064	N
Crested Pigeon	W	3	0.0050	349	0.0364	I**
Spinifex Pigeon	W	4	0.0066	5	0.0005	N
Diamond Dove	W	2	0.0033	84	0.0088	N
Peaceful Dove	W	4	0.0066	17	0.0018	D*
Red-tailed Black Cockatoo	W	3	0.0050	7	0.0007	N
Galah	W	4	0.0066	280	0.0292	I**
Little Corella	W	6	0.0099	60	0.0063	N
Cockatiel	W	3	0.0050	73	0.0076	N
Australian Ringneck	W	2	0.0033	70	0.0073	N
Mulga Parrot	W	4	0.0066	62	0.0065	N
Rock Parrot	C	10	0.0283	17	0.0137	N
Bourke's Parrot	W	0	0.0000	13	0.0014	N
Budgerigar	W	2	0.0033	192	0.0200	I**
Pallid Cuckoo	W	9	0.0149	39	0.0041	D***
Black-eared Cuckoo	W	0	0.0000	32	0.0033	N
Horsfield's Bronze Cuckoo	W	8	0.0132	66	0.0069	N
Tawny Frogmouth	W	0	0.0000	19	0.0020	N
Spotted Nightjar	W	3	0.0050	27	0.0028	N
Australian Owllet-nightjar	W	0	0.0000	28	0.0029	N
Blue-winged Kookaburra	W	6	0.0099	19	0.0020	D***
Red-backed Kingfisher	W	4	0.0066	41	0.0043	N
Rainbow Bee-eater	W	1	0.0017	58	0.0060	N
White-browed Treecreeper	W	2	0.0033	4	0.0004	N
Black-tailed Treecreeper	W	4	0.0066	4	0.0004	N
Splendid Fairy-wren	W	0	0.0000	51	0.0053	N
Variiegated Fairy-wren	W	22	0.0364	187	0.0195	D**
Blue-breasted Fairy-wren	W	0	0.0000	1	0.0001	N
White-winged Fairy-wren	W	8	0.0132	121	0.0126	N
Southern Emu-wren	C	9	0.0255	4	0.0032	(D***)
Rufous-crowned Emu-wren	W	0	0.0000	9	0.0009	N
Thick-billed Grasswren	C	13	0.0368	44	0.0355	N
Red-browed Pardalote	W	7	0.0116	7	0.0007	N
Striated Pardalote	W	1	0.0017	16	0.0017	N
White-browed Scrubwren	C	20	0.0567	83	0.0669	N
Rufous Fieldwren	C	19	0.0539	74	0.0595	N
Redthroat	W	7	0.0116	136	0.0142	N
Weebill	W	0	0.0000	22	0.0023	N
Dusky Gerygone	C	5	0.0142	36	0.0290	N
Broad-tailed Thornbill	W	13	0.0215	46	0.0048	D***
Slaty-backed Thornbill	W	0	0.0000	10	0.0010	N
Chestnut-rumped Thornbill	W	1	0.0017	106	0.0110	I*
Samphire Thornbill	C	9	0.0255	35	0.0282	N
Yellow-rumped Thornbill	W	2	0.0033	7	0.0007	N
Southern Whiteface	W	3	0.0050	70	0.0073	N
Banded Whiteface	W	0	0.0000	4	0.0004	N
Brown Honeyeater	W	11	0.0182	9	0.0009	D***
Black Honeyeater	W	0	0.0000	8	0.0008	N
Pied Honeyeater	W	4	0.0066	74	0.0077	N
Singing Honeyeater	W	19	0.0315	337	0.0351	N
Grey-fronted Honeyeater	W	0	0.0000	4	0.0004	N
White-plumed Honeyeater	W	6	0.0099	75	0.0078	N
Brown-headed Honeyeater	W	0	0.0000	5	0.0005	N
White-fronted Honeyeater	W	3	0.0050	32	0.0033	N
Tawny-crowned Honeyeater	W	3	0.0050	33	0.0034	N
Yellow-throated Miner	W	3	0.0050	67	0.0070	N
Spiny-cheeked Honeyeater	W	4	0.0066	131	0.0136	N
Red Wattlebird	W	0	0.0000	1	0.0001	N
White-fronted Chat	C	6	0.0099	21	0.0022	N
Orange Chat	W	3	0.0050	19	0.0020	N
Crimson Chat	W	7	0.0116	149	0.0155	N

Table 2 (cont.)

Common Name	Distribution pattern	pre-1951		post-1950		Change
		No. of records	Proportion of records	No. of records	Proportion of records	
Red-capped Robin	W	5	0.0083	92	0.0096	N
Hooded Robin	W	7	0.0116	43	0.0045	D*
Yellow Robin	W	0	0.0000	3	0.0003	N
Southern Scrub-robin	W	3	0.0050	39	0.0041	N
Grey-crowned Babbler	W	1	0.0017	34	0.0035	N
White-browed Babbler	W	13	0.0215	188	0.0196	N
Western Wedgebill	W	13	0.0215	297	0.0309	N
Chestnut Quail-thrush	W	0	0.0000	9	0.0009	N
Chestnut-breasted Quail-thrush	W	1	0.0017	12	0.0013	N
Varied Sittella	W	2	0.0033	8	0.0008	N
Crested Bellbird	W	18	0.0298	219	0.0228	N
Golden Whistler	W	0	0.0000	2	0.0002	N
Rufous Whistler	W	0	0.0000	105	0.0109	I*
White-breasted Whistler	C	3	0.0085	6	0.0048	N
Grey Shrike-thrush	W	4	0.0066	127	0.0132	N
Mangrove Grey Fantail	C	3	0.0085	43	0.0347	I*
Grey Fantail	W	1	0.0017	40	0.0042	N
Willie Wagtail	W	11	0.0182	255	0.0266	N
Magpie-lark	W	8	0.0132	97	0.0101	N
Black-faced Cuckoo-shrike	W	7	0.0116	145	0.0151	N
Ground Cuckoo-shrike	W	0	0.0000	3	0.0003	N
White-winged Triller	W	5	0.0083	63	0.0066	N
Masked Woodswallow	W	1	0.0017	140	0.0146	I**
Black-faced Woodswallow	W	6	0.0099	339	0.0353	I**
Little Woodswallow	W	6	0.0099	13	0.0014	D***
Grey Butcherbird	W	1	0.0017	89	0.0093	N
Pied Butcherbird	W	4	0.0066	102	0.0106	N
Australian Magpie	W	3	0.0050	32	0.0033	N
Grey Currawong	W	1	0.0017	12	0.0014	N
Torresian Crow	W	5	0.0083	30	0.0031	D*
Little Crow	W	18	0.0298	378	0.0394	N
Australian Raven	W	0	0.0000	3	0.0003	N
Spotted Bowerbird	W	0	0.0000	3	0.0003	N
White-backed Swallow	W	10	0.0166	76	0.0079	D*
Welcome Swallow	C	16	0.0453	170	0.1371	I***
Tree Martin	W	7	0.0116	111	0.0116	N
Fairy Martin	W	0	0.0000	41	0.0043	N
Yellow White-eye	C	6	0.0170	60	0.0484	I**
Grey-breasted White-eye	C	21	0.0595	57	0.0460	N
Rufous Songlark	W	5	0.0083	21	0.0022	D**
Brown Songlark	W	4	0.0066	66	0.0069	N
Singing Bushlark	W	2	0.0033	13	0.0014	N
Mistletoebird	W	4	0.0066	24	0.0025	N
Zebra Finch	W	16	0.0265	322	0.0335	N
Painted Finch	W	2	0.0033	3	0.0003	N
Australian Pipit	W	19	0.0315	488	0.0508	I*

islands. Uncommon to moderately common resident; usually in pairs or family parties. Most kinds of scrub, thicket and tall heath, including mangroves. Breeding in August–September. Possibly declined (Table 2) but is more frequently encountered in the Peron area (where many of the early observations were made) than in inland parts of the study area.

Acanthiza robustirostris Milligan, 1903 Slaty-backed Thornbill

Mainly eastern part of region, recorded in Kennedy

Range, near Gascoyne Junction, eastern boundary of region at Carey Downs, Muggon and Bullardoo, and 3 km south-east of Overlander. Locally moderately common, e.g. at Kennedy Range but generally uncommon; usually in pairs or family parties. Mainly canopy of tall mulga, especially on flats and watercourses. Breeding in August–September.

Acanthiza uropygialis Gould, 1838 Chestnut-rumped Thornbill

Mainly eastern part of region, west to Booloogooro, Boolathana, Callagiddy, Wooramel, Peron

Peninsula, Nanga and Nerren Nerren (but largely absent from south-west corner). Moderately common to very common; usually in pairs or small parties, also commonly forming feeding flocks with other small insectivores. Most kinds of thicket, scrub and tall heath (except those adjacent to coast). Breeding in June–September. May have increased in abundance (Table 2) but it is possible that the apparent increase is due in part to the species being more common away from the coast, while most early observers were near the coast.

Acanthiza iredalei iredalei Mathews, 1911 Samphire Thornbill

Southern shores of Lake MacLeod; near-coastal flats between Gascoyne and Wooramel Rivers; northern Peron Peninsula and Edel Land (near Carrarang). Common resident on mainland coast between Carnarvon and Long Point, scarce or uncommon elsewhere; usually in small parties. Samphire, stunted mangroves and low coastal scrub. Breeding in August.

Acanthiza chrysorrhoa (Quoy and Gaimard, 1830) Yellow-rumped Thornbill

Mainly eastern part of region, west to Lake MacLeod, Kennedy Range, lower Wooramel, Tamala and Zuytdorp. Uncommon and patchily distributed; usually in pairs or small parties. Lightly wooded or open country. Breeding recorded just outside region (Landor) from June–September.

Aphelocephala leucopsis castaneiventris (Milligan, 1903) Southern Whiteface

Greater part of region north to Boologooro and Kennedy Range National Park and west to Bush Bay, Wooramel, Hamelin, Cooloomia and Nerren Nerren but absent from Peron Peninsula, Edel Land, far south-west corner and islands. Common in southern part of region, less frequent in north; usually in small parties (up to 15). Lightly or sparsely wooded country (mainly mulga and bowgada scrubs) with shrub understorey. Breeding July–September in south, also April–May in north of region.

Aphelocephala nigricincta (North, 1895) Banded Whiteface

Only recorded from Gascoyne Junction, Callagiddy and far east of region at Byro. Probably nomadic (all dated records April to August except one Gascoyne Junction record in February). Scarce; usually in pairs or small parties (up to 8). Low open shrubland mainly on stony soils. Breeding reported just outside the region from February–August.

Meliphagidae

Lichmera indistincta indistincta (Vigors and Horsfield, 1827) Brown Honeyeater

Northern part of region at Carnarvon, Boolathana and Kennedy Range National Park; also south of

region north to Dirk Hartog I, Tamala, Peron Peninsula, Hamelin and upper Wooramel. Locally common e.g. at springs in Kennedy Range but generally scarce or uncommon and patchily distributed in ones, twos or small parties. Well wooded habitats specially creekside thickets and scrubs. There has been a statistically significant change in the reporting rate (Table 2) but this may be because the species is more common near the coast, where most early observations were made. Breeding recorded in September on the Murchison.

Certhionyx niger (Gould, 1838) Black Honeyeater

Mainly eastern interior of region, recorded at Manberry, Kennedy Range National Park, Byro, Woodleigh, Nanga and Overlander; also unconfirmed record from Carnarvon. Infrequent visitor (mostly May–July). Scarce; in ones or twos. Lightly wooded country especially mulga and other open scrubs. Breeding in July.

Certhionyx variegatus Lesson, 1830 Pied Honeyeater

Throughout the region, including Peron Peninsula and Edel Land. Locally and seasonally common (e.g. wet seasons on Callagiddy 1970–72 and around Overlander 1991), but generally uncommon; usually in ones, twos or family parties, occasionally flocks (up to 10). Lightly wooded habitats including dune scrub on Kennedy Ranges where attracted to flowering *Banksia ashbyi*. Breeding July to September.

Lichenostomus virescens (Vieillot, 1817) Singing Honeyeater

Throughout the region, including Peron Peninsula, Edel Land and Bernier, Dorre, Dirk Hartog and Salutation Is Scarce to very common (most numerous in coastal habitats); mostly single, commonly in twos, occasionally in small parties (up to 10). All kinds of thicket and scrub including mangroves. Breeding June to September.

Lichenostomus plumulus (Gould, 1841) Grey-fronted Honeyeater

Far south of region, north to Tamala, base of Peron Peninsula, Nilemah and Toolonga (i.e. north to the mulga-eucalypt line). Scarce or absent south of Nanga and west of Nerren Nerren. Locally common but generally scarce; in ones, twos or small parties. Mainly mallee scrubs on sandplains. One undated breeding report (but breeding in late spring-summer judging from records in adjacent regions).

Lichenostomus penicillatus Gould, 1837 White-plumed Honeyeater

Northern and eastern part of region, south to Yaringa, Woodleigh and Muggon. Very common in pairs and small flocks on the Gascoyne and Wooramel Rivers, moderately common elsewhere.

Mainly river gums but commonly visiting other woodlands in vicinity of watercourses. Breeding in January–February, May and July–August.

Melithreptus brevirostris leucogenys Milligan, 1903
Brown-headed Honeyeater

Far south-west of region, north to Tamala, Nanga and Woodleigh and east to Coburn, Toolonga and Coolcalalaya. This represents the northern limit for this species in Western Australia. Moderately common; in pairs or small flocks (up to 20). Mainly mallee scrubs south of mulga-eucalypt line. Breeding in October.

Phylidonyris albifrons (Gould, 1841) White-fronted Honeyeater

Throughout the region. Irregular visitor, recorded in all months in far south and only winter in far north. Locally common in some years, e.g. Nanga in 1994, but generally scarce; in ones twos or small parties (abundance and frequency sharply declining northwards). Mainly shrublands, especially on sandplains. Breeding in June, August, October and December.

Phylidonyris melanops (Latham, 1802) Tawny-crowned Honeyeater

Only recorded in south-west corner of region at Zuytdorp, the northern limit of this species for Western Australia. Scarce in coastal heaths. Breeding in October 1994.

Manorina flavigula (Gould, 1840) Yellow-throated Miner

Greater part of region, west to Boolathana, Carnarvon, Callagiddy, Wooramel, Nanga, Coburn and Nerren Nerren (absent from Peron Peninsula, Edel Land and islands). Uncommon to common; usually in pairs or small parties (up to 20). All well wooded habitats, including towns and homesteads. Breeding in August–October.

Acanthagenys rufogularis Gould, 1838 Spiny-cheeked Honeyeater

Throughout the region. Moderately common to common in eastern part of region, but generally scarce or absent near coast; in ones, twos or small flocks, sometimes wandering flocks (up to 30) tending to move north in winter. Mainly mulga and other acacia scrubs, also mallee and other eucalypt scrubs and woodlands. Breeding in September–October.

Anthochaera carunculata (White, 1790) Red Wattlebird

Far south of region north presumably to mulga-eucalypt line, Nerren Nerren (one record from Woodleigh in 1977). The northern limit of this species in Western Australia. Scarce, in ones and twos. Probably mainly winter visitors from further south. Eucalypt woodlands, mainly south of mulga-

eucalypt line. Breeding reported just outside region in September.

Epthianura albifrons (Jardine and Selby, 1828) White-fronted Chat

Western coastal areas, from Lake MacLeod south to Hamelin (including Peron Peninsula and Dirk Hartog I.) and inland to Boolathana, Yaringa and Woodleigh. Nomadic. Locally common or moderately common (e.g. Yaringa, Carbla and Hamelin) but generally scarce; usually in pairs or small parties, also flocks (up to 50). Open or sparsely wooded country; samphire and other chenopod flats around coastal plains, saltlakes and artesian bores and short grass flats. Breeding in May and September.

Epthianura aurifrons Gould, 1838 Orange Chat

Mainly coastal areas from Lake MacLeod south to Hamelin (including Peron Peninsula) and inland to Woodleigh. Nomadic. Locally moderately common but generally uncommon (most numerous after good rains); usually in pairs or small flocks (up to 5). Mainly samphire and short grass flats. Breeding in August.

Epthianura tricolor Gould, 1841 Crimson Chat

Greater part of region including Kennedy Range, Peron Peninsula, Edel Land and Dirk Hartog Island, but not heavily wooded areas south of mulga-eucalypt line, i.e. south of Hamelin and west of Wannoo and Nerren Nerren. Nomadic, numbers varying according to rainfall; common in wet years but generally uncommon; usually in pairs or small flocks (up to 20). Sparsely wooded country, especially samphire and short grass flats with green herbage and *Triodia* plains regenerating after fire; attracted to flowering *Eremophilas*. Breeding July–September.

Petroicidae

Microeca fascinans assimilis Gould, 1841 Jacky Winter

Only recorded at Nerren Nerren in far south-west of region. Uncommon, two reports of single birds; open eucalypt woodlands, south of mulga-eucalypt line.

Petroica goodenovii (Vigors and Horsfield, 1827) Red-capped Robin

Greater part of region but scarce or absent south of Hamelin and west of Nerren Nerren; also a winter visitor or passage migrant to Dirk Hartog Island. Resident and winter visitor. Common in interior of region, scarce in coastal areas; usually in ones or twos. Mainly acacia scrubs and woodlands. Breeding July–September.

Petroica cucullata (Latham, 1802) Hooded Robin

Greater part of region including Peron Peninsula and Dirk Hartog Island (but absent from far south-

Bird distribution, status and changes

west corner). Scarce or uncommon in open coastal country (rare or absent north of Yaringa); moderately common in eastern part of region; in ones or twos. Mainly open scrubs (especially mulga but also other acacias). Breeding in August–September. Possibly declined in abundance (Table 2).

Eopsaltria australis griseogularis (Gould, 1838) Yellow Robin

Confined to far south of region, north to Tamala and Peron Peninsula and east to Nerren Nerren and Toolonga. This is the northern limit of this species in Western Australia. Uncommon to moderately common; in ones and twos. Thickets and scrubs of *Acacia*, *Eucalyptus* and *Melaleuca*. Breeding in July–August.

Drymodes brunneopygia Gould, 1840 Southern Scrub-robin

Confined to the far south of region, north to Herald Bight (Peron Peninsula) and east to Nerren Nerren (but absent from Edel Land). The northern limit of this species in Western Australia. A northern record from near the Manberry turnoff (24°04'S, 114°03'E) is well outside the normal range, and requires confirmation. Moderately common to common; usually in ones or twos. Scrubs and thickets of *Acacia*, *Melaleuca*, *Eucalyptus*, *Banksia*, *Scholtzia* and *Thryptomene*. Breeding in July–August.

Pomatostomidae

Pomatostomus temporalis rubeculus Gould, 1839 Grey-crowned Babbler

Eastern part of region, west to Minilya, the lower Gascoyne (Rocky Pool), mouth of Wooramel and Bompas Hill, near The Elbow of the Murchison. Moderately common; usually in small flocks (up to 8). Mainly river gums and tall open mulga especially along minor watercourses, occasionally other acacia scrubs. Breeding in July–August.

Pomatostomus superciliosus (Vigors and Horsfield, 1827) White-browed Babbler

Greater part of region including Peron Peninsula and Edel Land. Moderately common to common (more numerous in southern part of region); usually in pairs or small parties (up to 12). Mainly acacia thickets and scrubs, especially mulga; also mallee and tea-tree scrubs and bushy understorey along watercourses. Breeding June–October.

Cinclosomatidae

Psophodes occidentalis (Mathews, 1912) Western Wedgebill

Greater part of region including Peron Peninsula and Edel Land but not densely wooded south (south of Tamala, Nanga and Cooloomia) and far north-east (east of Kennedy Range and north of Gascoyne Junction). Very common in western part of region,

but uncommon and patchily distributed east of western side of Kennedy Range and Gascoyne Junction. Mainly open acacia scrubs and edges of denser vegetation. Breeding late June–early October.

Cinclosoma castanotus Gould, 1840 Chestnut Quail-thrush

Southern interior of region, north to Woodleigh and west to Peron Peninsula, Edel Land and Cooloomia. The northern limit of this species in Western Australia. Locally common in pairs or family parties. Mainly mixed scrubs and woodlands with dense understorey on red sands and loams. Breeding reported outside the region in August.

Cinclosoma castaneothorax marginatum Sharpe, 1883 Chestnut-breasted Quail-thrush

Mainly far east of region, west to Mardathuna, (including Kennedy Range), Gascoyne Junction, Callytharra Springs, near the Elbow of the Murchison and just east of our region on Bullardoo (also unconfirmed reports from Callagiddy and Boolathana). Moderately common to common; usually in pairs or family parties. Mainly stony rises with open scrub, especially mulga and bushy understorey (particularly *Eremophila* and *Ptilotus*). Breeding August–September.

Neosittidae

Daphoenositta chrysoptera pileata (Gould, 1838) Varied Sittella

Mainly eastern interior of region west to Booloogooro, Callagiddy, Woodleigh and Nerren Nerren. Scarce or uncommon and patchily distributed; usually in roving flocks (up to 6). Mainly river gum and mulga woodlands, especially along watercourses. Breeding August–September.

Pachycephalidae

Oreoica gutturalis (Vigors and Horsfield, 1827) Crested Bellbird

Throughout the region including Dirk Hartog Island. Common; usually single, occasionally in twos. Most wooded habitats especially mulga and other acacia scrubs; also mallee scrub and eucalypt woodlands. Breeding June–September.

Pachycephala pectoralis fuliginosa Vigors and Horsfield, 1827 Golden Whistler

Far south of region, north to Tamala and Nanga and east to Nerren Nerren. The northern limit of this species in Western Australia. Moderately common; usually in ones and twos. Mainly mixed scrubs of *Acacia* and *Eucalyptus*. Breeding reported outside the region in September.

Pachycephala rufiventris rufiventris (Latham, 1802) Rufous Whistler

Greater part of region, west to Lake MacLeod

(Quobba), Bush Bay, Wooramel, Tamala, Nanga, Coburn and Zuytdorp; scarce on Peron Peninsula. Common; usually single, occasionally in twos. Well-wooded habitats, especially tall open mulga, but also other acacia scrubs, open mallee, eucalypt woodlands and melaleuca scrubs. Coastal populations e.g. Bush Bay and Peron are probably augmented by winter visitors. Breeding in September. Possibly increased in abundance (first recorded north of the Murchison in 1959; see also Table 2) but is least common in those areas most frequented by early observers.

Pachycephala lanioides Gould, 1840 White-breasted Whistler

Confined to the coast from Carnarvon south to New Bay (25°13'S, 113°51'E). The southern limit of this species in Western Australia. Locally moderately common but generally scarce; in ones and twos. Confined to extensive stands of mangroves *Avicennia marina*. Breeding in September–October.

Colluricincla harmonica rufiventris Gould, 1841 Grey Shrike Thrush

Throughout the region, but not on islands. Moderately common; more numerous in south and east of region than in north and west (i.e. scarce in coastal areas north of Wooramel). Most wooded habitats especially mulga and other acacia scrubs, also mallee and river gums and mangroves. Breeding in February, and July–September.

Dicruridae

Rhipidura phasiana De Vis, 1884 Mangrove Grey Fantail

Northern Lake MacLeod and coast from Miaboolia Beach south to Long Point, also coastal northern Peron Peninsula south to Little Lagoon and Guichenault Point. The southern limit of this species in Western Australia. Common; usually in ones or twos. Confined to stands of mangroves *Avicennia marina*. Breeding in August, October and February. The apparent increase in reporting rate (Table 2) is due to the species only being separated from *R. fuliginosa* in recent times.

Rhipidura fuliginosa preissi Cabanis, 1851 Grey Fantail

Throughout the region but mainly southern and western zones; also White Island. Winter visitor and passage migrant (March–September) from south-western Australia. Common in the south west of region but becoming scarce or uncommon in the north and east; usually single occasionally in twos. All wooded habitats including mangroves.

Rhipidura (fuliginosa) albicauda North, 1895 White-tailed Fantail

Mainly far east of region; west to the upper

Wooramel and Nerren Nerren. Moderately common in south (Nerren Nerren) scarce elsewhere; usually in ones or twos. Scrubs and thickets of *Acacia*, *Eucalyptus*, *Melaleuca*, *Allocasuarina* and *Callitris*.

Rhipidura leucophrys leucophrys (Latham, 1802) Willie Wagtail

Throughout the region including Dirk Hartog Island. Common, resident, winter visitor (from south-western Australia) and passage migrant; in ones and twos. Lightly wooded country especially near water. Breeding July–October.

Grallina cyanoleuca (Latham, 1802) Magpie Lark

Greater part of region but as a resident bird absent from much of extreme south-west (south of Hamelin); also vagrant or accidental on Dirk Hartog Island. Uncommon to moderately common, with a considerable influx of visitors in autumn and winter (from south Western Australia); in ones, twos or small parties. Open or lightly wooded areas, riverine flats and bare or short grass flats near water, including station bores and mills. Breeding in May and August–October.

Campephagidae

Coracina novaehollandiae novaehollandiae (Gmelin, 1789) Black-faced Cuckoo Shrike

Throughout the region including Dirk Hartog Island. Common resident, passage migrant and winter visitor (February to September) from south Western Australia; usually in ones or twos, also flocks (up to 20) during migration. Mainly well-wooded habitats. Breeding mainly July–September, occasionally February–April.

Coracina novaehollandiae subpallida Mathews, 1912

Northern part of region south to Wooramel River. Largely confined to river systems (Minilya, Gascoyne and Wooramel). Moderately common resident; usually in ones and twos. Mainly river gums.

Breeding birds from Mardathuna and Meedo are similar to Pilbara *subpallida*; however, those from the Murchison are darker above and below and are intermediate between *novaehollandiae* and *subpallida*.

Coracina maximus (Rüppell, 1839) Ground Cuckoo-shrike

Recorded only from Merlinleigh (Kennedy Range) in November 1982, Kennedy Range (24°31'S, 114°57'E) in May 1995, and Callagiddy June 1972. Numerous records to east of Camarvon Basin (e.g. Landor). Scarce or uncommon resident and winter visitor from further east. Usually in pairs or small parties (up to 4).

Lalage tricolor (Swainson, 1825) White-winged Triller

Greater part of region, west to Quobba,

Boolathana, Carnarvon, Callagiddy, Wooramel, Tamala and Zuytdorp but absent from Peron Peninsula (apart from one record, July 1985), Edel Land and islands. Breeding visitor and passage migrant. Locally common in wet years, Scarce in dry years; in ones, twos or small flocks (up to 10) and larger flocks in northward autumn passage. Most wooded habitats especially tall mulga and river gums with lush herbage. Breeding July–October.

Artamidae

Artamus leucorhynchus leucopygialis (Gould, 1842)
White-breasted Woodswallow

Confined to northern Lake MacLeod, vicinity of Carnarvon and sections of Gascoyne River, also casual on northern Peron Peninsula (Herald Bight and near Denham). Common resident; usually in ones, twos or family parties. Mainly in and near mangroves.

Artamus personatus (Gould, 1841) Masked Woodswallow

Greater part of region but scarce or absent in far south-west (south of Hamelin and west of Wannoo and Nerren Nerren). Nomadic visitor. Locally and seasonally uncommon to very common, and breeding in wet years. Usually in small flocks occasionally large flocks (up to 1000). Lightly wooded country, attracted to flowering shrubs and trees. Breeding in August–September. Possibly increased in abundance (Table 2) but this result may have been influenced by the irruptive nature of this species.

Artamus superciliosus (Gould, 1837) White-browed Woodswallow

Rare visitor from eastern Australia, pair recorded at Callagiddy in 1976, also reported for Woodleigh in July 1980 and October 1998.

Artamus cinereus melanops Gould, 1865 Black-faced Woodswallow

Greater part of region, including Dirk Hartog I. but scarce or absent on northern Peron Peninsula (north of Nanga) and in far south-west (west of Cooloomia). Uncommon near coast, but generally moderately common to common in interior; usually in ones, twos or small parties (up to 12). Lightly wooded country especially on plains. Breeding in August–October. Possibly increased in abundance (Table 2) but this result may be influenced by the species being less common near the coast (where most early observations were made).

Artamus cyanopterus (Latham, 1801) Dusky Woodswallow

Scarce winter visitor (June–July) from southern Western Australia to far south of region, north to Yaringa, Woodleigh and Peron Peninsula. The northern limit of this species in Western Australia.

Artamus minor Vieillot, 1817 Little Woodswallow

Regionally confined to Kennedy Range, Peron Peninsula and Edel Land, also Dirk Hartog Island. One record from near the Zuytdorp Cliffs. In Kennedy Range, locally moderately common in pairs or small parties (up to 10), on Peron and Edel Land possibly only a winter visitor (all records in August). Mainly about cliffs, in gorges, at breakaways and on rocky coasts. Breeding reported just outside the region in September–October. There has been a statistically significant increase in reporting rate (Table 2) but this result is likely to be due to the restricted geographic pattern exhibited by the species.

Cracticidae

Cracticus torquatus torquatus (Latham, 1802) Grey Butcherbird

Greater part of region including Dirk Hartog Island, but rare or absent on northern Peron Peninsula and near-coastal plains west of Manberry, Boolathana and Callagiddy south to 24 km NW of Wooramel. Moderately common in south, uncommon to moderately common in north; usually in ones and twos. Most kinds of scrub and thicket especially tall dense mulga. Breeding in June–August and October.

Cracticus nigrogularis (Gould, 1837) Pied Butcherbird

Greater part of region, west to Gnaraloo, Quobba, Bush Bay, Woodleigh, Hamelin and Zuytdorp but absent from Peron Peninsula and Edel Land. Generally scarce in far south and western coastal plains; moderately common in north-eastern part of region; usually single occasionally in twos, threes or fours. Lightly wooded country. Breeding in August–October.

Cracticus tibicen tibicen (Latham, 1802) Australian Magpie

Mainly eastern part of region west to Minilya, Brick House, Callagiddy, Wooramel, Woodleigh, Tamala and Zuytdorp. Moderately common in southern half of region, becoming uncommon and patchily distributed in north and on coastal plains; usually in pairs or small parties (up to 10). Mainly sparsely vegetated flats in vicinity of tall trees (mainly river gums also bloodwoods and mulgas). Breeding in August–September.

Strepera versicolor plumbea Gould, 1846 Grey Currawong

Confined to far south-west at Tamala, Cooloomia and Zuytdorp. The northern limit of this species in Western Australia. Scarce, ones and twos in dense scrub of *Acacia*, *Melaleuca* and *Eucalyptus*. Breeding just outside the region from late July to early September.

Corvidae

Corvus orru ceciliae Mathews, 1912 Torresian (Western) Crow

Mainly eastern part of region west to Minilya, Booloogooro, Callagiddy, Wooramel, Woodleigh, Nerren Nerren and lower Murchison. Uncommon to moderately common (most numerous about the lower Gascoyne and Wooramel Rivers); usually in ones or twos, occasionally small parties. Mainly vicinity of tall trees (for nesting) and water; attracted to road kills. Breeding in August–September. Possibly declined in abundance (Table 2). We tentatively recognise this subspecies for western populations as they differ in nest, eggs and voice from those in eastern Australia.

Corvus bennetti North, 1901 Little Crow

Throughout the region including Bernier and Dirk Hartog Islands [also listed for Dorre I. by Storr (1985) but source of this record is unknown]. Uncommon to very common (most numerous in southern and western pastoral country); scarce or absent in waterless parts of far south-west (south of Tamala); in ones, twos or flocks (up to 100). Possibly partly migratory after breeding, moving south and south-west into cooler and less arid country. Lightly wooded country (especially mulga and other open *Acacia* scrub) in vicinity of water; attracted to road kills and thermals. Breeding July to September also February. Although not statistically significant, the reporting rate has increased (Table 2) and it is likely that this species has benefited from pastoralism, as is believed to be the case in the adjacent Murchison region (Saunders and Curry, 1990).

Corvus coronoides perplexus Mathews, 1912 Australian Raven

Far south, Wooramel River at Meedo, Nanga, Nerren Nerren, Zuytdorp and lower Murchison River. The northern limit for this species in Western Australia. Scarce, usually in ones or twos. Mainly open eucalypt and acacia woodlands (river gums on the Wooramel and Murchison) in vicinity of water; attracted to road kills. Breeding on lower Murchison in August–September.

Ptilonorhynchidae

Ptilonorhynchus maculatus guttatus (Gould, 1862) (Western) Spotted Bowerbird

Regionally confined to Kennedy Range, Woodleigh and lower Murchison River (Yandil). Uncommon and patchily distributed; usually single. Mainly thickets of *Acacia* in rocky gullies and along watercourses.

Hirundinidae

Cheramoeca leucosterna (Gould, 1841) White-backed Swallow

Greater part of region including Dirk Hartog Island and Kennedy Range but absent from area south of Hamelin and west of Nerren Nerren. Common in western coastal plains; uncommon to moderately common elsewhere; usually in ones, twos or small parties (up to 7). Mainly open or lightly wooded sandy or loamy plains, also dunes with *Triodia* on Kennedy Range. Breeding August–September. Possibly declined in abundance (Table 2) but this result may be due to the species being more frequent in areas visited by early observers.

Hirundo rustica gutturalis Scopoli, 1786 Barn Swallow

Rare summer visitor from northern hemisphere to Carnarvon; only recorded in February and early March 1982.

Hirundo neoxena Gould, 1843 Welcome Swallow

Throughout the region, including many islands. Common resident on coasts; uncommon to moderately common elsewhere. In interior largely confined to mills, towns, homesteads, woolsheds, dams, wetlands, wells and abandoned mines; provision of artificial water points and nest sites has resulted in the highly significant increase in the reporting rate (Table 2). Probably present in interior only since European settlement. Breeding June to October.

Hirundo nigricans nigricans Vieillot, 1817 Tree Martin

Greater part of region including (in winter or on passage) Dirk Hartog Island.

Resident, winter visitor and passage migrant. Common; usually in small parties, occasionally flocks (up to 30). Migratory, moving north from the south-west of the State in autumn and south in late winter and early spring. Mainly open country in vicinity of water especially river pools. Breeding in May and August–September.

Hirundo ariel (Gould, 1843) Fairy Martin

Mainly interior of region west to Lake MacLeod, Boolathana, mouth of Wooramel River, Peron Peninsula, Wannoo and lower Murchison. Formerly scarce or absent (first record 1970), now common to moderately common; usually in small parties or flocks (up to 200). Mainly open country in vicinity of fresh water and nest sites (cliffs, caves, breakaways, rock piles, bridges, culverts, tanks and buildings). Provision of artificial water points and nest sites has resulted in increase. Breeding August to October.

Zosteropidae

Zosterops luteus Gould, 1843 Yellow White-eye

Regionally confined to northern Lake MacLeod and mainland coast from Miaboolia Beach south to Long Point, and northern Peron Peninsula south to

Little Lagoon and Monkey Mia. Common resident of mangroves *Avicennia marina*; usually in pairs or small parties, occasionally flocks (up to 30). Breeding July to February. Apparently increased in abundance (Table 2).

Zosterops lateralis gouldii Bonaparte, 1850 Grey-breasted White-eye (Silvereye)

Coasts and coastal plains inland to Boolathana, Callagiddy and Woodleigh, including Peron Peninsula, Edel Land, Bernier and Dirk Hartog Islands and islands in Freycinet Estuary. Common resident; usually in pairs or small parties occasionally flocks (up to 40). Mainly thickets of *Acacia*, *Nitraria* and *Ficus*, but also in samphire. Breeding July–September.

Sylviidae

Acrocephalus australis gouldi (Dubois, 1901) Australian Reed Warbler

Mainly coastal plains from 16 km north of Carnarvon south to Hamelin; also creek at Old Mooka. Locally common e.g. at Yaringa and Hamelin, but generally uncommon and patchily distributed. Mainly *Typha* and sedges at drains and artesian bore overflows.

Megalurus gramineus gramineus (Gould, 1845) Little Grassbird

Regionally confined to northern Lake MacLeod and coasts and coastal plains from Miaboolia Beach south to Hamelin. Moderately common resident of coastal areas, in ones or twos. Mainly mangroves (*Avicennia marina*) and samphire; also *Typha* growing along drains and around overflows from artesian bores.

Cincloramphus mathewsi Iredale, 1911 Rufous Songlark

Greater part of region but no records from far south-west, i.e. west of Wooramel, Overlander and Nerren Nerren. Common and widespread in wet years but generally uncommon to moderately common; in ones, twos or small parties. Lightly wooded grasslands, especially flats beside watercourses. Breeding July to September. Possibly decreased in abundance (Table 2).

Cincloramphus cruralis (Vigors and Horsfield, 1827) Brown Songlark

Greater part of region including Dorre, Dirk Hartog and Salutation Islands but few records from far south-west. Common breeding visitor in wet years, but generally uncommon to moderately common; in ones and twos. Treeless or sparsely wooded grassy plains (including *Triodia*), especially coastal and riverine plains; also samphire-saltbush flats around saltlakes and claypans. Breeding July–August also February in far north.

Alaudidae

Mirafra javanica horsfieldi Gould, 1847 Singing Bushlark

Only recorded at Minilya, Boolathana, Jimba Jimba, Callagiddy, Bush Bay and Hamelin Pool. The southern limit of this species in Western Australia. Rare or uncommon; possibly more frequent in far north in wet years; mainly in ones and twos. Treeless or sparsely wooded flats. Breeding reported at Minilya in August and Jimba Jimba in October.

Dicaeidae

Dicaeum hirundinaceum hirundinaceum (Shaw, 1792) Mistletoebird

Greater part of region including Dirk Hartog Island, but not northern coastal areas (west of Boologooro, Callagiddy and Woodleigh) except for one record at Brickhouse. Probably nomadic; recorded all months except July but abundance varies greatly. Uncommon in ones or twos. Most well-wooded habitats. Breeding recorded just outside the region in August.

Passeridae

Taeniopygia guttata castanotis (Gould, 1837) Zebra Finch

Greater part of region (including Dirk Hartog I. and Salutation I.), but scarce or absent in far south-west of region (south of Hamelin and west of Coburn and Nerren Nerren) except for one record at Zuytdorp Cliffs (Storr, 1991). Common or very common in pastoral country; usually in pairs or small flocks, often in hundreds at water. Treeless or lightly wooded grassland country in vicinity of water, especially stock-watering troughs. Breeding late February to October. Although not statistically significant, the reporting rate has increased (Table 2). On the other hand, Zebra Finches were only recorded in 14 of the 42 years before 1950 for which there are records, compared with 35 of 45 years of observation since that period, suggesting that the species has increased significantly, probably due to the provision of artificial water sources.

Neochmia ruficauda clarescens (Hartert, 1899) Star Finch

Rare visitor to lower Gascoyne (Carnarvon, Callagiddy and Rocky Pool); also one report from lower Wooramel. The southern limit of this species in Western Australia.

Emblema pictum Gould, 1842 Painted Finch

Far north of region at Boologooro, Boolathana and Kennedy Range. Uncommon; usually in pairs or small flocks (up to 6). In Kennedy Range mainly stony areas and dunes with *Triodia*. Probably descending to adjacent plains to water during dry periods.

Motacillidae

Anthus australis australis Vieillot, 1818 Australian Pipit

Throughout the region (including islands). Common to very common; in ones, twos or small parties. Sparsely vegetated country: coastal beaches and dunes, samphire and grassy flats, claypans, bare ground, road edges, airfields, around mills and homesteads. Breeding May to October. Has apparently increased in abundance (Table 2), probably as a result of opening up of some areas through grazing by domestic stock.

Motacilla flava Linnaeus, 1758 Yellow Wagtail

Uncommon visitor from north-east Asia; one (subspecies unknown) observed at Carnarvon on 16 February 1991 (*Western Australian Bird Notes* No. 58: 2, 7).

Changes in Status

There were 11 798 records that we could use for a comparison of reporting rates between the two periods either side of 1950. (Some records could not be assigned confidently to one or other of these periods, and were ignored for this comparison). These records were distributed between the periods as shown in Table 1. Changes in reporting rate are documented in Table 2; about 20 species have increased in abundance, about 120 are unchanged and about 20 have decreased.

DISCUSSION

The Avifauna and its Distribution

A total of 279 species (184 non-passerine and 95 passerine) have been recorded from the area covered by this paper. This number can be compared with the 273 species (175 non-passerine and 98 passerine) listed by Storr (1985) for the much larger Gascoyne region. Few additional passerine species could be expected for the Carnarvon Basin, however more work along the coast would probably add additional waders to the list.

Overall the Carnarvon Basin region contains a moderately rich avifauna. Most of this diversity is due to the large size of the region with a wide variety of habitats in general, but also to the fact that the southern part of the region straddles the mulga-eucalypt line and is the transition zone from summer to winter dominated rainfall. This provides an admixture of species from the northern arid zone and the southern subhumid zone. Northern arid zone species include Diamond Dove, Cockatiel, Red-browed Pardalote, Black Honeyeater, Spotted Bowerbird and Painted Finch, while southern subhumid zone species include Yellow Robin, Golden Whistler, Southern Emu-wren and Blue-breasted Fairy-wren.

Ford (1987) and Schodde and Mason (1999) delineate the Murchison River drainage as a major geographic barrier separating the Pilbara and the south-west regions and initiating differentiation within a number of species and subspecies. In the present day context, a far more dominant biogeographic feature in this region is the mulga-eucalypt suture zone (Serventy and Whittell, 1967) that serves to terminate the ranges of some species and also serves as a zone of overlap and in some cases intergradation, for a number of closely related species and subspecies, e.g. Variegated Fairy-wren and Blue-breasted Fairy-wren, Striated Pardalote (northern *Pardalotus striatus murchisoni* and southern *P. s. westraliensis*), White-browed Scrubwren (northern *Sericornis frontalis balstoni* and southern *S. f. maculatus*), Chestnut Quail-thrush and Chestnut-breasted Quail-thrush, Grey Fantail (northern *Rhipidua fuliginosa albicauda* and southern *R. f. preissi*), Black-faced Cuckoo-shrike (northern *Coracina novaehollandiae subpallida* and southern *C. n. novaehollandiae*) and the three corvids (Torresian Crow, Little Crow and Australian Raven) that are in unusual sympatry.

The two Shark Bay peninsulas, Peron and Edel Land, also provide an interesting contrast. Peninsulas generally have depauperate faunas being largely surrounded by sea and with limited access to land based animals. Apart from the dead-end effect, Peron and Edel Land also differ markedly in both soil type and vegetation, Peron with more arid zone characteristics and Edel Land largely an extension of the south-western region. These differences are reflected in their avifaunas with Peron containing a number of arid zone species not found on Edel Land, e.g. Galah, Cockatiel, Mulga Parrot, Thick-billed Grasswren and Hooded Robin. Noteworthy also is the Southern Scrub-robin and Yellow Robin both occurring on Peron but confined to the base of Edel Land. The fauna of Peron is also enriched by a number of mangrove species that have colonised it from the north including Mangrove Grey Fantail, White-breasted Woodswallow and Yellow White-eye. The ranges of a number of species terminate at the base of both peninsulas, e.g. Grey-fronted Honeyeater, Brown-headed Honeyeater, Chestnut Quail-thrush and Golden Whistler, despite what appears to be suitable habitat for some of these further north. Twelve species that are largely marine breed on islands in the region: Wedge-tailed Shearwater, Pied Cormorant, Eastern Reef Heron, Osprey, White-bellied Sea Eagle, Silver Gull, Pacific Gull, Caspian Tern, Lesser Crested Tern, Crested Tern, Bridled Tern and Fairy Tern. The offshore islands are also an important refuge for the Rock Parrot which is at its northern limit at Shark Bay and for three endemic malurids: Variegated Fairy-wren *Malurus lamberti bernieri* (on Bernier and Dorre

I.); White-winged Fairy-wren *Malurus leucopterus leucopterus* (on Dirk Hartog I.); and the Southern Emu-wren *Stipiturus malachurus hartogi* (on Dirk Hartog I.). Also noteworthy is the fact that the Thick-billed Grasswren *Amytornis textilis* is now extinct on Dirk Hartog I. (not recorded since 1918).

Apart from small stands in the Houtman Abrolhos and near Bunbury, there are no mangroves south of Shark Bay. The small blocks of mangal in the Carnarvon Basin extend as a broken belt along the coast and on Lake MacLeod and contain seven species that are largely confined or dependent on mangroves: Mangrove Heron, Brahminy Kite, White-breasted Whistler, Mangrove Grey Fantail, Dusky Gerygone, Yellow White-eye and White-breasted Woodswallow. All of these are of northern origin and all are at their southern limit in Western Australia: the Mangrove Heron, Mangrove Grey Fantail, Yellow White-eye and White-breasted Woodswallow range south to northern Peron Peninsula; the White-breasted Whistler occurs south to Bush Bay; Dusky Gerygone south almost to Long Point; and Brahminy Kite to Carnarvon. Many other birds frequently visit mangroves to feed, nest or shelter; these include Pied Cormorant, Darter, Little Egret, Sacred Kingfisher, Tree Martin, Broad-tailed Thornbill, White-browed Scrubwren, Variegated Fairy-wren, Little Grassbird, Singing Honeyeater and Zebra Finch.

Coastal samphire flats support mainly ground dwelling species including the Bustard, Little Button-quail, White-browed Scrubwren, Rufous Fieldwren, Samphire Thornbill, Singing Bushlark and Little Grassbird.

Coastal *Acacia* and *Nitraria* thickets are important habitat for the Grey-breasted White-eye a southern species ranging north to just beyond the Carnarvon Basin (Point Cloates). Flooded samphire flats and coastal wetlands are also important for waterfowl and some waders including Grey Teal, Little Egret, Greenshank, Sharp-tailed Sandpiper, Banded Stilt and Red-capped Plover. In this habitat the Chestnut Teal is now locally extinct (no record since 1916).

The eastern acacia zone covers about 70% of the region and contains a large number of sedentary species such as Australian Ringneck, Chestnut-breasted Quail-thrush, White-browed Treecreeper, Yellow-throated Miner, Spiny-cheeked Honeyeater, Grey-crowned Babbler, Magpie and White-tailed Fantail. Although no longer extant on Dirk Hartog Island, or in most parts of its former range in Western Australia, the Thick-billed Grasswren is still plentiful in scrubs and thickets on Woodleigh and northern Peron Peninsula. This zone also contains a large component of nomads and breeding and non-breeding visitors including Sacred Kingfisher, Rainbow Bee-eater, Black Honeyeater, Pied Honeyeater, Crimson Chat and

Masked Woodswallow.

The Kennedy Range contains one species, the Rufous-crowned Emu-wren, that is regionally confined to its plateau and this area also supports a number of species that are rare elsewhere in the Carnarvon Basin including Slaty-backed Thornbill, Painted Finch and Spotted Bowerbird. The Splendid Fairy-wren is at its northern limit in the Kennedy Range.

The southern zone with its extensive eucalypt scrubs and woodlands contrast sharply with the *Acacia* dominated areas further north but cover only about 10% of the Carnarvon Basin. This habitat contains 17 southern species that are on or near their northern limit, viz. Malleefowl, Regent Parrot, Yellow Robin, Golden Whistler, Southern Scrub-robin, Blue-breasted Fairy-wren, Southern Emu-wren, Striated Pardalote (subspecies *westraliensis*), Brown-headed Honeyeater, Grey-fronted Honeyeater, Tawny-crowned Honeyeater, Grey Currawong, Chestnut Quail-thrush, Red Wattlebird, Dusky Woodswallow, Australian Raven and Jacky Winter. When flowering the eucalypts, banksias, hakeas, melaleucas and grevilleas attract many honeyeaters.

A few species are more common on watercourses and in creekside vegetation than in other habitats. They include the Blue-winged Kookaburra, Black-tailed Treecreeper, Red-browed Pardalote, White-plumed Honeyeater and Black-faced Cuckoo-shrike (subspecies *subpallida*). The Blue-winged Kookaburra is at its southern limit on the Wooramel River and the Black-tailed Treecreeper on the Gascoyne River. Noteworthy here also is the fact that the Torresian Crow and Australian Raven are sympatric between the Wooramel and Murchison Rivers. The Australian Raven is at its northern limit on the Wooramel and the Torresian Crow at its southern limit on the Murchison. Permanent river pools are also important for the Darter, Little Black Cormorant, Peaceful Dove, Spinifex Pigeon and Star Finch. The Pheasant Coucal appears to be locally extinct on the lower Minilya River (no reports this century) and Major Mitchell's Cockatoo formerly occurred on the Wooramel River.

Due to the irregularity of the climate the following birds show considerable nomadism: Emu, Stubble Quail, anatids, Straw-necked Ibis, Black-tailed Native Hen, Bustard, Little Button-quail, Red-necked Avocet, Red-kneed Dotterel, Cockatiel, Budgerigar, Banded Whiteface, Black Honeyeater, Pied Honeyeater, White-fronted Honeyeater, White-fronted Chat, Crimson Chat, White-winged Triller, Masked Woodswallow and Mistletoebird. The honeyeaters mentioned above wander over most of the Gascoyne region in search of flowering trees and shrubs.

A breakdown of the avifauna under each of the main habitat types is given below (where the status

of a species is similar in two or more habitats it was included in each of them).

1. Inshore seas, tidal mudflats, beaches and coastal cliffs: 66 species (5 passerine)
2. Islands 70 species (20 passerine)
3. Mangal 20 species (13 passerine)
4. Coastal Plains 171 species (40 passerine)
5. Eastern Acacia Zone 111 species (55 passerine)
6. Kennedy Range 90 species (54 passerine)
7. Southern Eucalypt Zone 108 species (57 passerine)
8. Watercourses 120 species (51 passerine)

This gives an indication of the richness of each habitat type, but more particularly it shows the importance of the minor habitats especially the southern eucalypt zone, watercourses and mangal. One site of particular importance is Lake MacLeod. It has been reported several times as supporting high numbers of species and individuals of waterbirds, with the highest count being 114 956 individuals of 53 species in September 1987 (Jaensch and Vervest, 1990).

Relationships between climatic factors (precipitation, temperature) and the broad scale distribution of birds in the Carnarvon Basin, and the influence of substrate and vegetation characteristics at a finer scale, are discussed elsewhere (Burbidge, Johnstone, Fuller and Stone, 2000).

The visitors, which make up about 30 percent of the fauna, can be divided into seven main groups.

1. Non-breeding summer visitors from the northern hemisphere, e.g. Black-tailed Godwit, Grey Plover, Oriental Pratincole, Common Tern, Fork-tailed Swift and Barn Swallow.
2. Breeding summer visitors from north, e.g. Wedge-tailed Shearwater and Bridled Tern.
3. Non-breeding visitors from south, e.g. Square-tailed Kite, Elegant Parrot, Shining Bronze Cuckoo, Sacred Kingfisher, Western Gerygone and Grey Fantail.
4. Non-breeding visitors from north, e.g. Magpie Goose, Plumed Whistling Duck, Wandering Whistling Duck, Black Kite, Brolga and Flock Pigeon.
5. Passage migrants e.g. many seabirds and waders.
6. Resident species whose numbers are greatly augmented by visitors in winter e.g. Brown Goshawk, Collared Sparrowhawk, Kestrel, Pallid Cuckoo, Striated Pardalote (subspecies *westraliensis*), Magpie Lark, Black-faced Cuckoo-shrike, Dusky Woodswallow and Tree Martin.
7. Vagrants e.g. Intermediate Egret, Australian White Ibis, Letter-winged Kite, Black Falcon and Kelp Gull.

Breeding

Based on the number of species known to have

bred in each month (i.e., with eggs), breeding of the land bird fauna mostly occurs in the months of June to October (Figure 3). More species are known to breed in August than in any other month, with 78% of breeding land birds recorded as having bred in that month. This pattern does not match the temporal pattern of records of occurrence of these species – 15 299 dated records of occurrence for 116 land bird species known to breed in the study area show peaks in May and August to October. (Note that this is in part a measure of effort rather than simply a measure of occurrence). Figure 3 therefore probably does show a reasonable measure of the breeding season over the bulk of the study area. This peak of breeding in spring is consistent with Schodde's (1982) view that spring is the time of the major peak of breeding in arid zone birds. Schodde also considered that there was a significant pause in breeding in winter (June–July) but our data suggest that this is when breeding commences for many species in the Carnarvon Basin. Much of our study area is near the coast and this may influence climate to an extent that breeding can commence earlier here than further inland. On the other hand, Davies (1979) showed that breeding of land birds in the southern inland of Western Australia is slightly earlier than breeding in the wheatbelt and extreme south-west, and occurs over a longer period. Our data are consistent with this trend, with breeding in the Carnarvon Basin (north of the area investigated by Davies) being even earlier. This conforms well with Nix's (1976) prediction, based on the timing of maximum quarterly growth index values, that timing of the peak breeding season should be earlier as one goes from the extreme south west of Australia north through the wheatbelt and the Carnarvon Basin. Matching of the predicted time with the observed time is less precise as one goes north (peak growth rates are predicted to be in late autumn – early winter across much of the Carnarvon Basin), indicating that commencement of breeding may also be influenced by interactions with other factors such as photoperiod or temperature. North of the Carnarvon Basin, Nix (1976) predicted that the peak of breeding would be in summer. In our data-set there is a minor peak in breeding in February. This may be an indication of the influence of species with northern affinities (e.g. Peaceful Dove, White-plumed Honeyeater, Mangrove Grey Fantail) that occur in the study area, together with breeding by some widespread species (e.g. Banded Lapwing, Brown Songlark) breeding at this time of year in the north of the study area, where summer rainfall is more likely to occur.

In the north-east of the Carnarvon Basin a number of species nest immediately after good rains, irrespective of the time of year (e.g. Little Button-quail, Budgerigar, Zebra Finch).

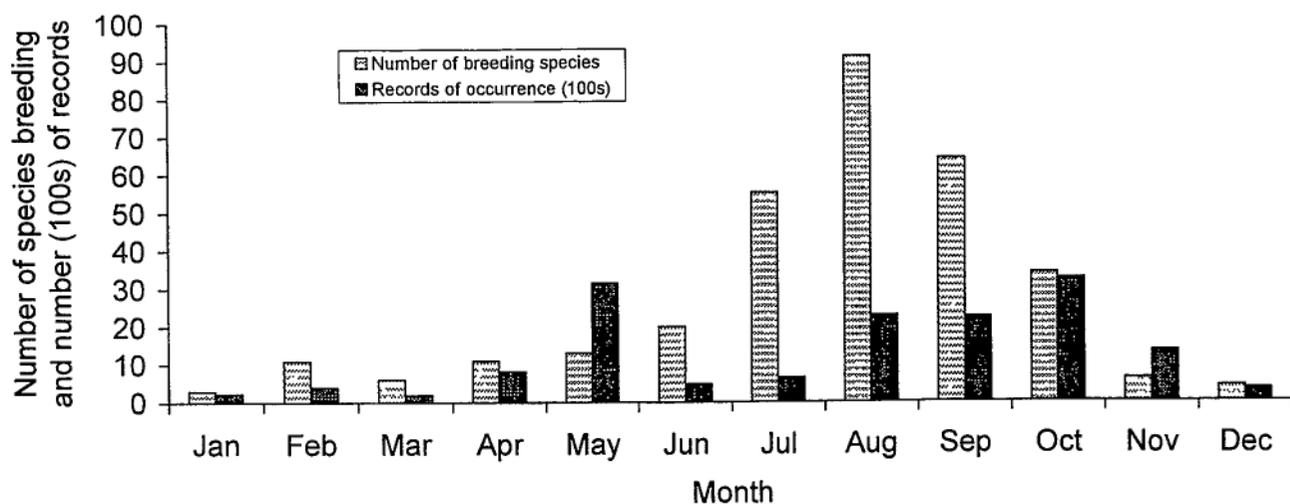


Figure 3 Breeding of land birds in the southern Carnarvon Basin.

Changes in Status

Changes in status are difficult to assess because of the factors cited above. Nevertheless, of the 162 breeding species we assessed, none is known to have become extinct in the study area, about 20 (13%) appear to have increased in abundance over the last century, about 75% show no detectable change, and 10–15% have declined. [A possible loss is the Pheasant Coucal, collected from the lower Minilya by Carter in 1887 and not reported since, and thought to have declined in the Pilbara (Storr, 1984)]. Overall, changes in the Carnarvon Basin are comparable to those in the nearby Murchison River catchment, where Saunders and Curry (1990) found that 18% of 118 species had increased, no change could be detected in 75% and 7% had decreased. However, they also noted that the Night Parrot, Scarlet-chested Parrot and Thick-billed Grasswren have apparently disappeared from the catchment. Curry and Hacker (1990) believed that only 4% of bird species in the arid rangelands of Western Australia have declined and about 9% increased, although these are likely to be under-estimates (Recher, 1999). Changes in the Carnarvon Basin and the Murchison catchment appear to be less than in western New South Wales, however, where Smith and Smith (1994) found that 29% of 291 species increased, 36% showed no consistent overall trend and 35% decreased. Furthermore, six species are believed to be extinct in western New South Wales. As suggested by Smith and Smith (1994) the greater degree of change in western New South Wales is probably due to the longer history of European exploitation of the area and more intensive settlement. When the whole of the Australian arid zone is considered (Reid and Fleming, 1992) about 20% (of 230 species) have increased, no change has been detected in 50%, and 30% have declined in at

least part of their range, although some of these have increased in other areas.

For many of the species for which we have noted a change in abundance, other observers elsewhere in the arid zone have noted similar changes. However, there are some differences. The species we believe to have increased have been reported to have increased elsewhere, with the possible exception of the Chestnut-rumped Thornbill and Rufous Whistler. However, as noted under the species accounts above, changes in reporting rates for these two species may have been a result of the different dispersion of observers at different periods in time. There are bigger differences in the lists of declining species. Our data suggest a possible decline in the Spotted Harrier, Peaceful Dove, Pallid Cuckoo, Little Woodswallow, White-backed Swallow and Rufous Songlark. These species have not been reported as declining elsewhere, but closer monitoring of these species across their ranges would be warranted. For some species, such as Thick-billed Grasswren, Southern Whiteface and Rufous Fieldwren, we did not detect a change, but changes have been reported from other parts of the arid zone. The suspected differences in changes in status in some species in the Carnarvon Basin compared with other areas suggest that either some different factors have been operating, that different changes will occur depending on the pre-disturbance species composition in the area, that there is a degree of random change once the processes of ecosystem change commence, or there is enough 'noise' in the different data sets to lead to some erroneous conclusions. Nevertheless, despite these difficulties, our data suggest that birds of the Carnarvon Basin have suffered less declines than in some other areas such as western New South Wales.

In conclusion it should be noted that this study has used a combination of both past and present

survey data. The broad scale information compiled from the Storr data bank of historical records together with contemporary quadrat based sampling has produced a far more definitive picture of the distribution, status and changes in the avifauna of the region than would otherwise have been possible.

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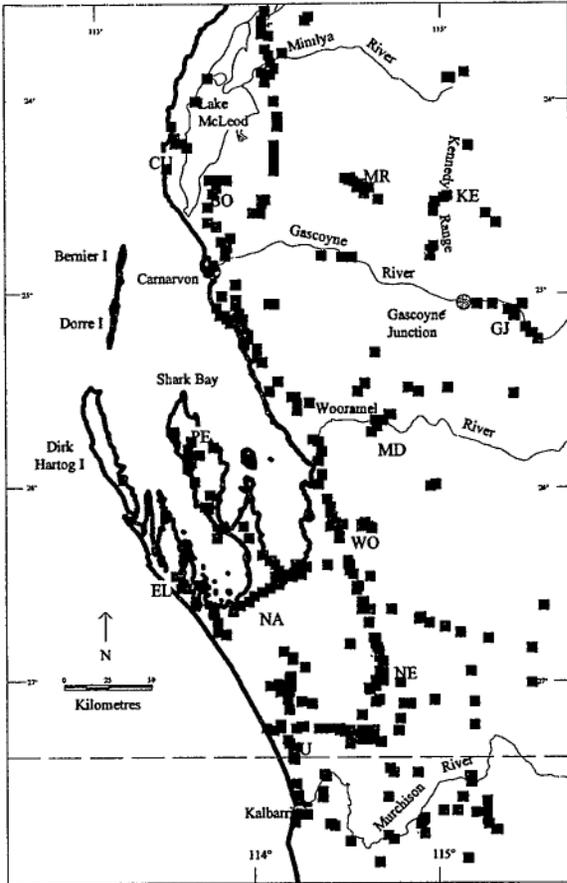
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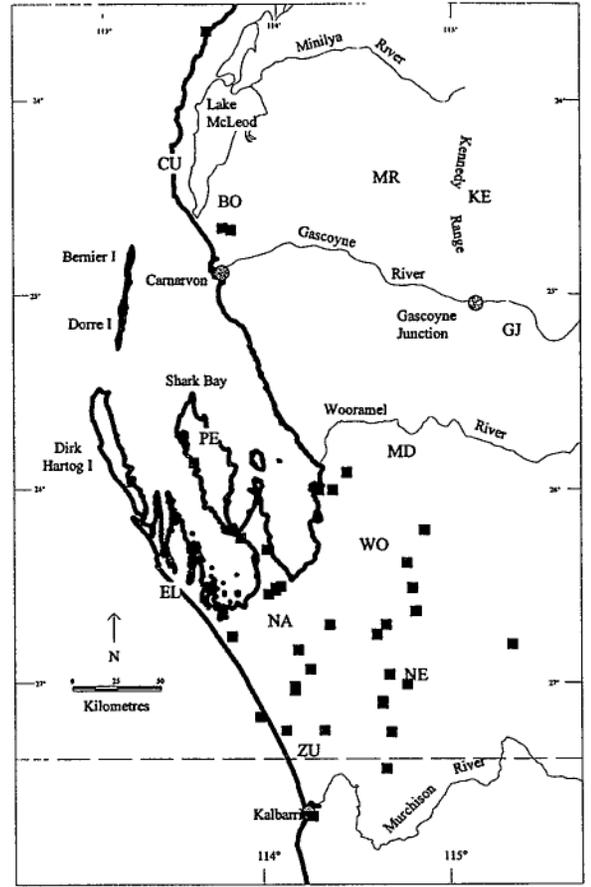
Manuscript received 3 November 1998; accepted 8 March 1999.

APPENDIX

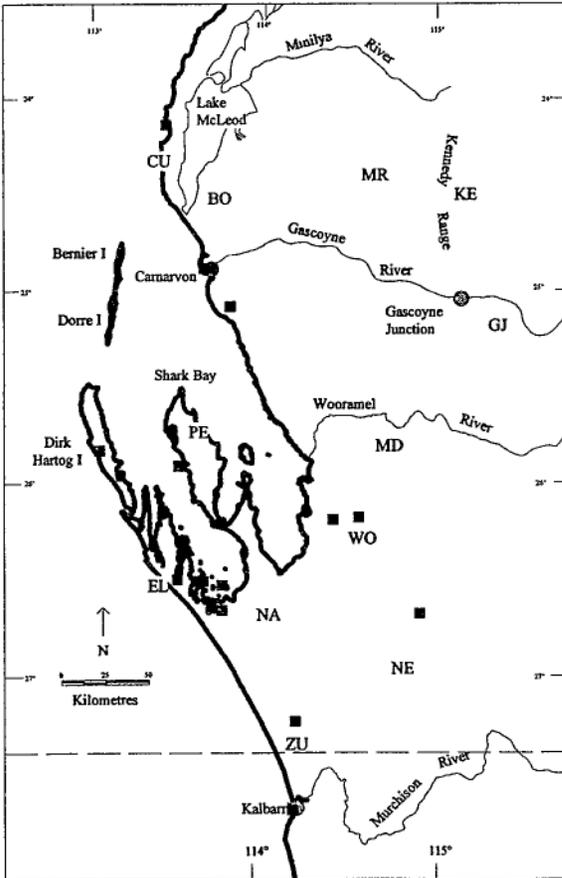
Locations of records of each of the 162 bird species known or suspected to breed in the southern Carnarvon Basin. Coverage of records from south of the dashed line at about latitude 27.25°S is incomplete.



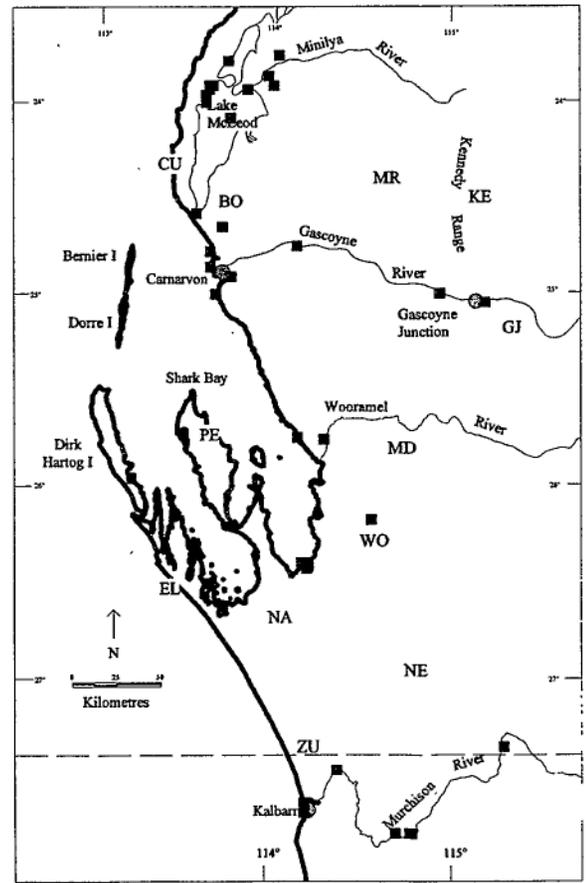
Emu



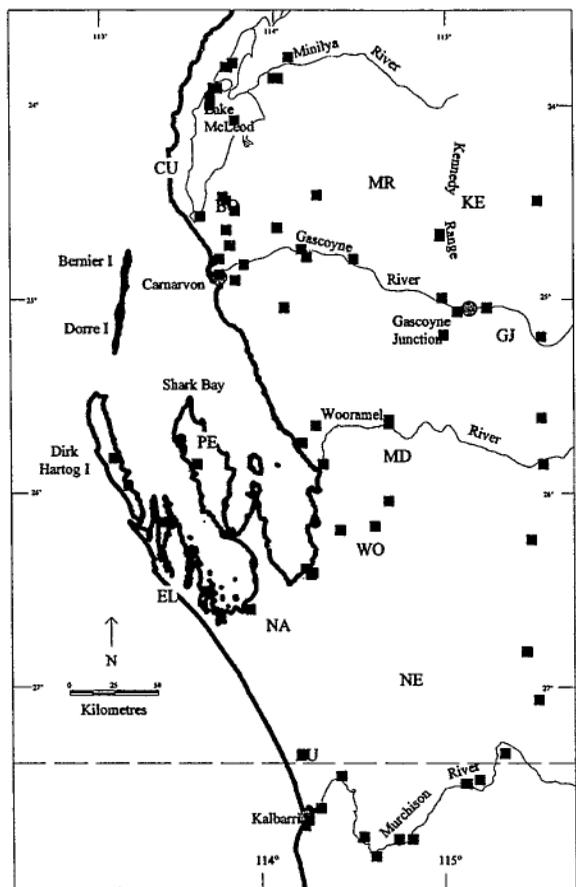
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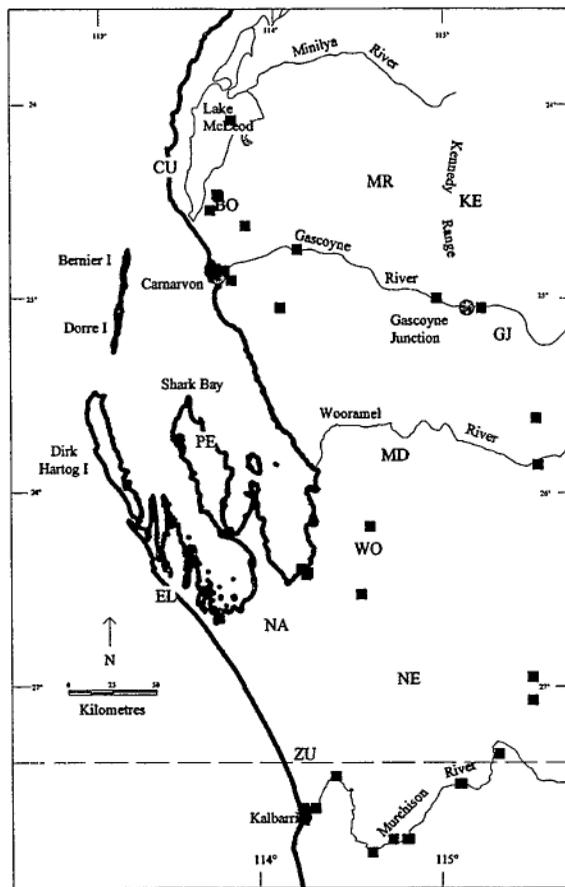
Stubble Quail



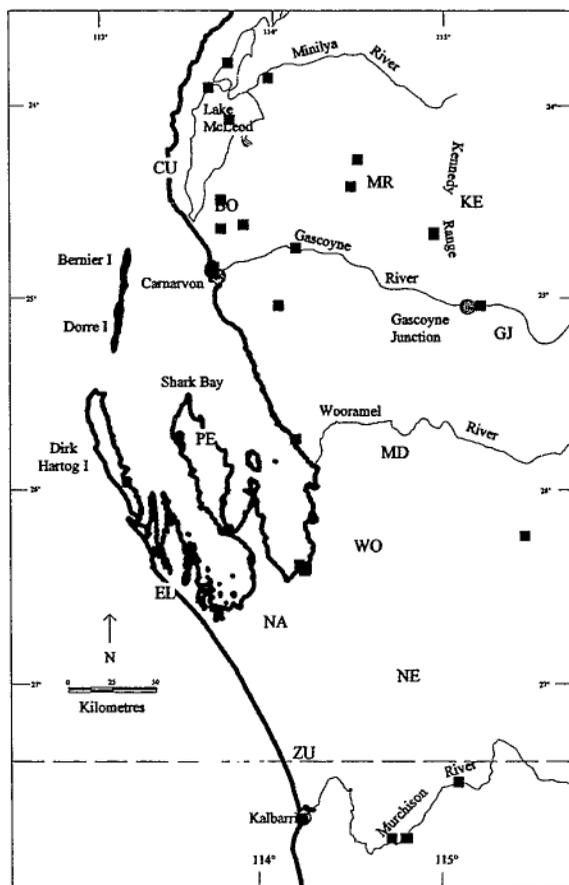
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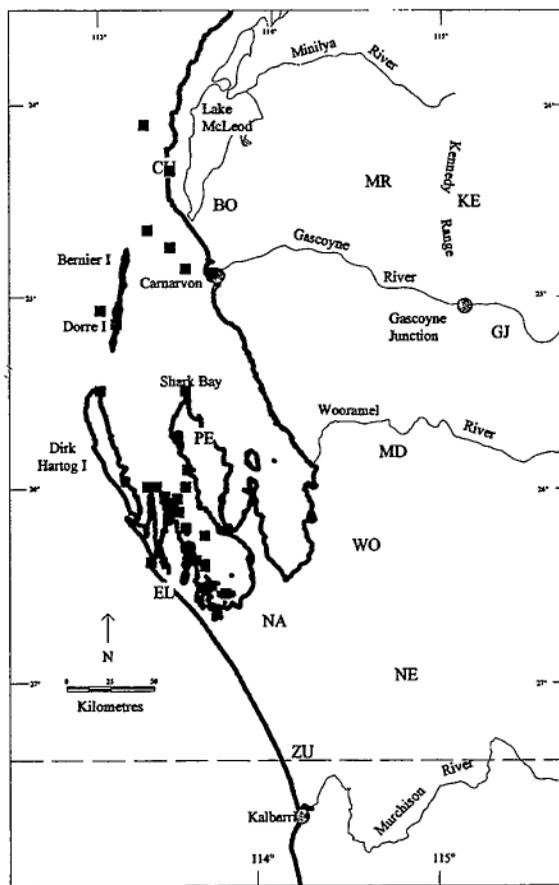
Grey Teal



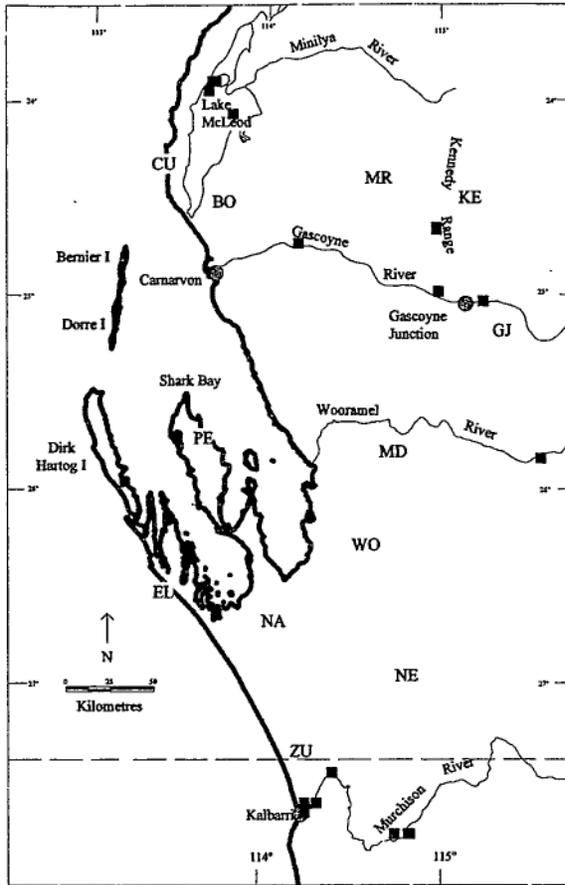
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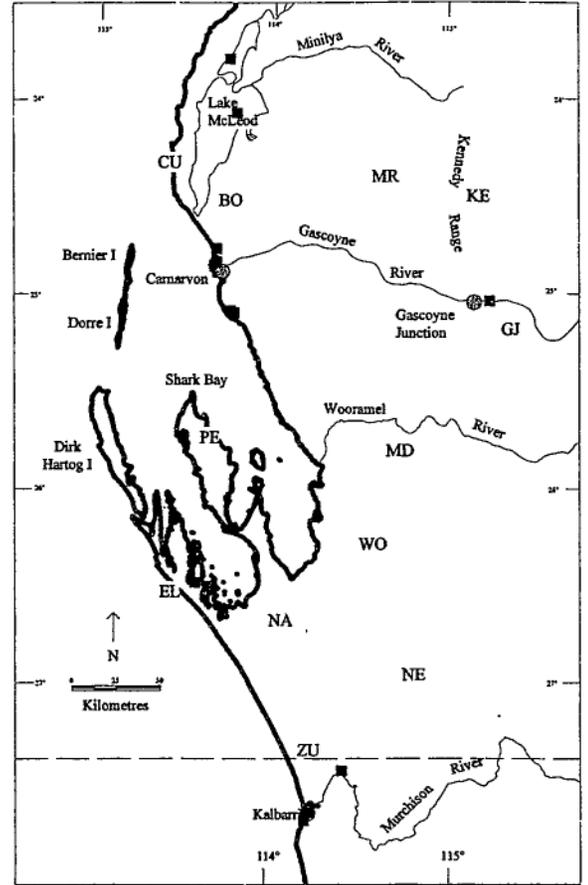
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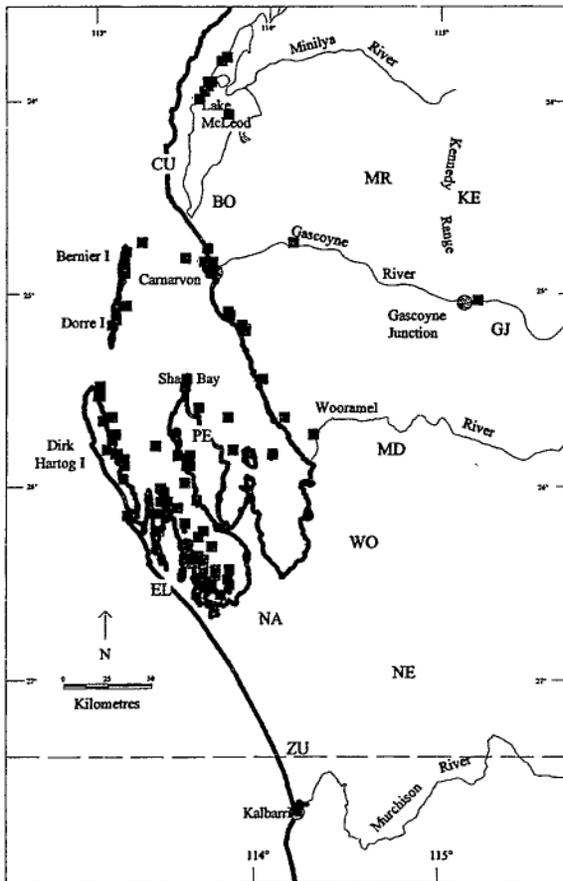
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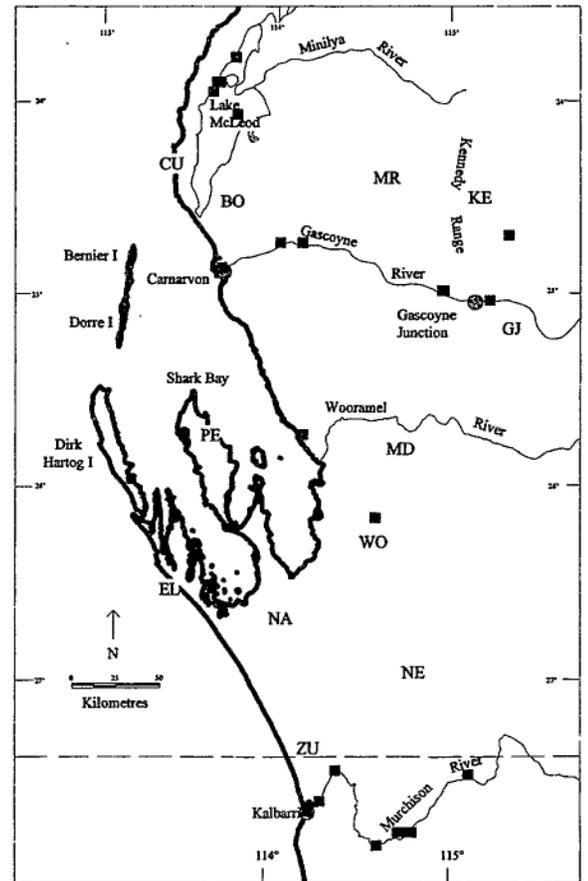
Darter



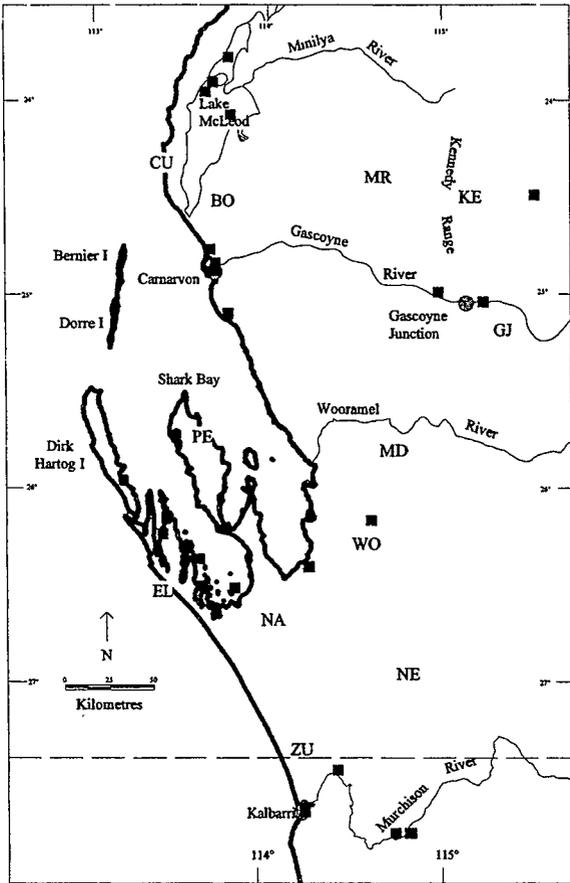
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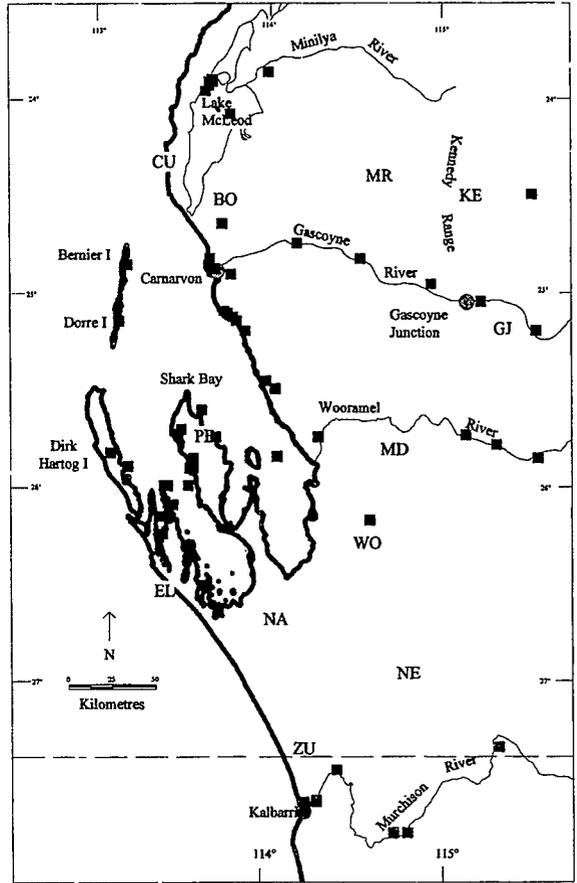
Pied Cormorant



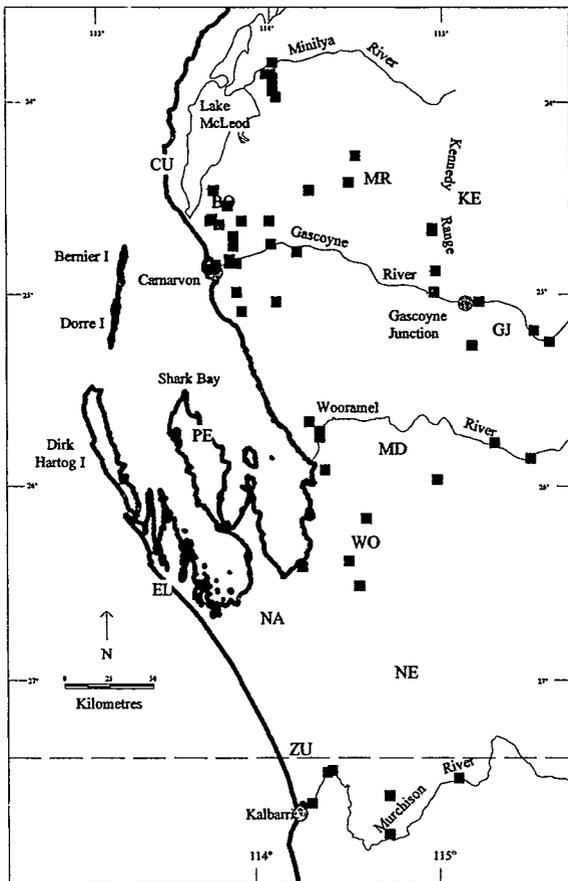
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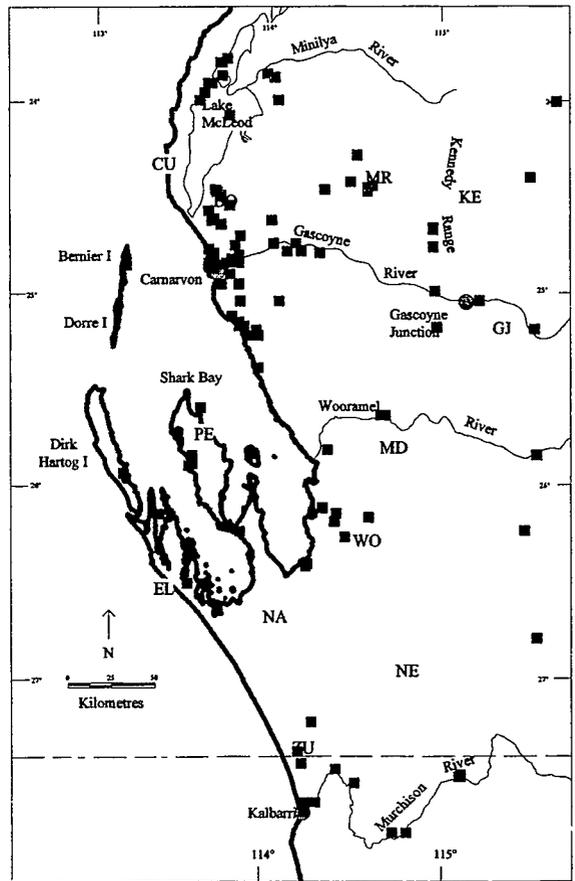
Little Pied Cormorant



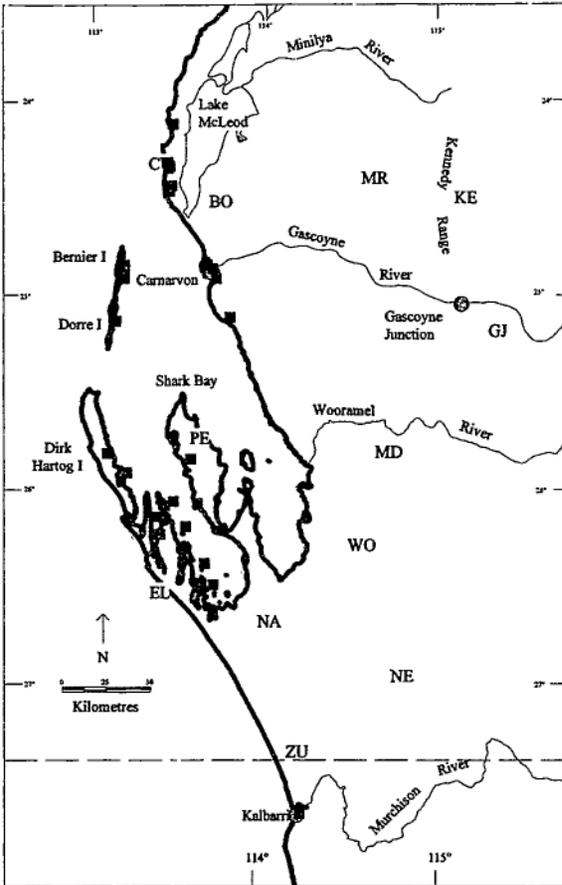
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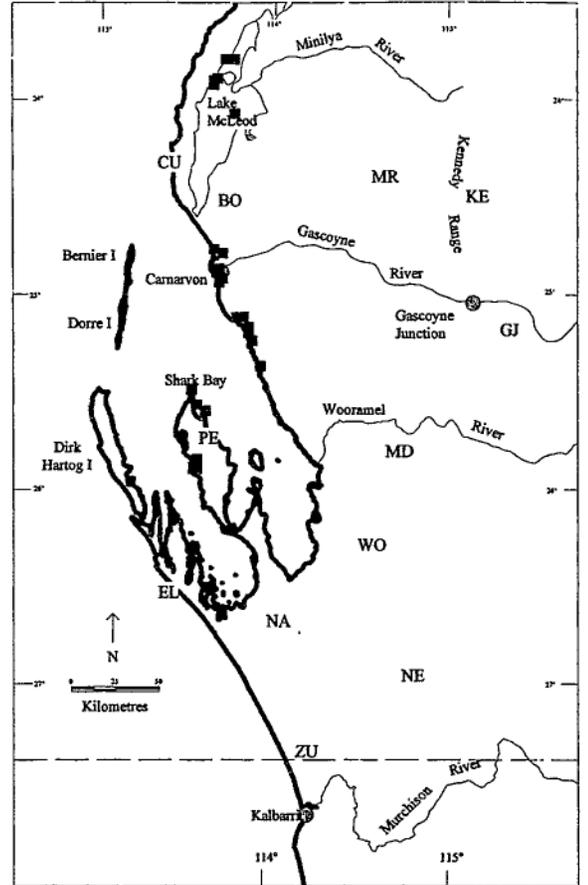
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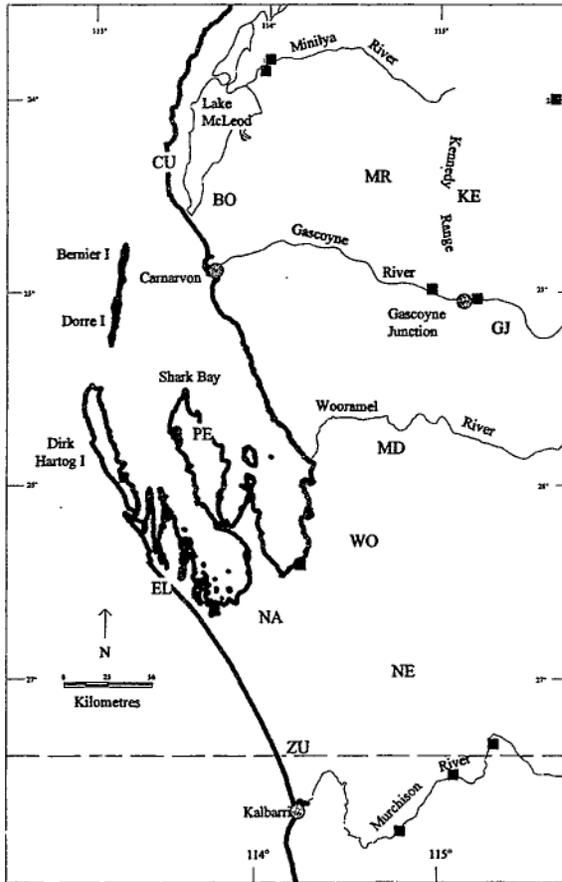
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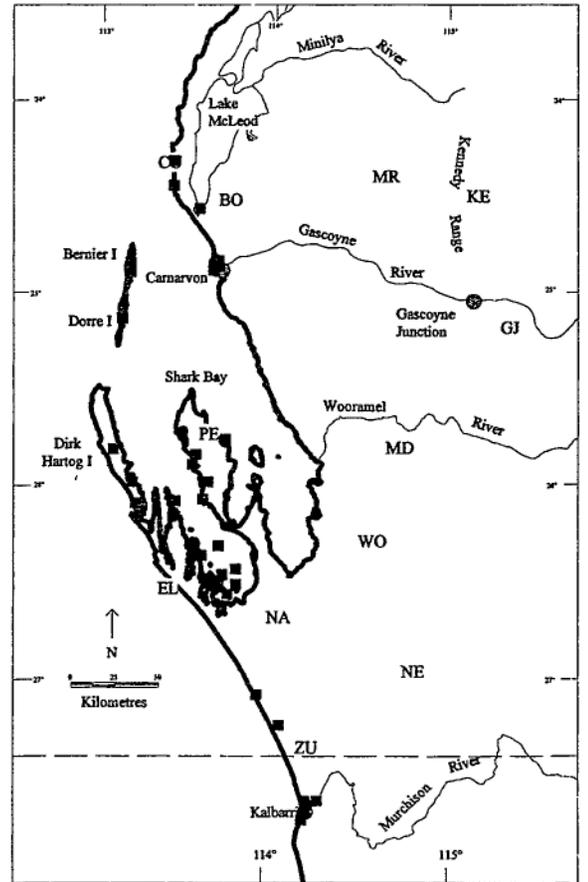
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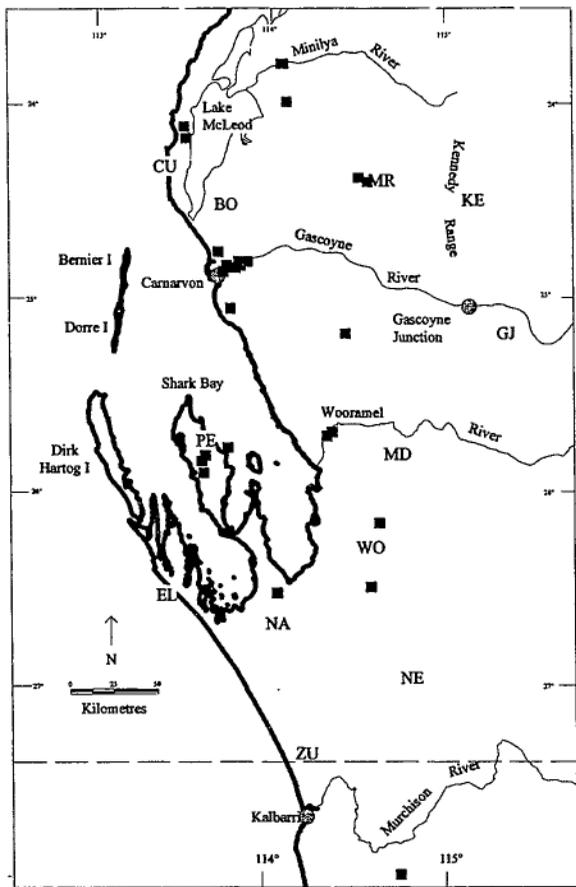
Striated Heron



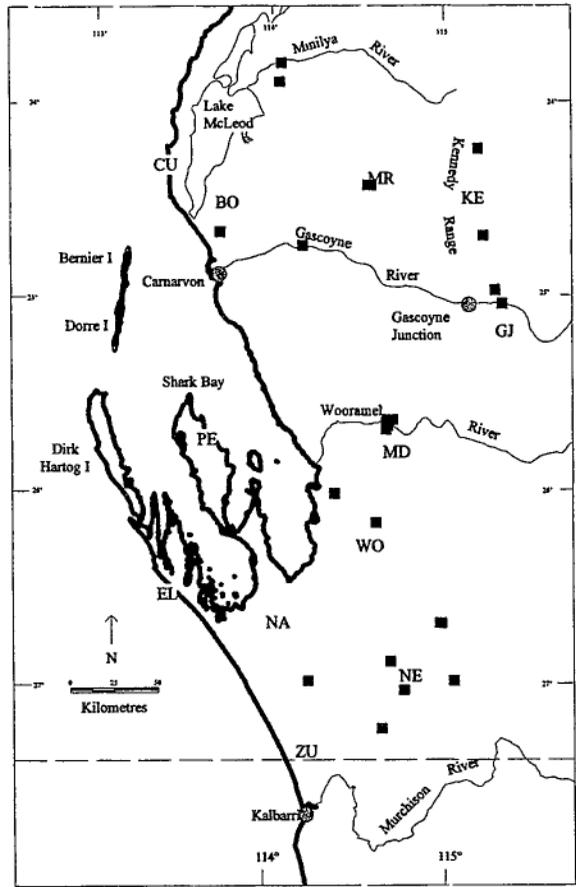
Yellow-billed Spoonbill



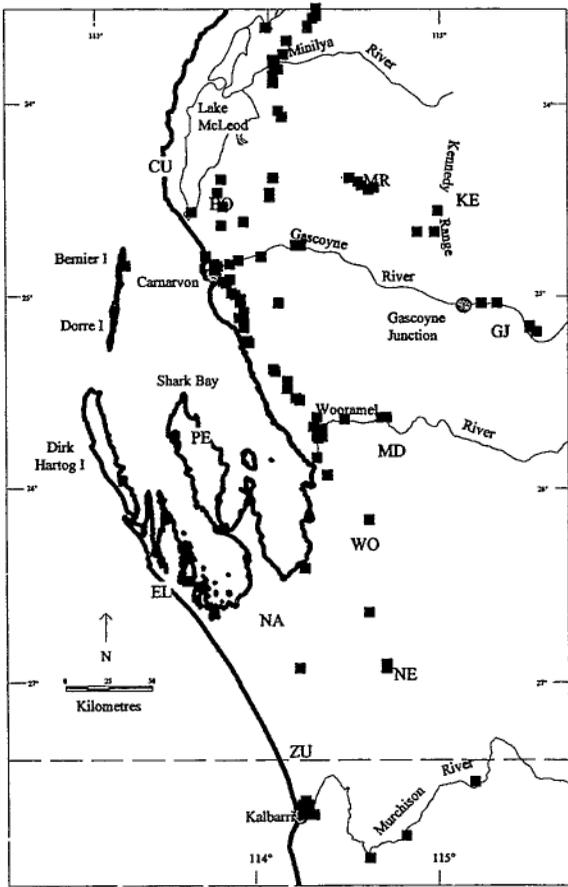
Osprey



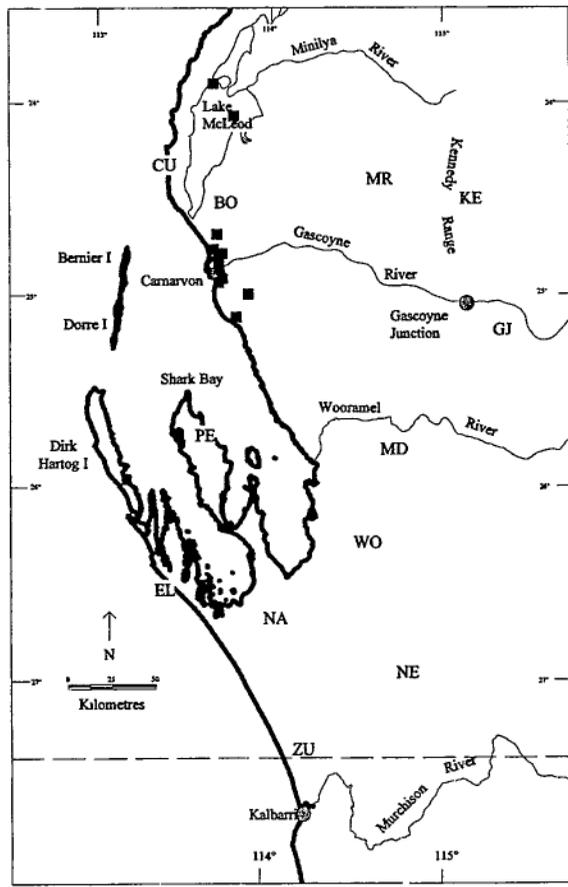
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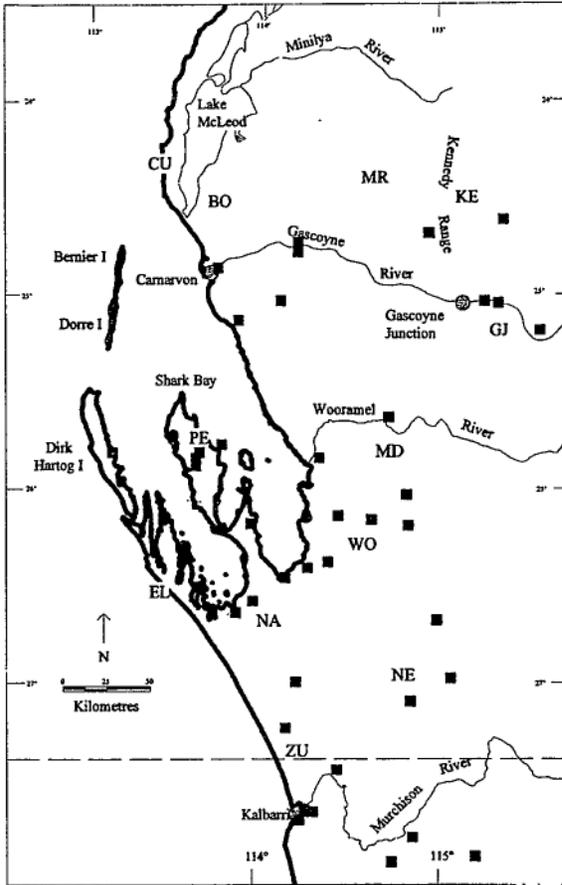
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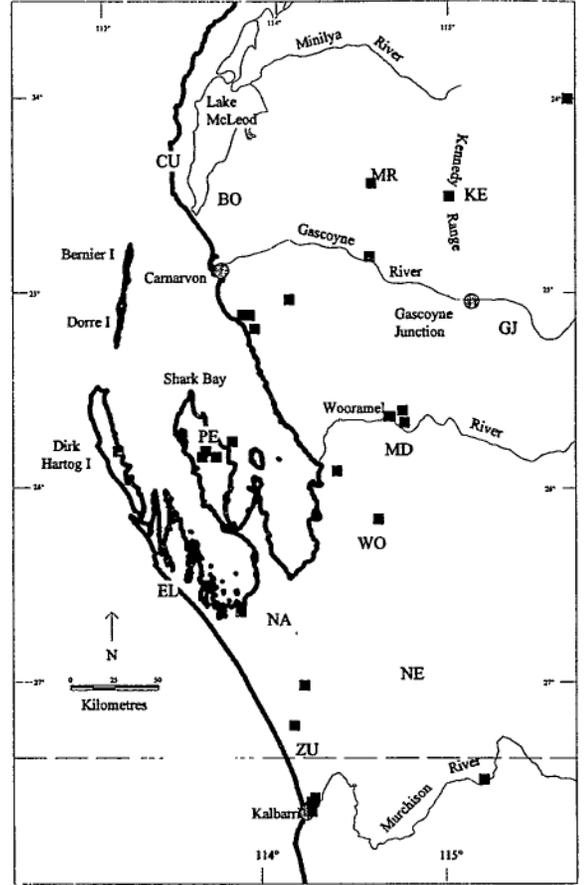
Whistling Kite



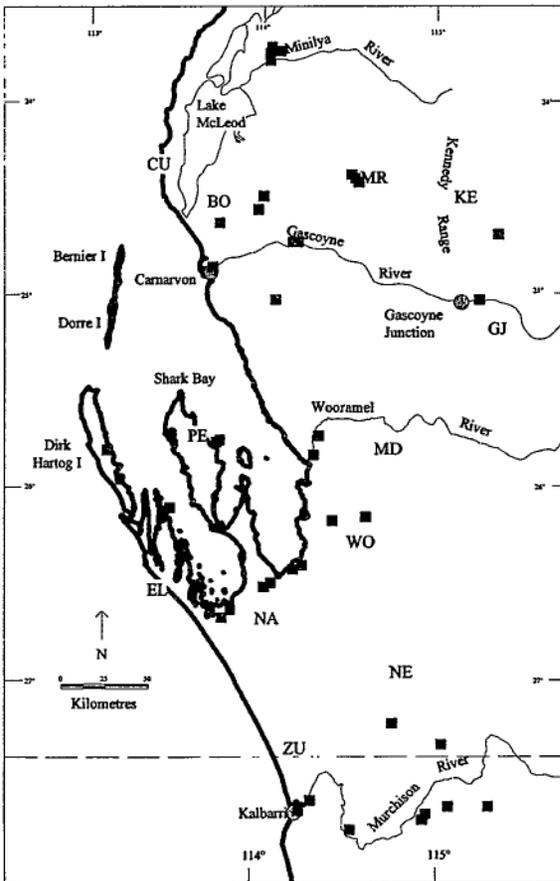
Brahminy Kite



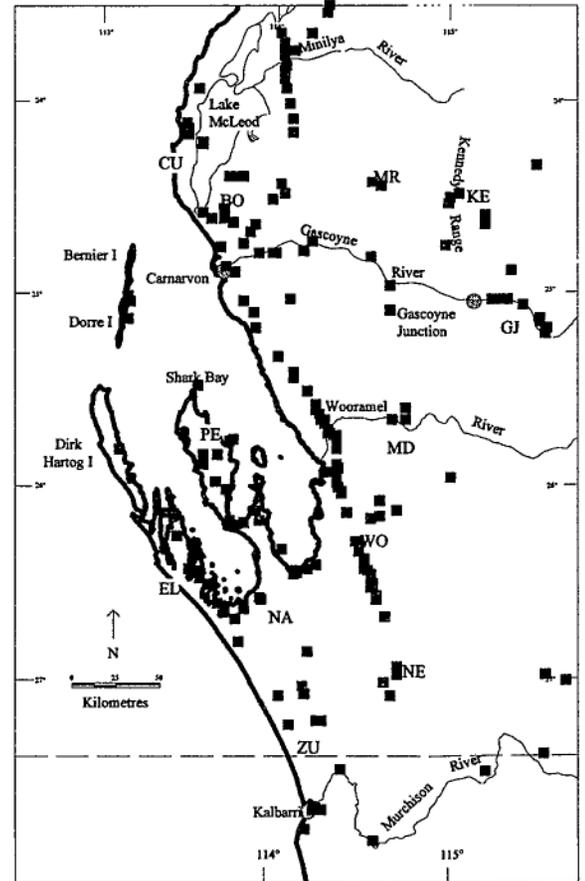
Brown Goshawk



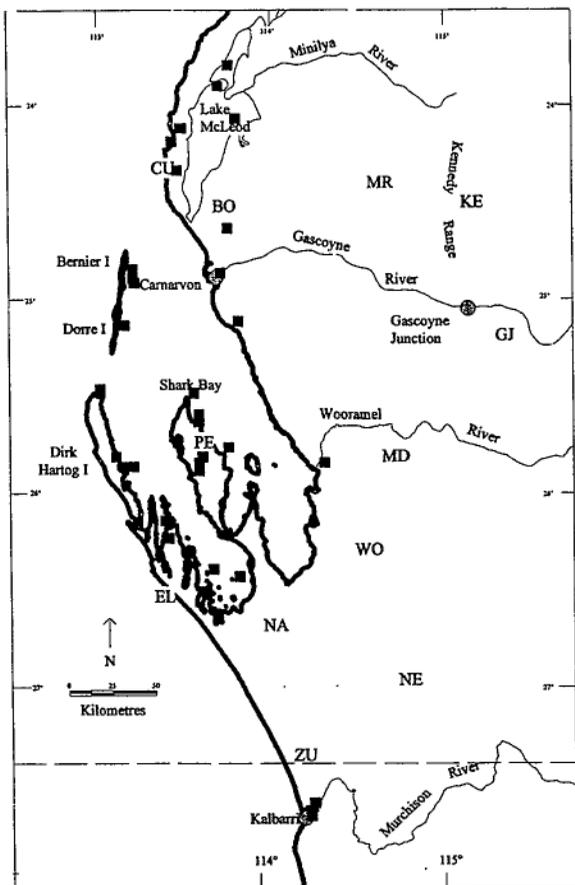
Collared Sparrowhawk



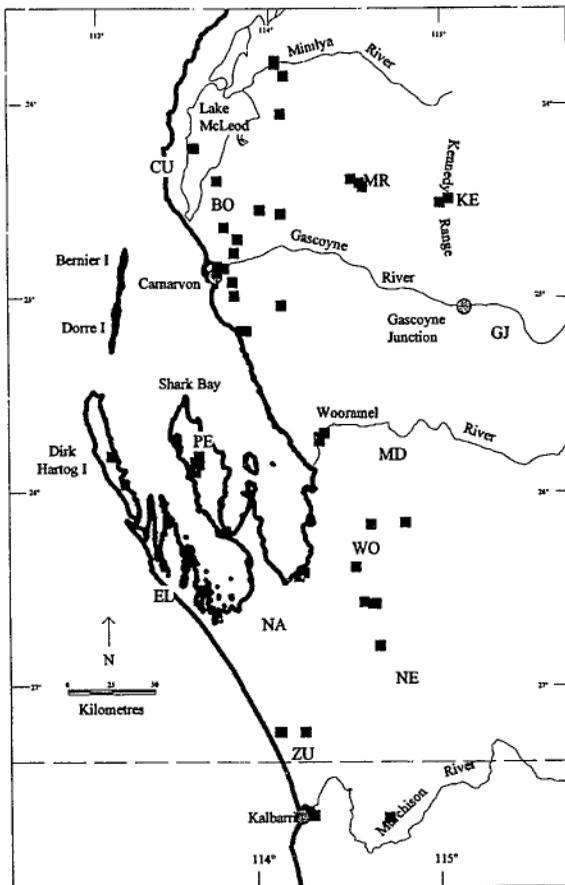
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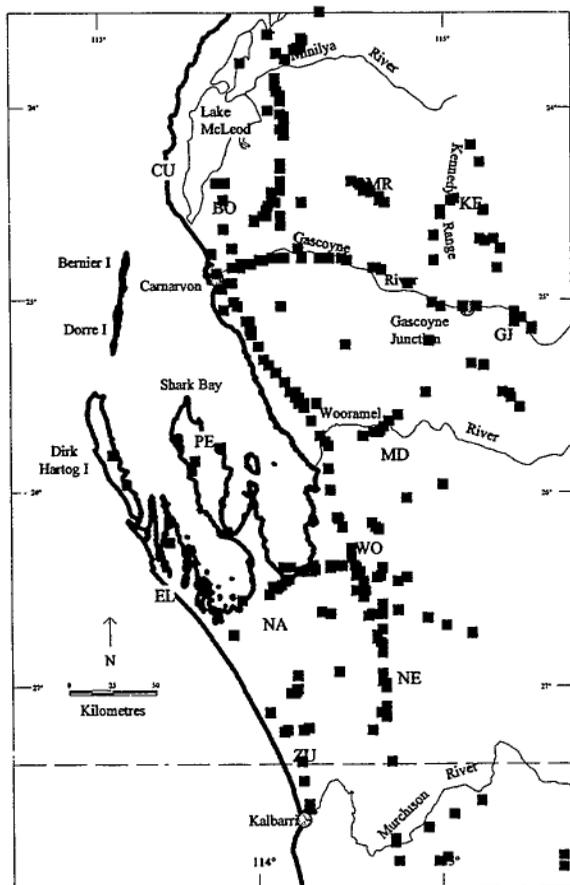
Wedge-tailed Eagle



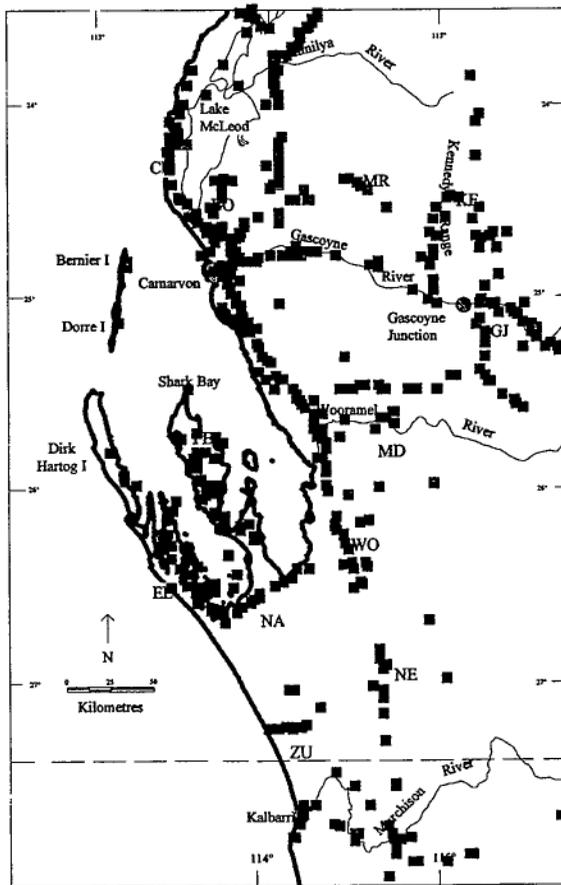
White-bellied Sea-Eagle



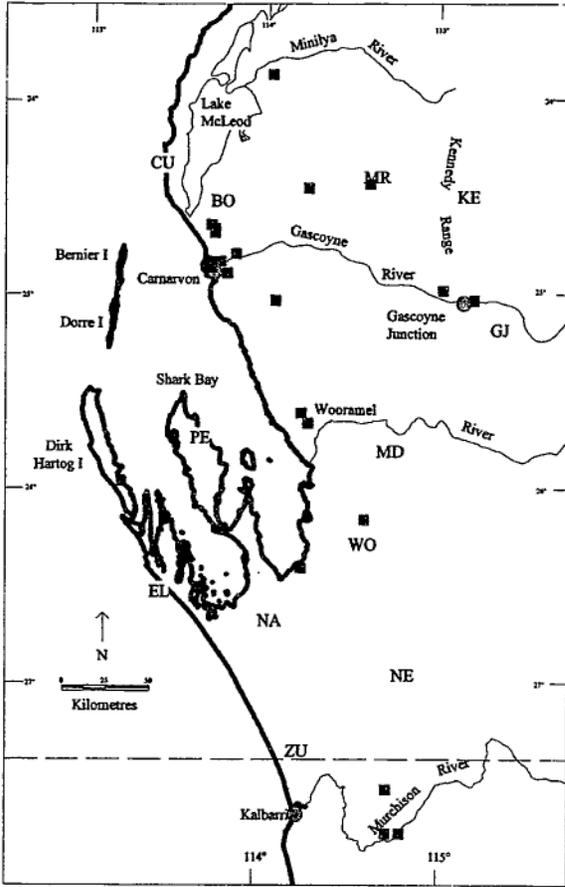
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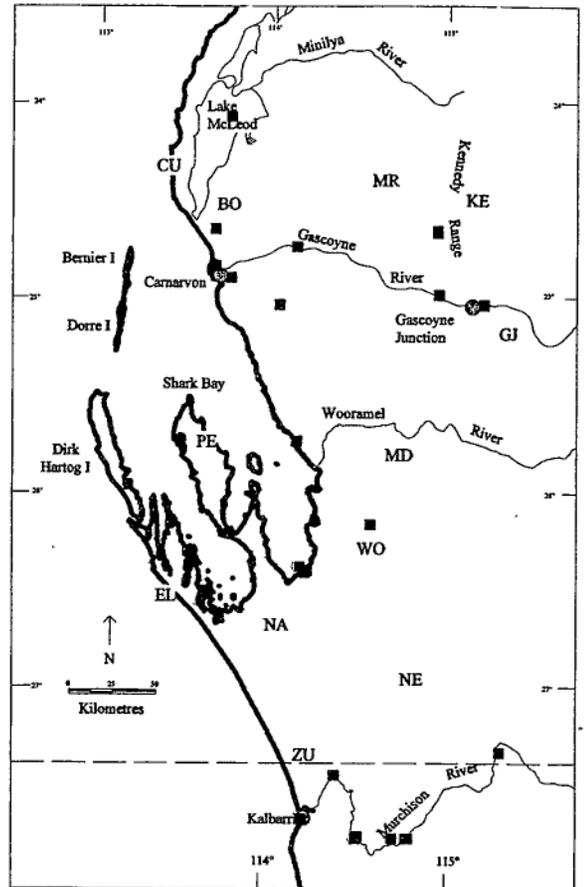
Brown Falcon



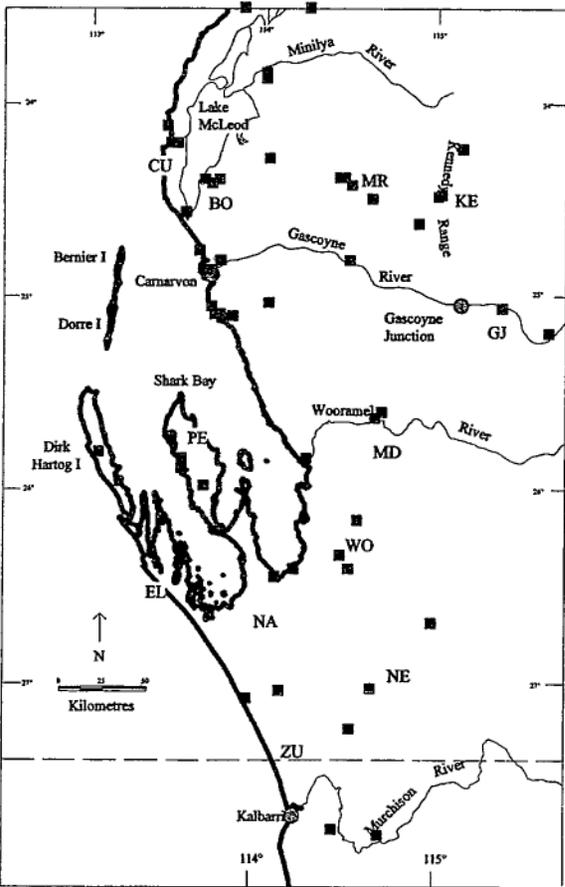
Australian Kestrel



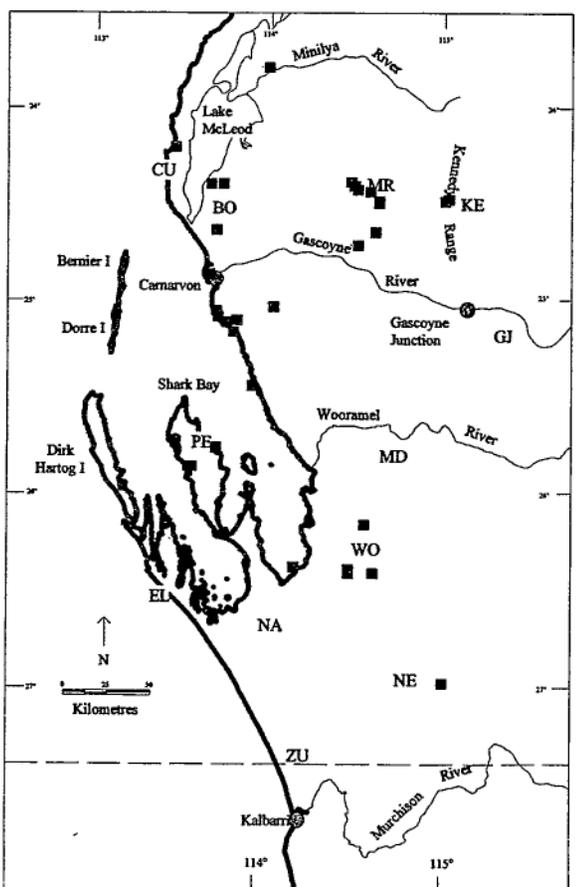
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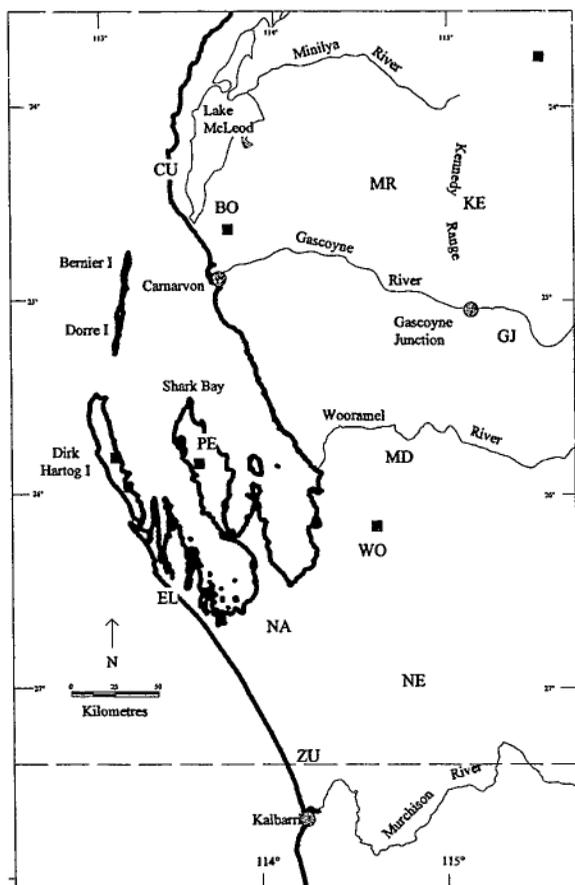
Eurasian Coot



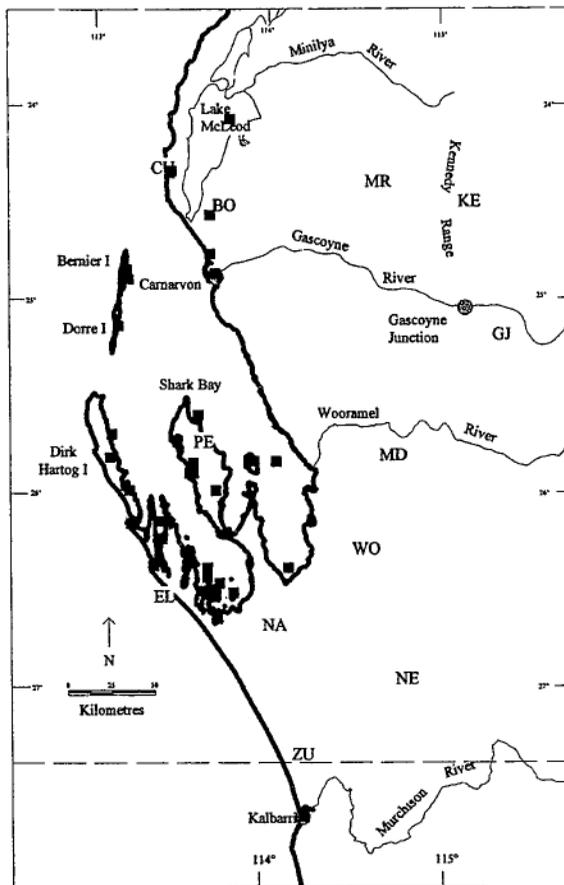
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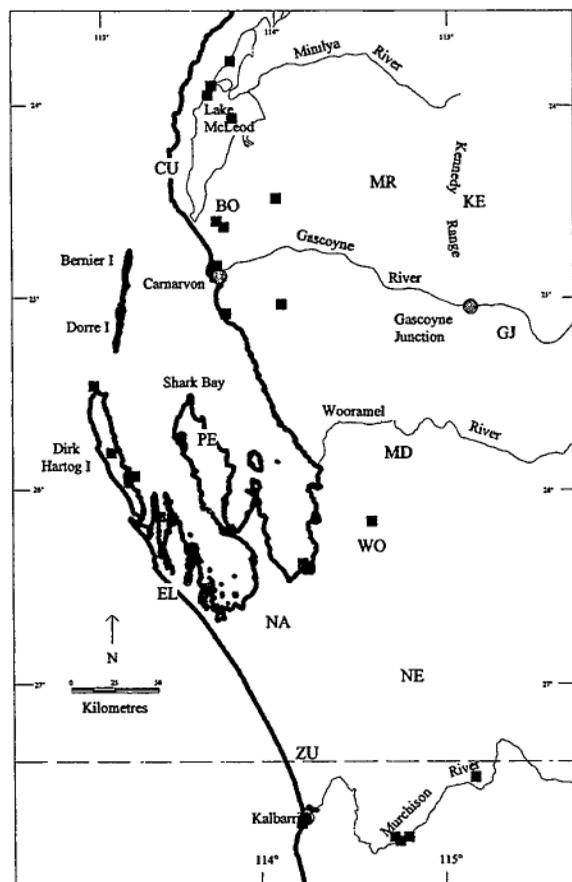
Little Button-quail



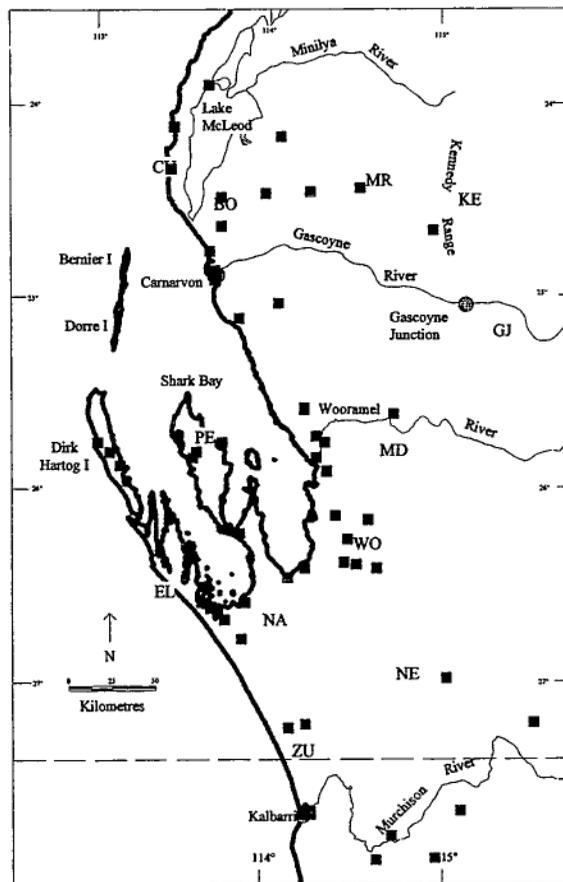
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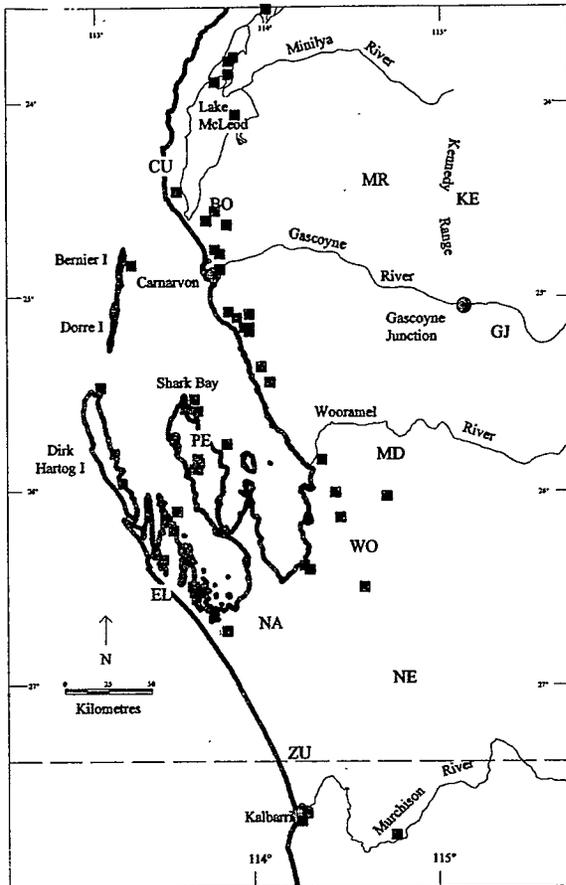
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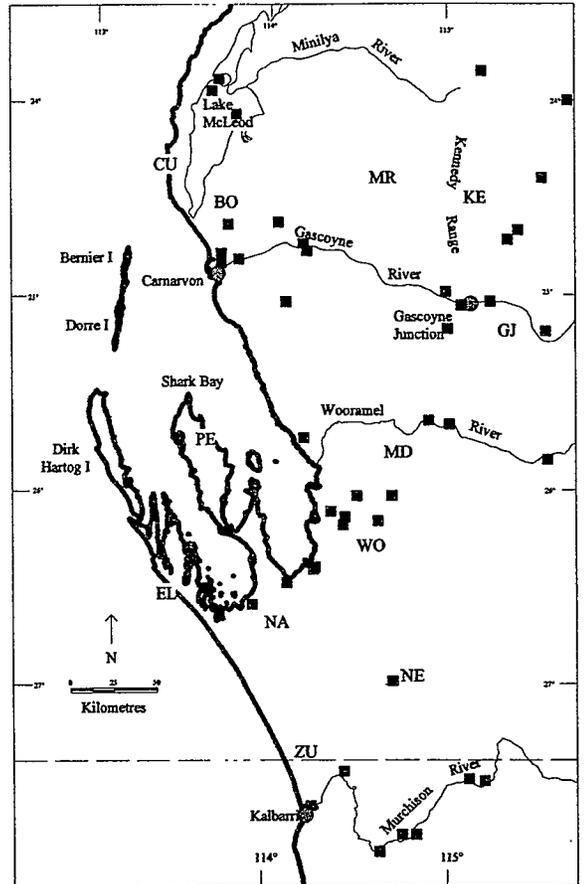
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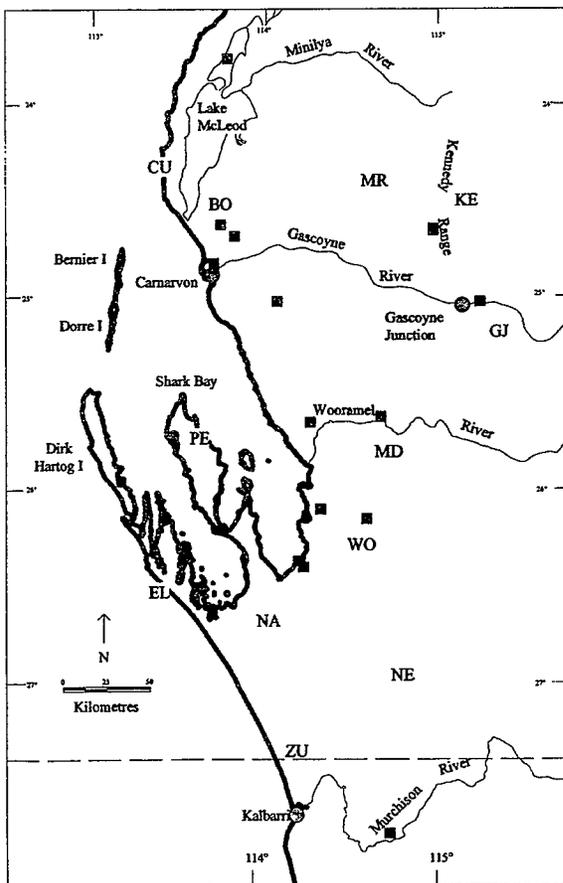
Banded Lapwing



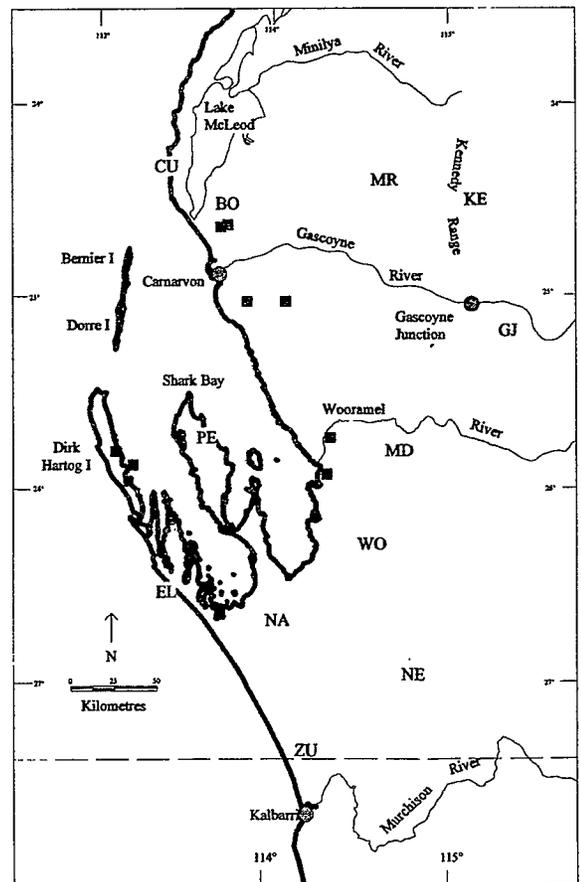
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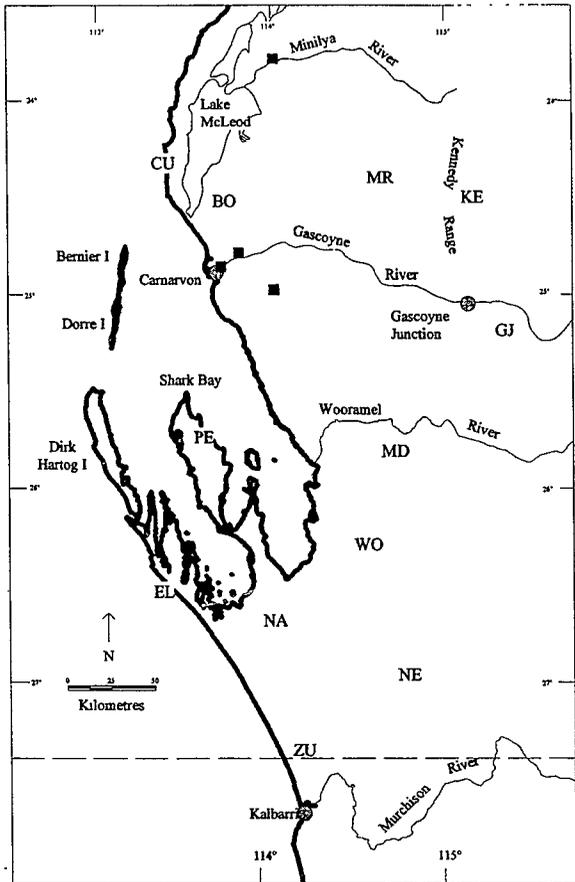
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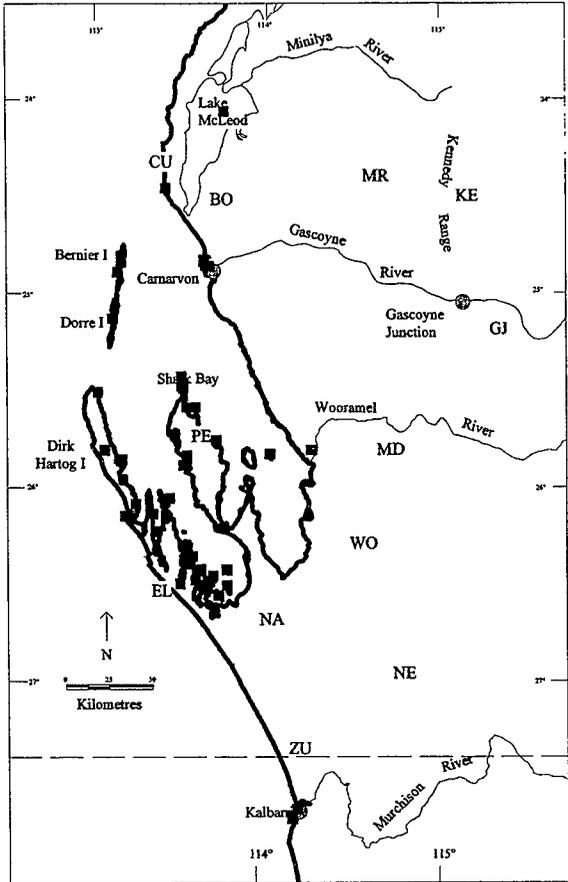
Red-kneed Dotterel



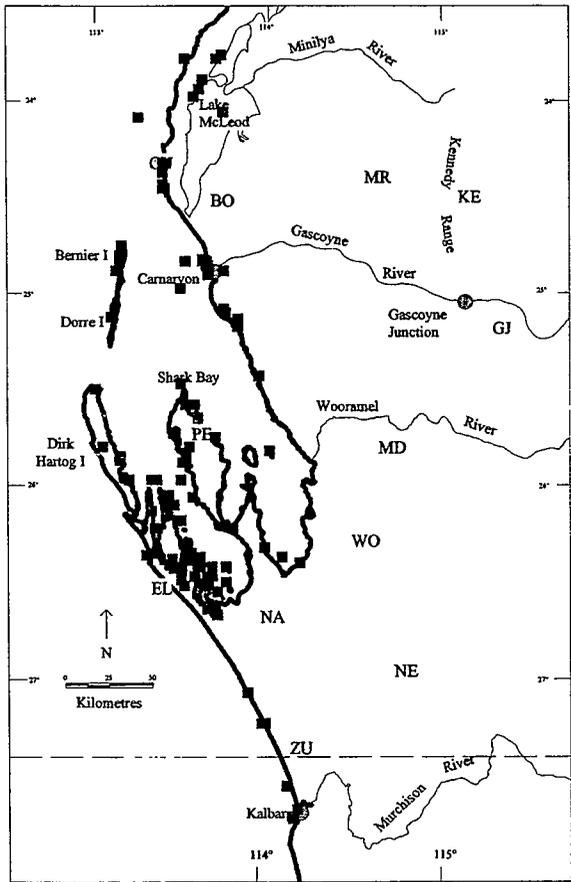
Inland Dotterel



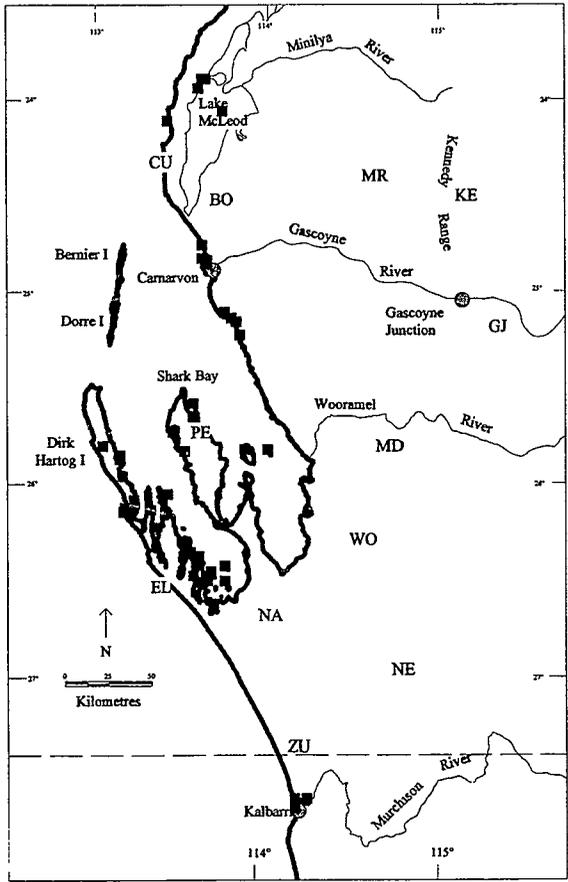
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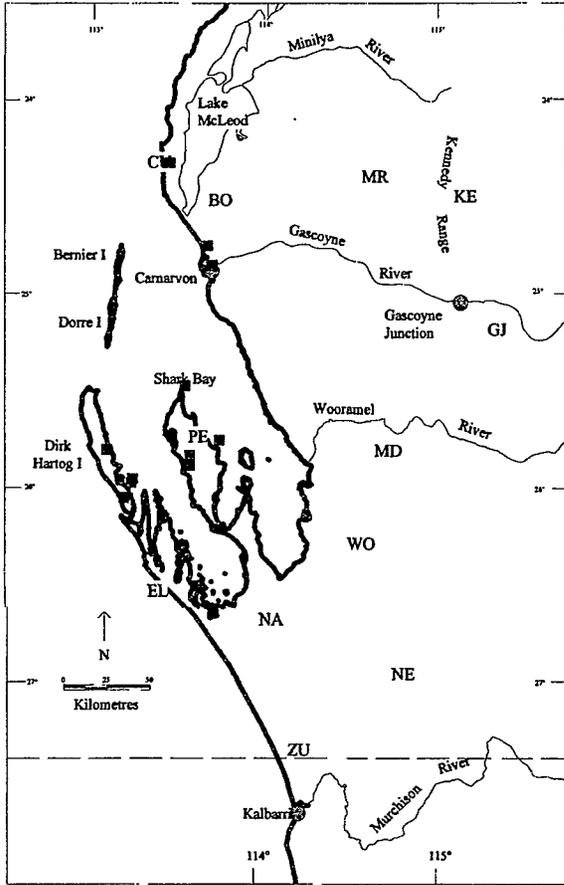
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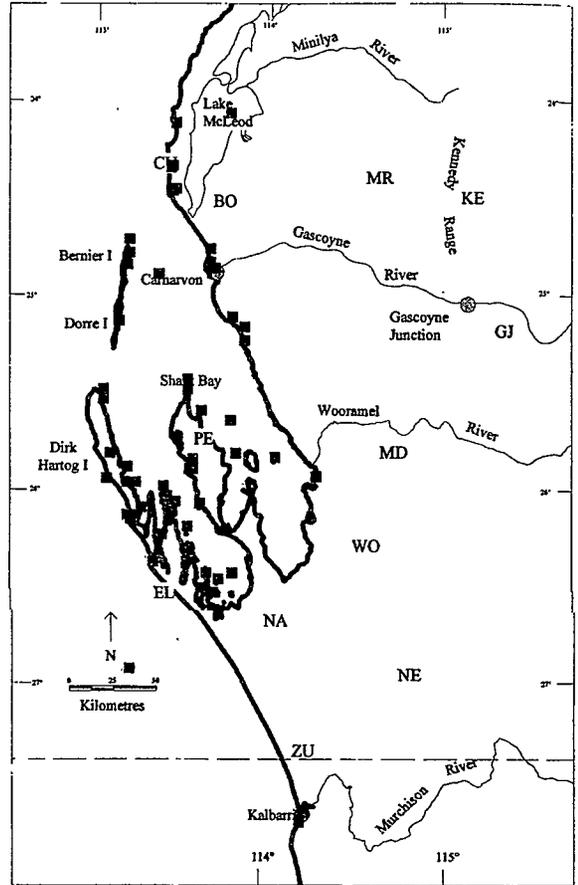
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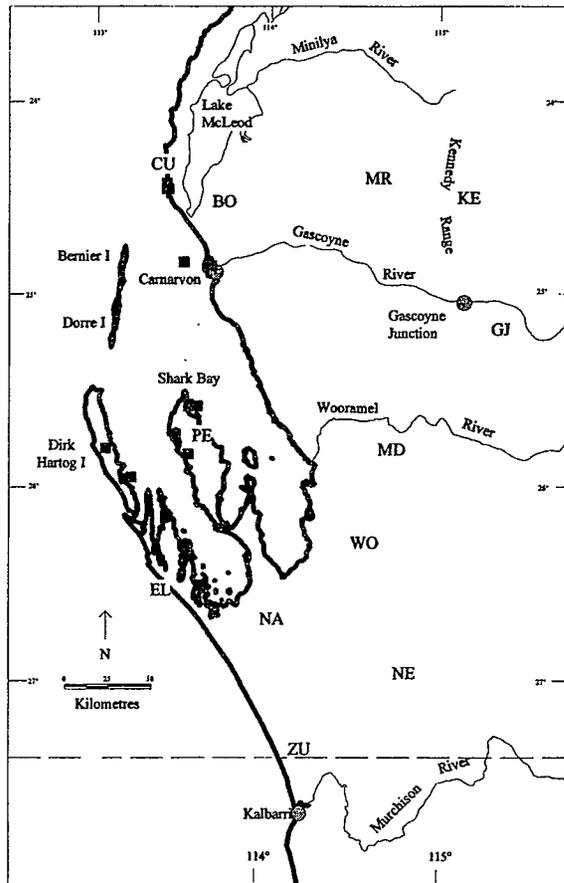
Caspian Tern



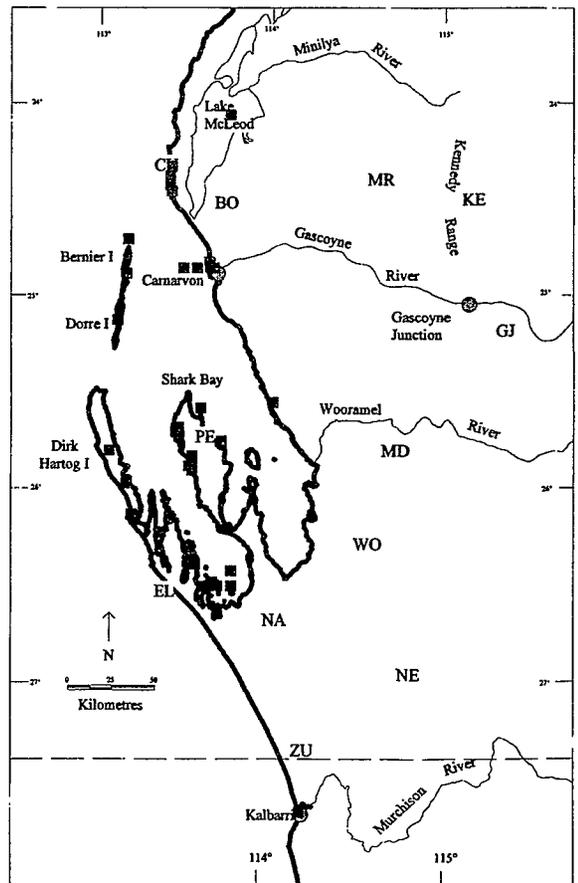
Lesser Crested Tern



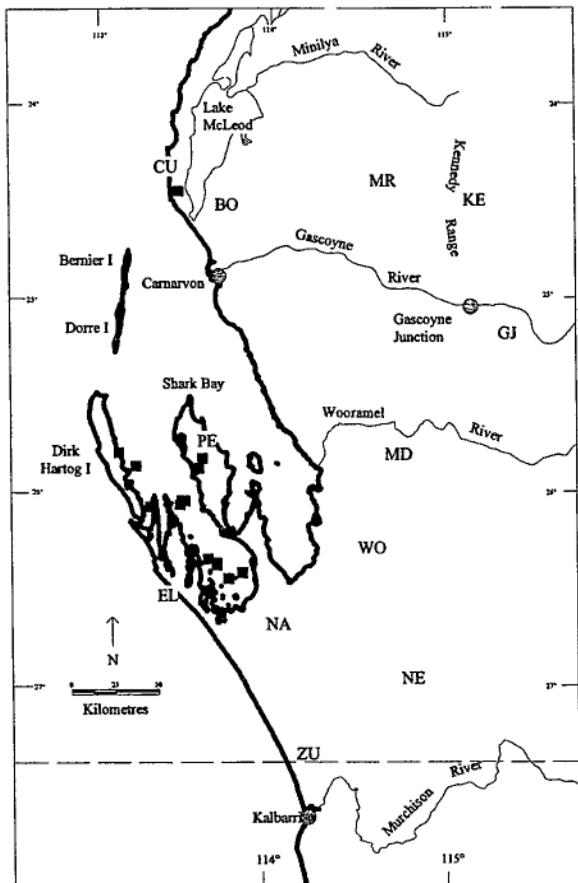
Crested Tern



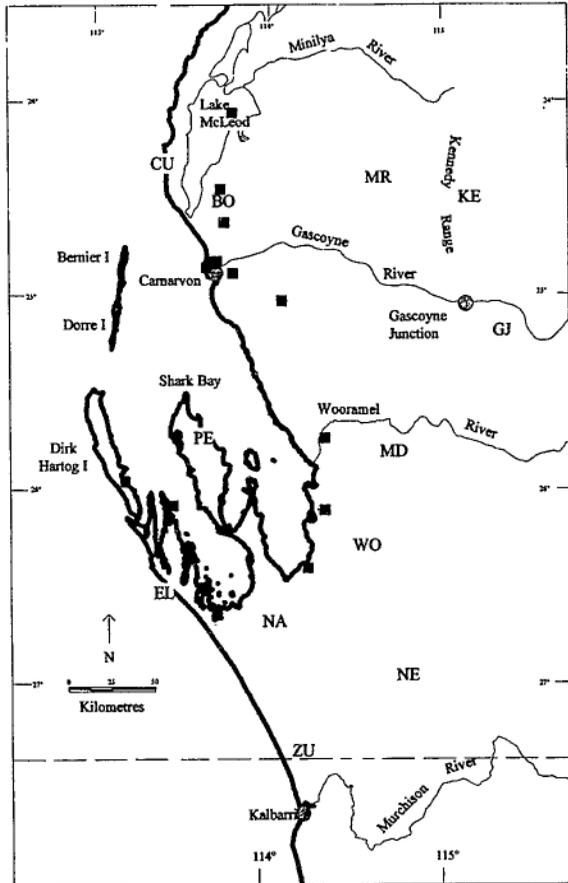
Roseate Tern



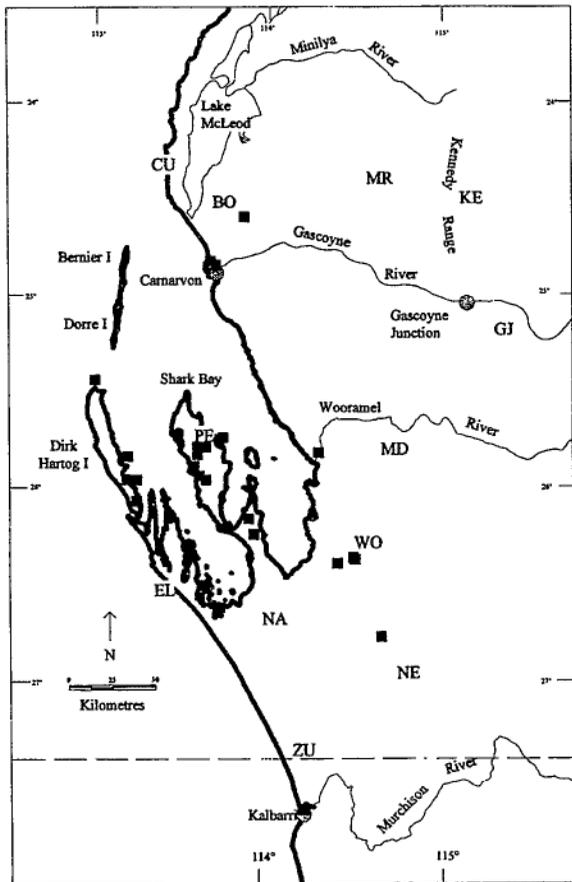
Fairy Tern



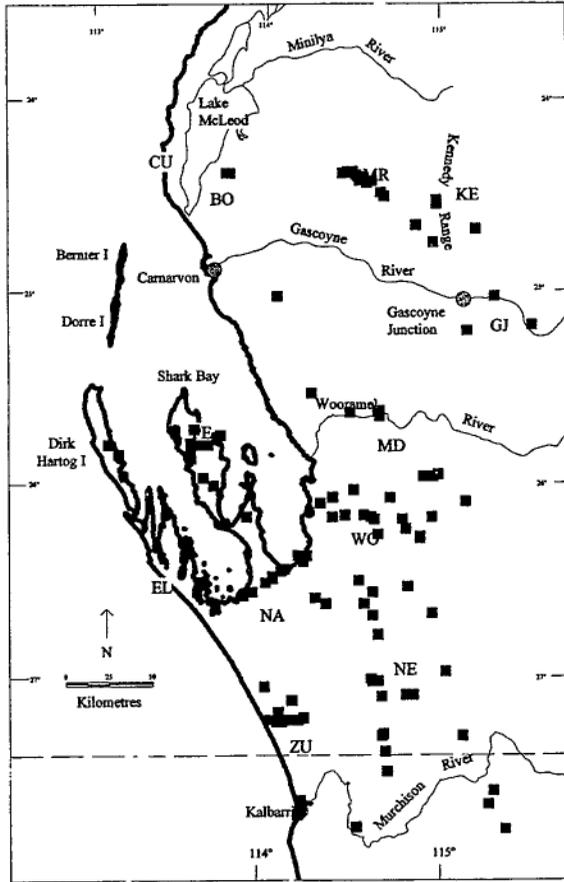
Bridled Tern



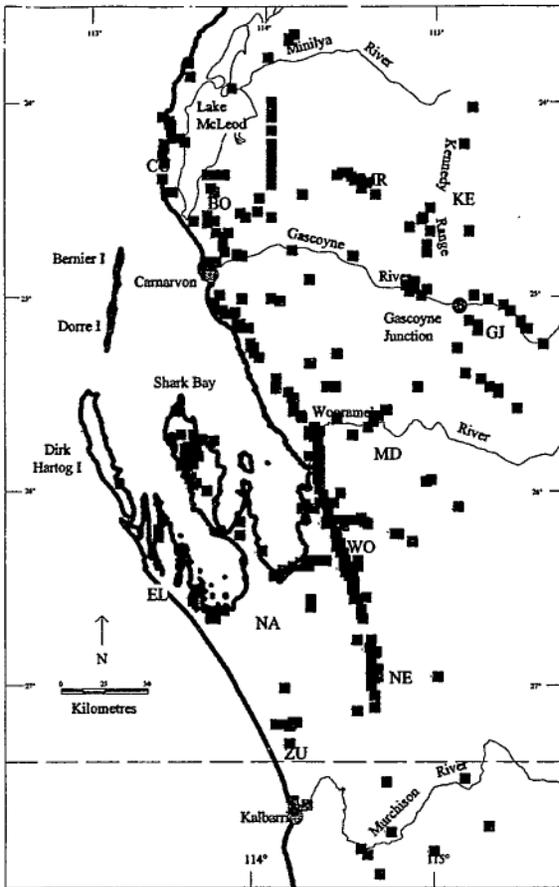
Whiskered Tern



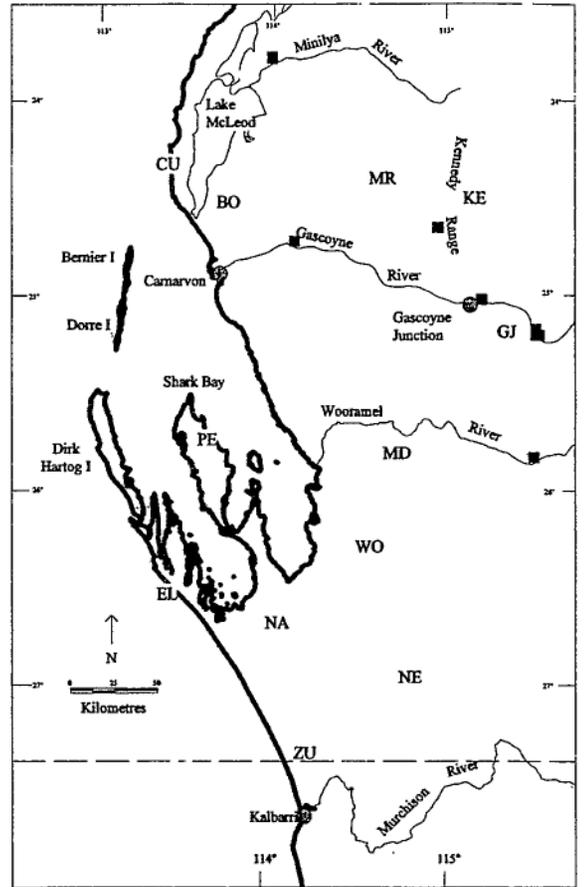
Laughing Turtle-Dove



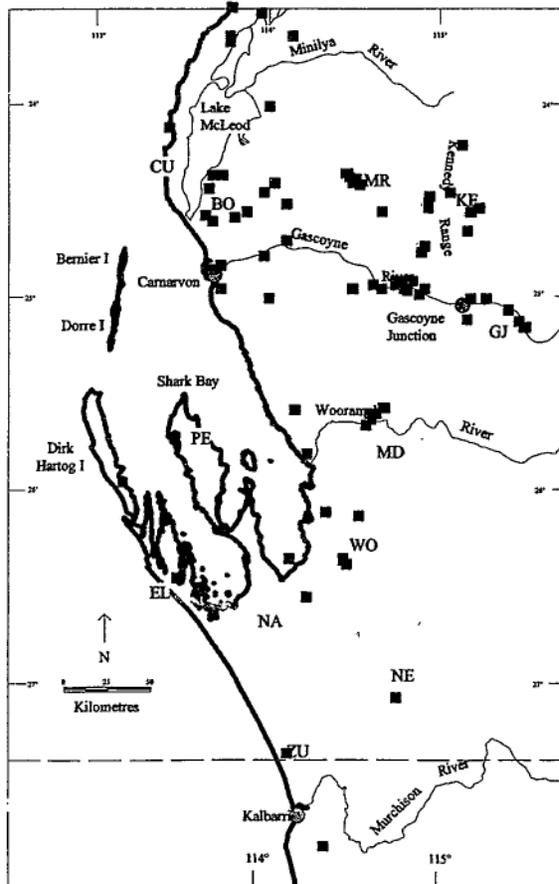
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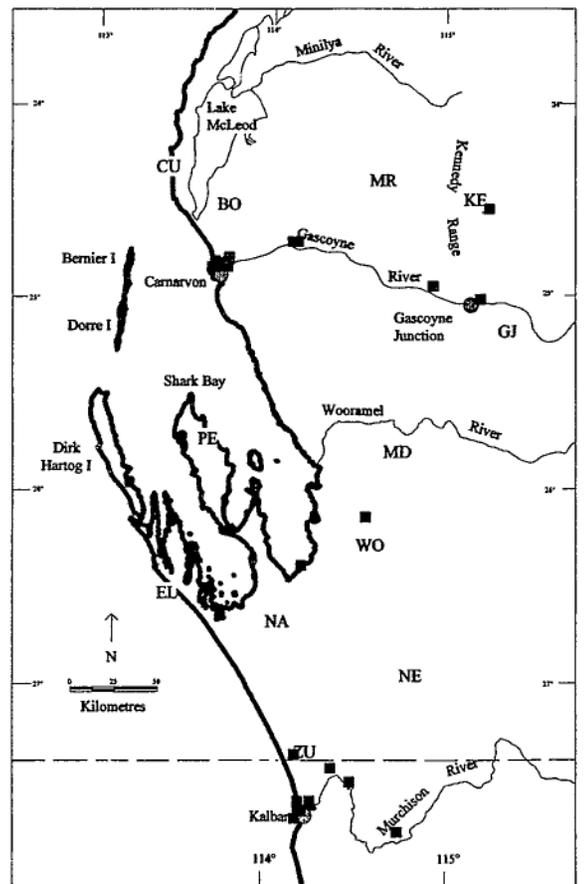
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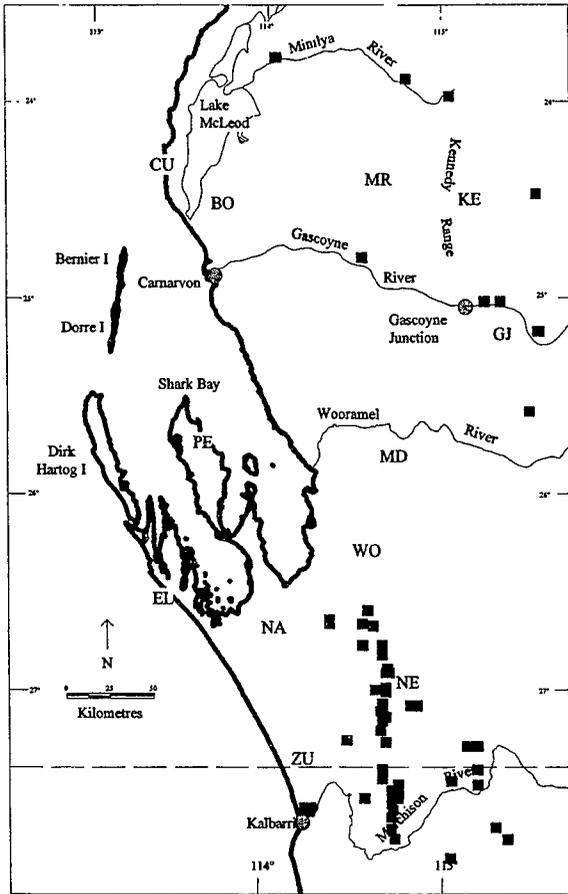
Spinifex Pigeon



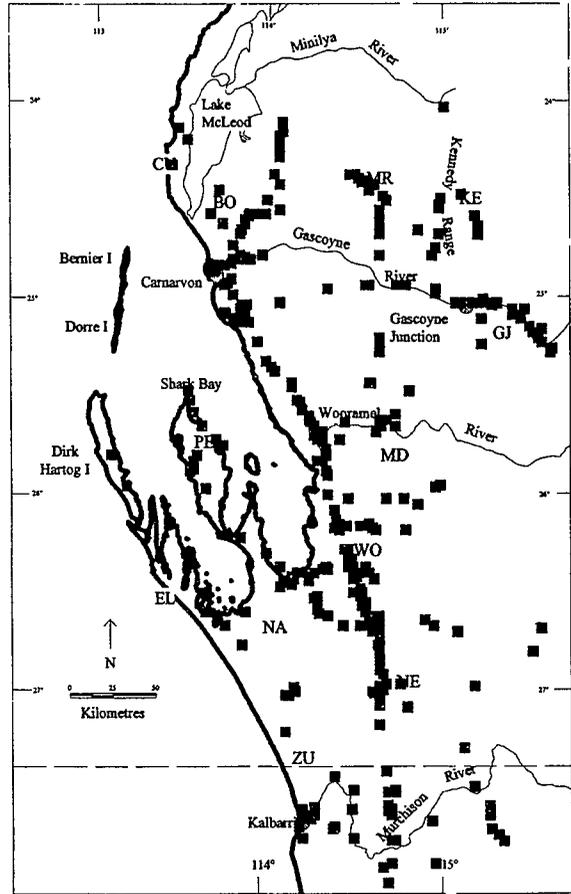
Diamond Dove



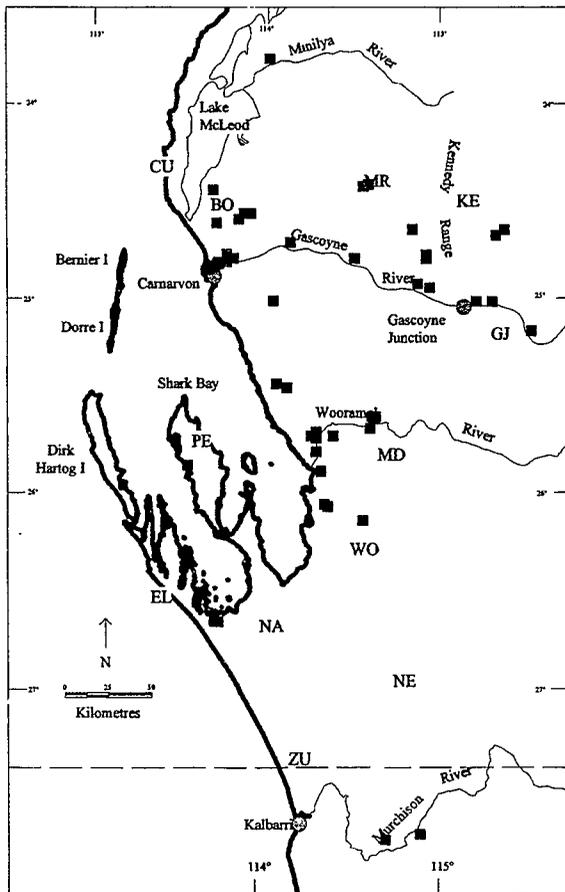
Peaceful Dove



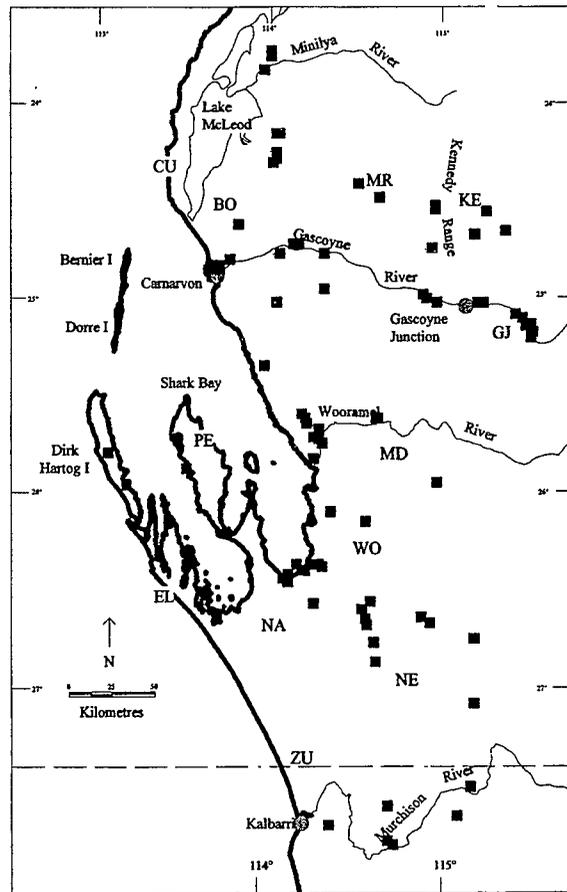
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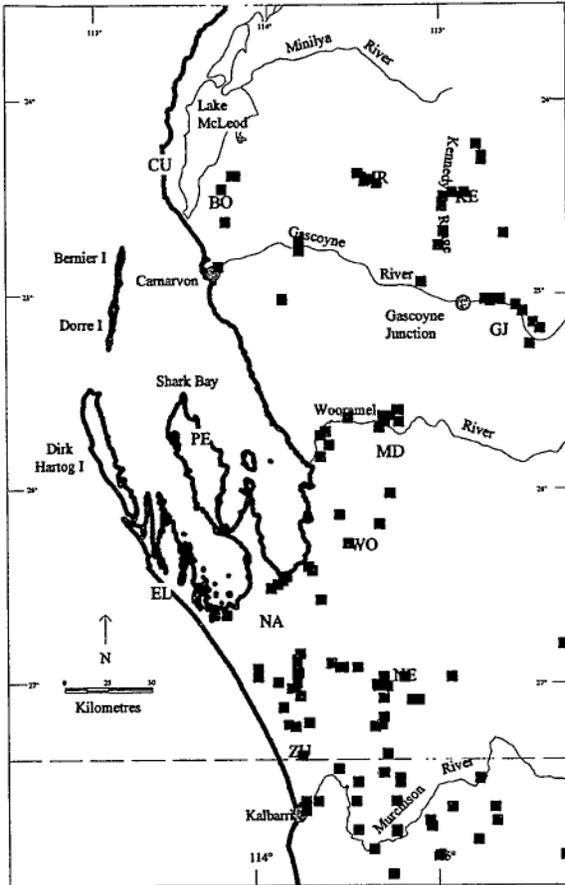
Galah



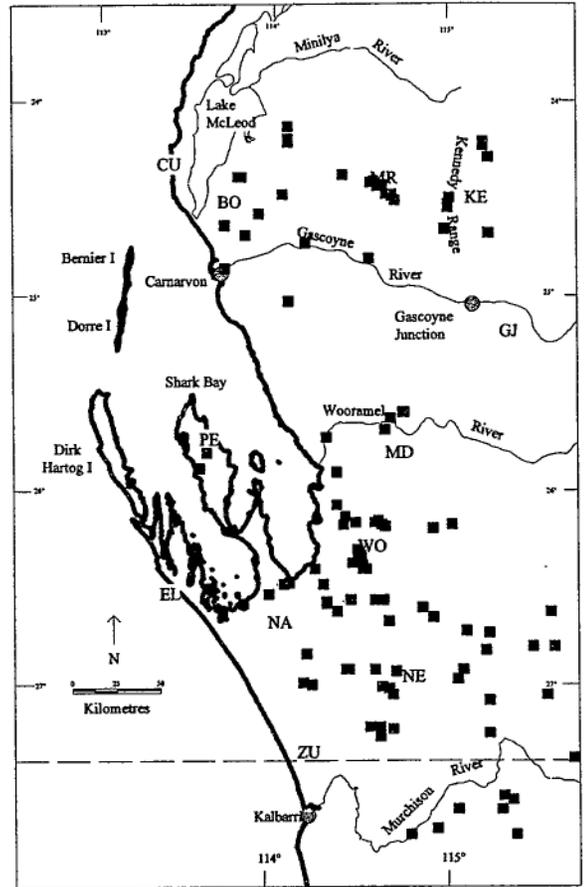
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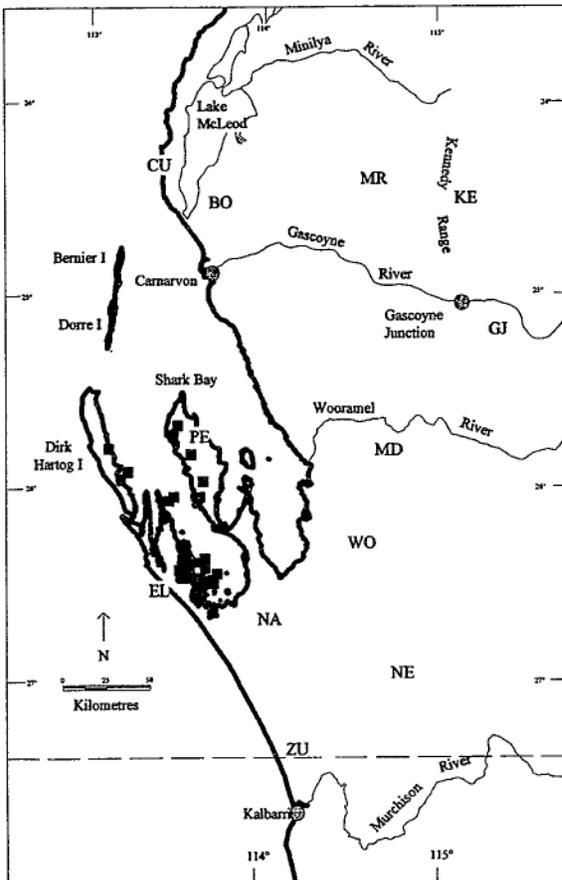
Cockatiel



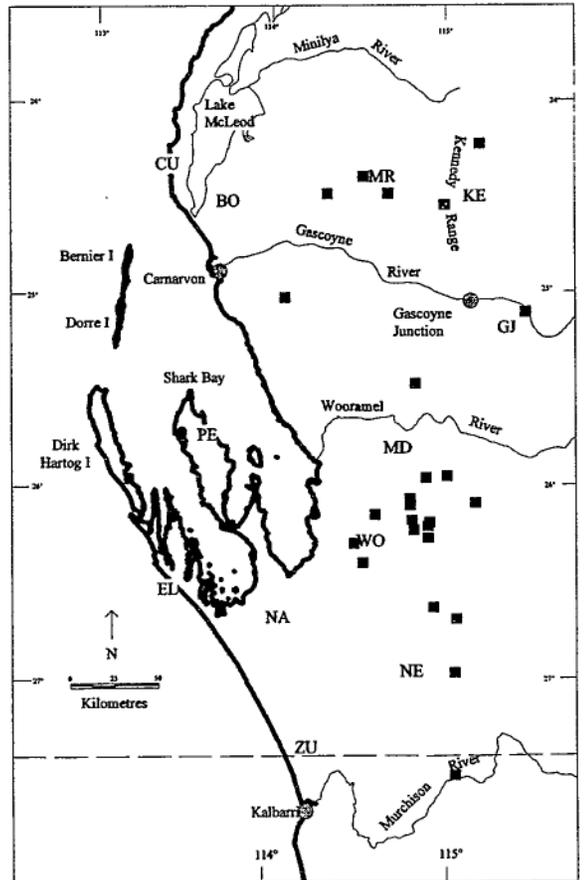
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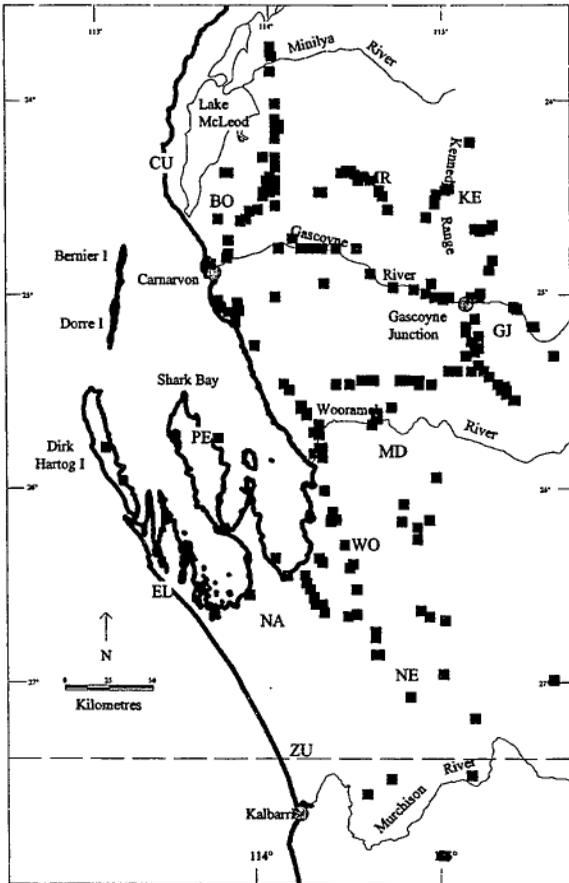
Mulga Parrot



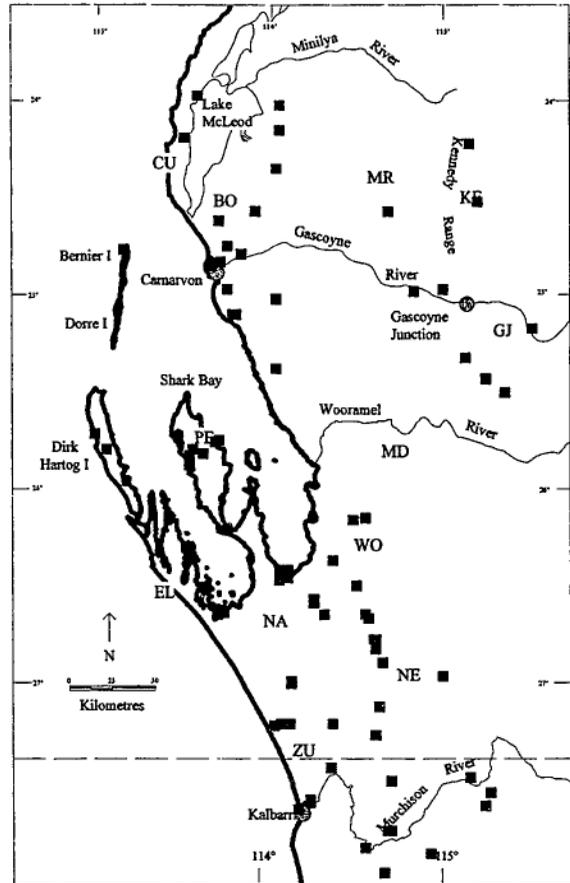
Rock Parrot



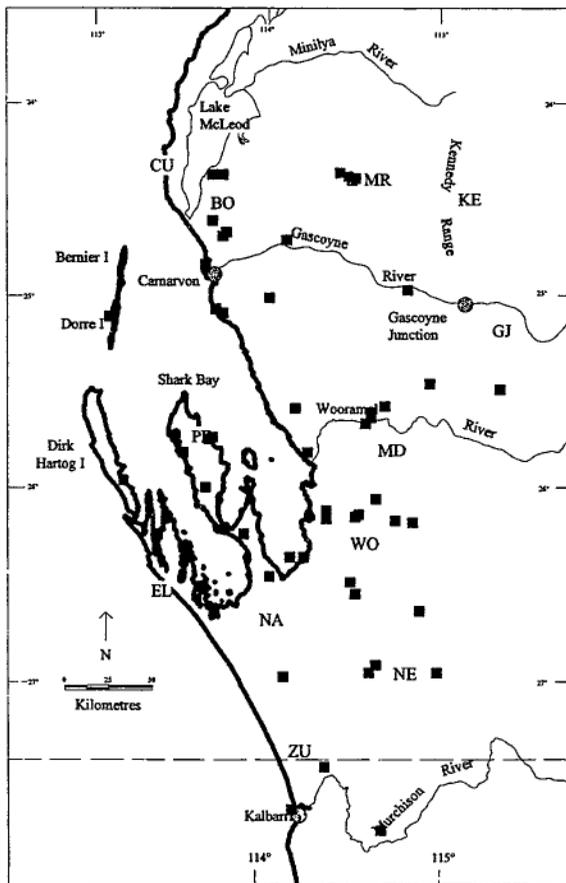
Bourke's Parrot



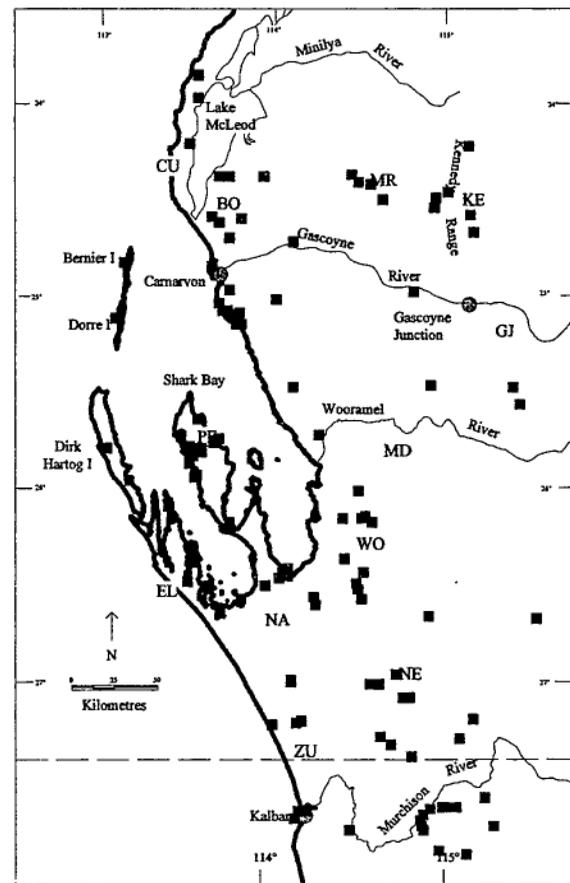
Budgerigar



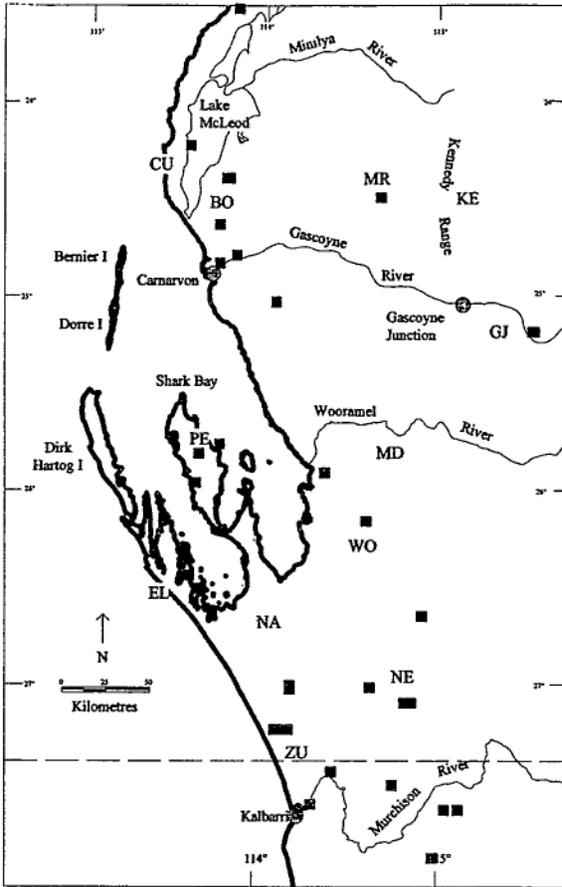
Pallid Cuckoo



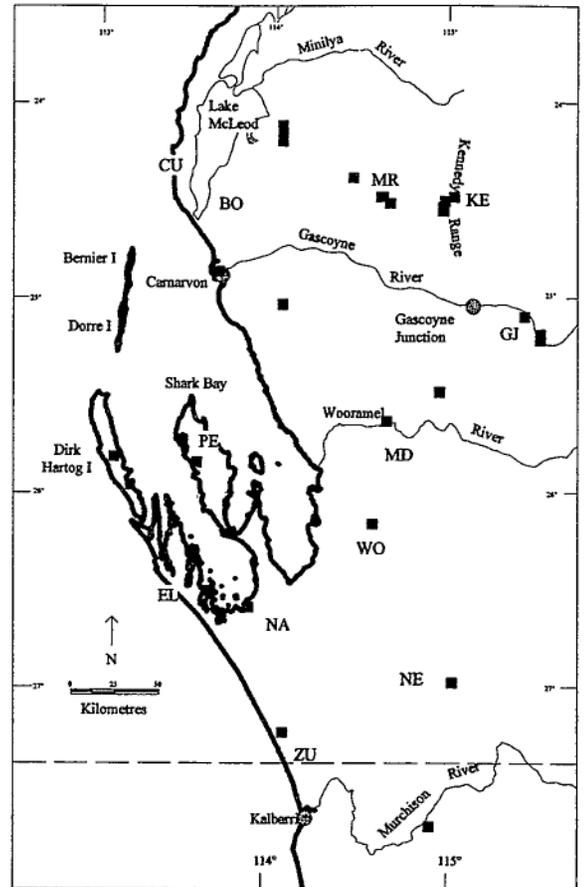
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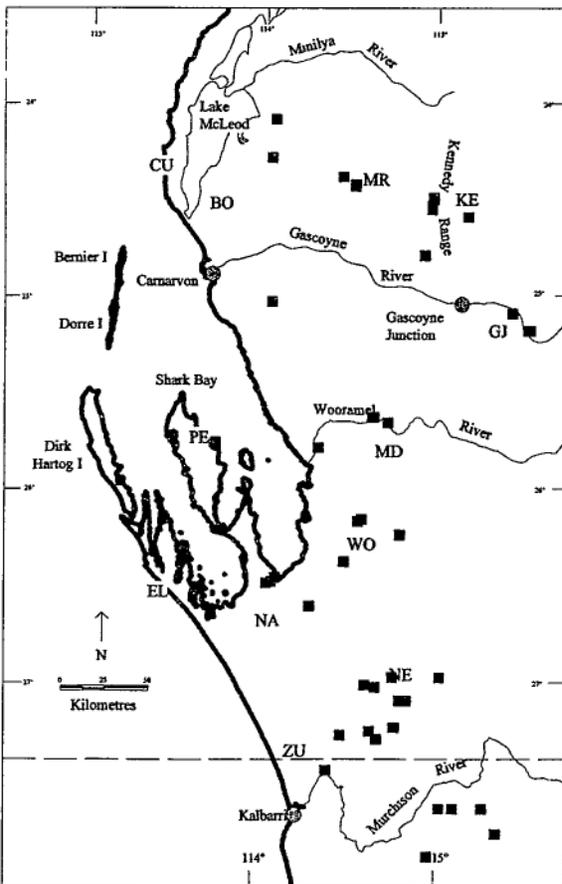
Horsfield's Bronze Cuckoo



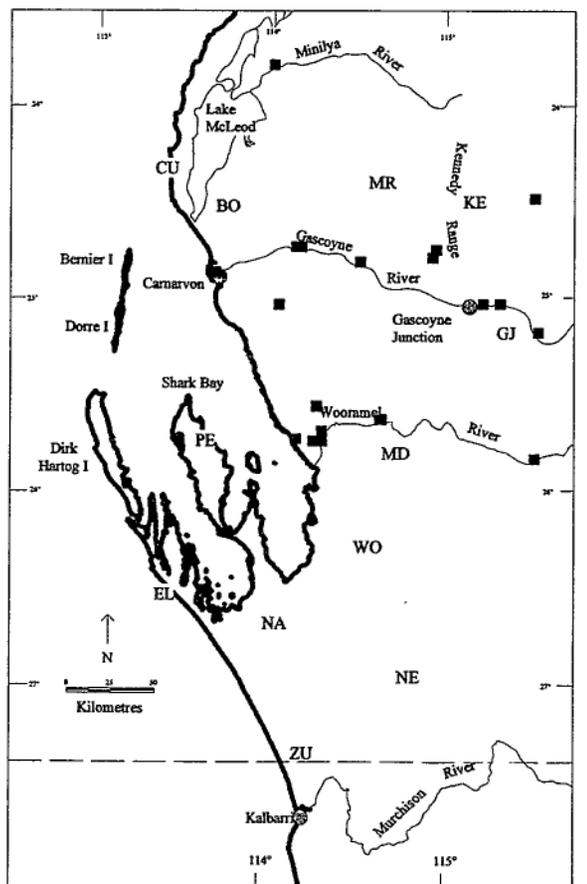
Tawny Frogmouth



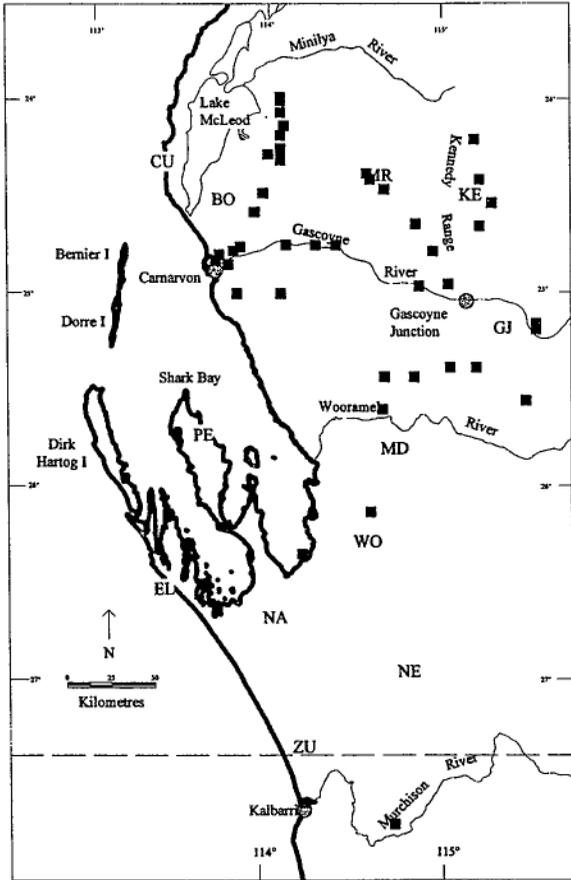
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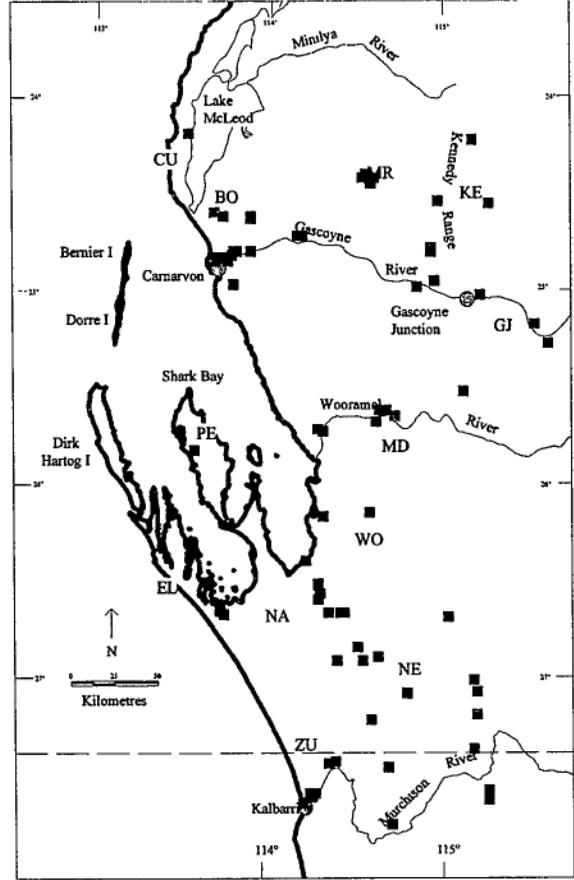
Australian Owlet-nightjar



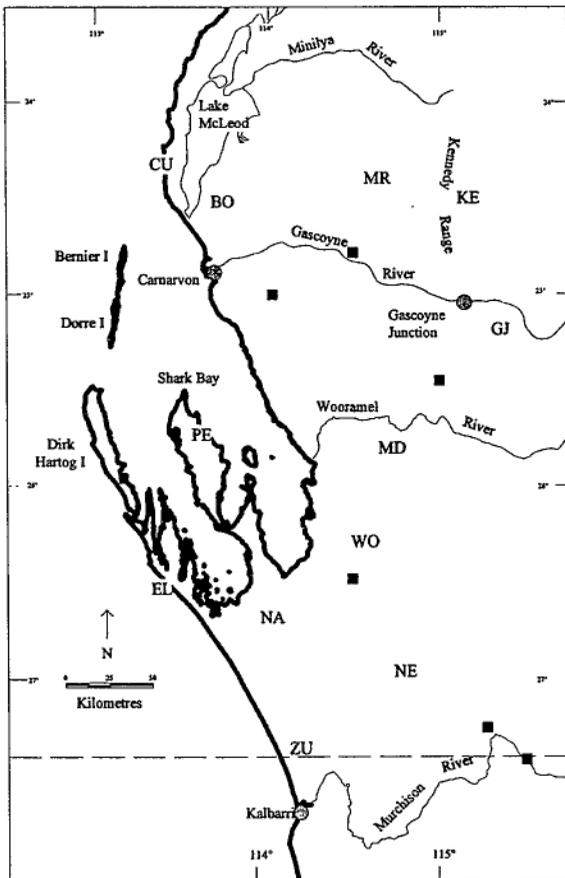
Blue-winged Kookaburra



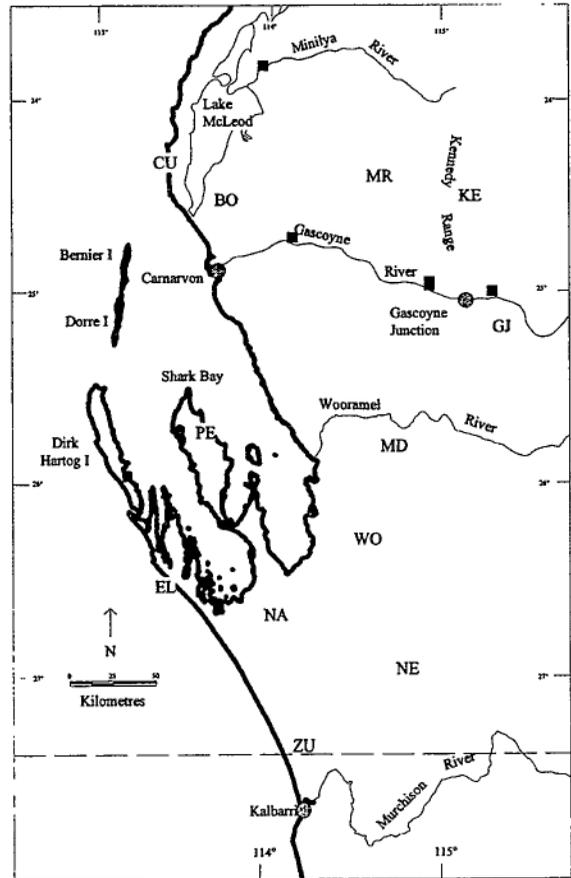
Red-backed Kingfisher



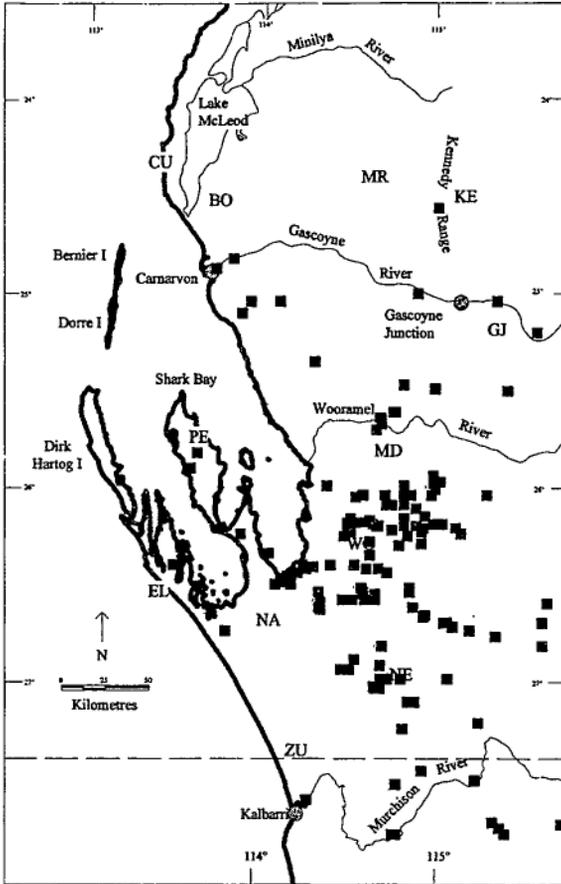
Rainbow Bee-eater



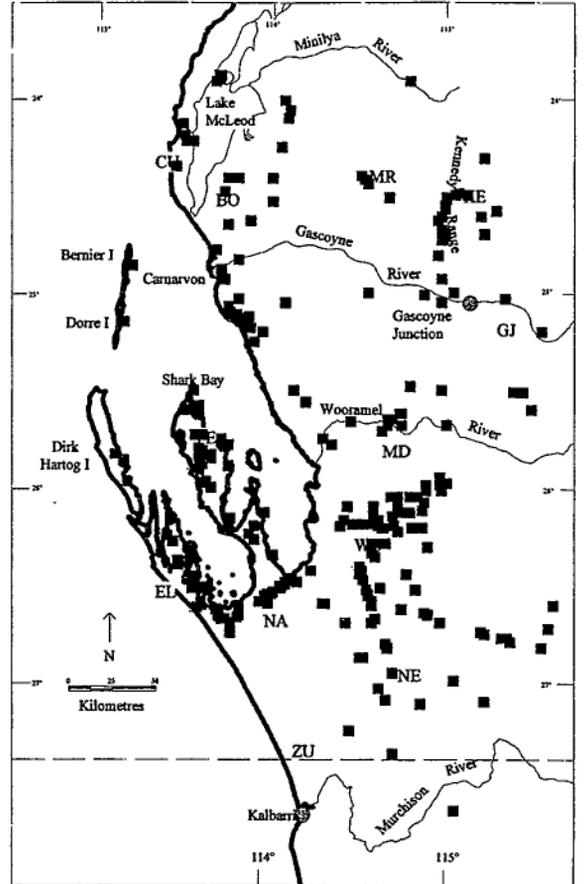
White-browed Treecreeper



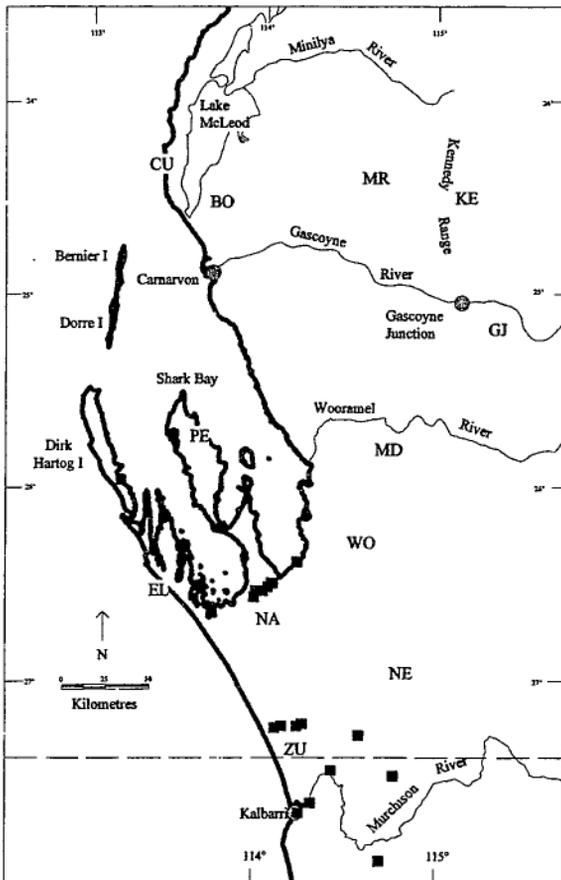
Black-tailed Treecreeper



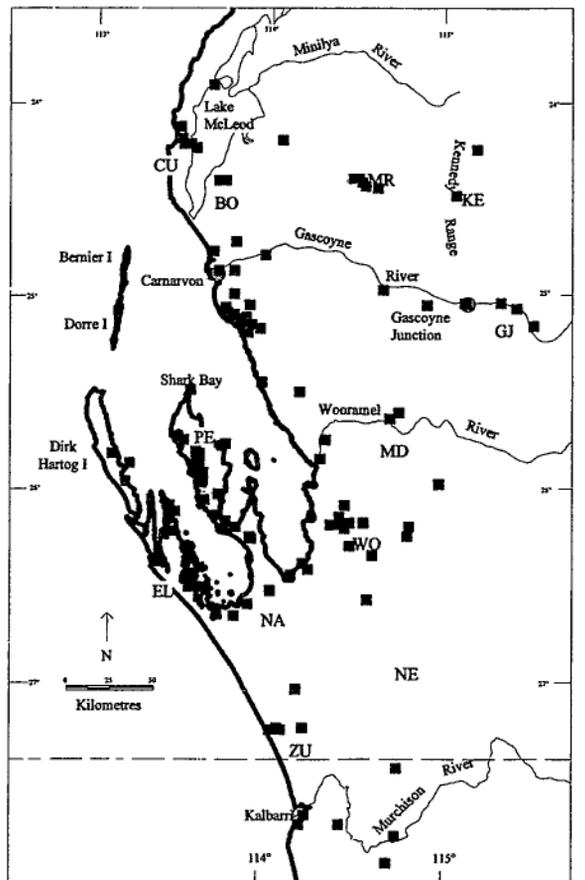
Splendid Fairy-wren



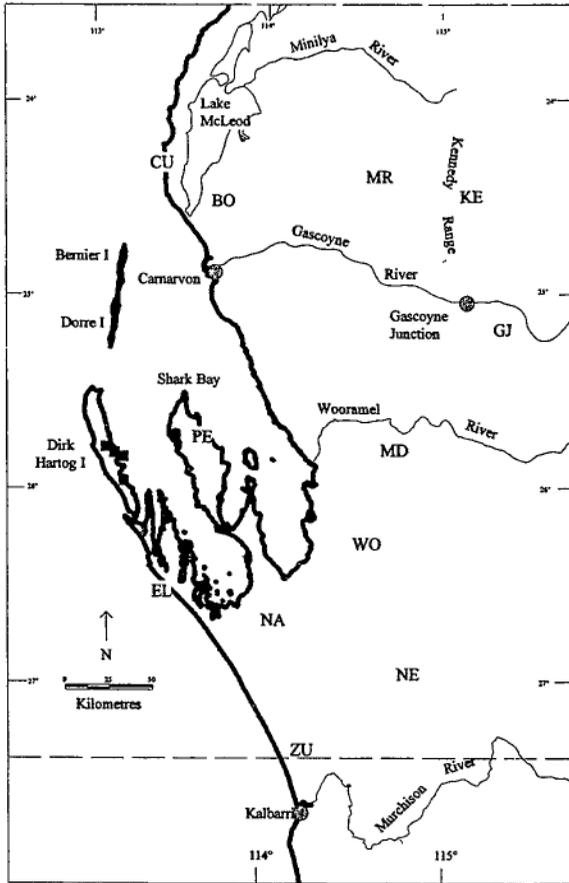
Variegated Fairy-wren



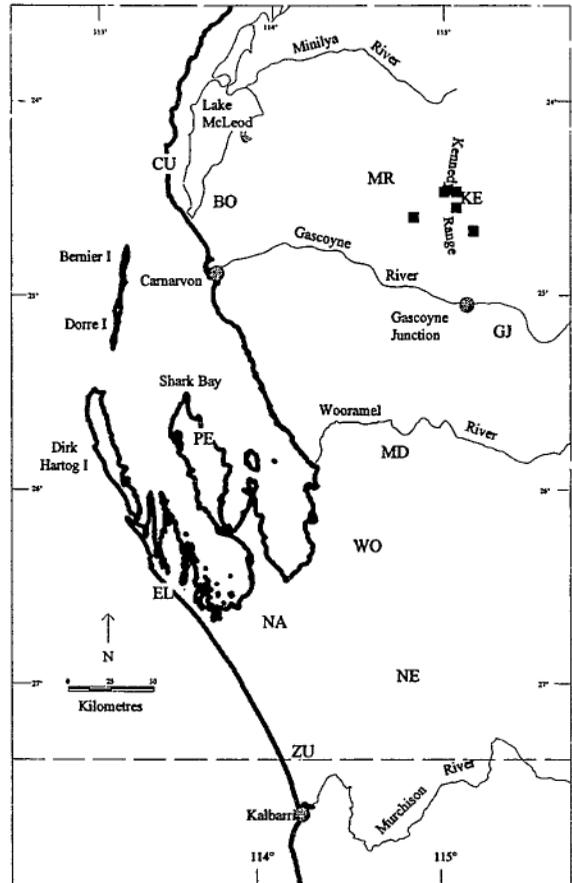
Blue-breasted Fairy-wren



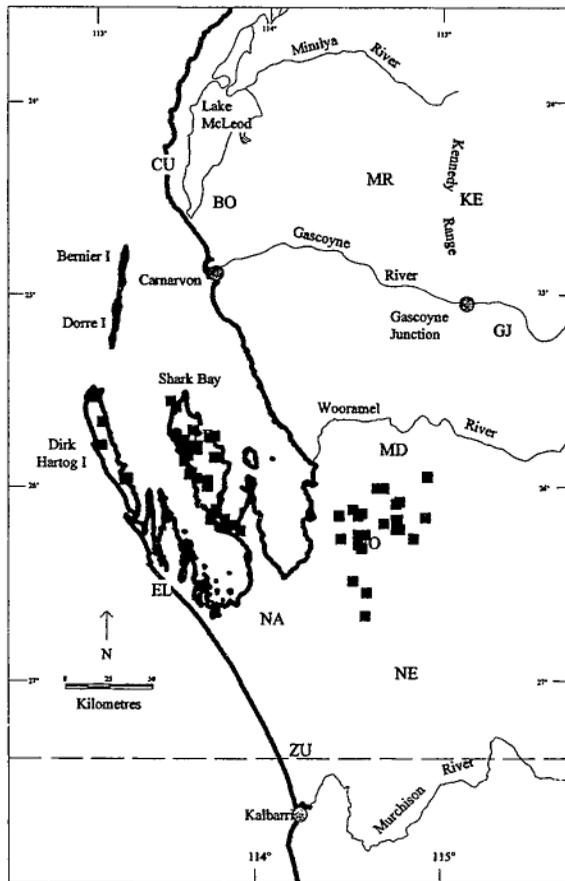
White-winged Fairy-wren



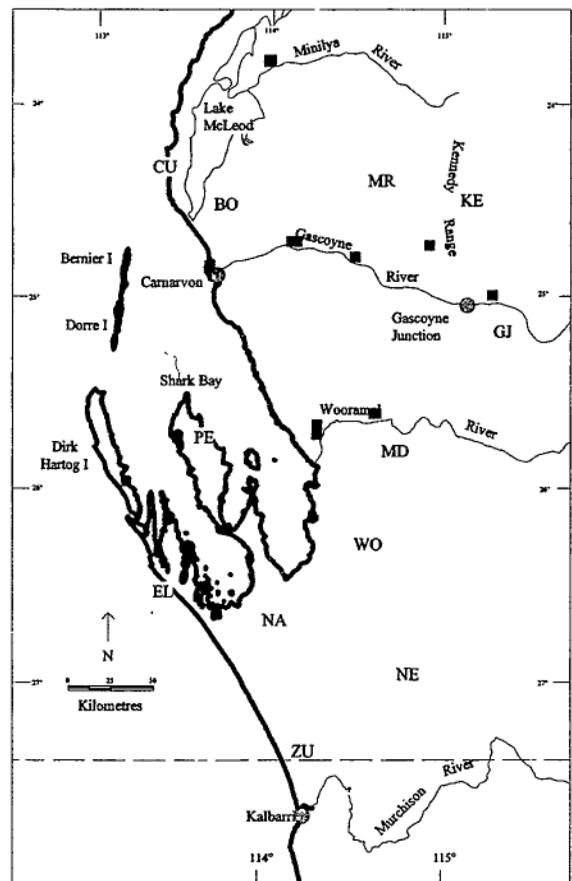
Southern Emu-wren



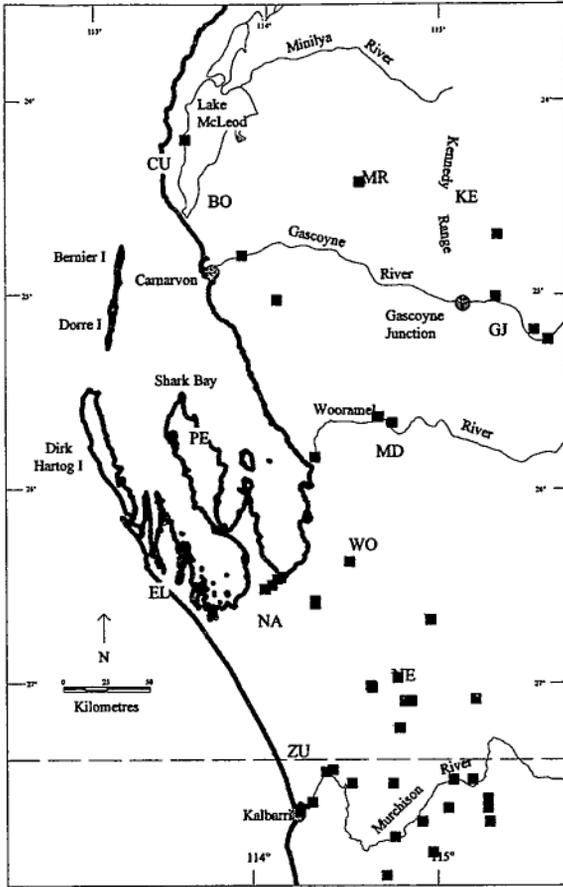
Rufous-crowned Emu-wren



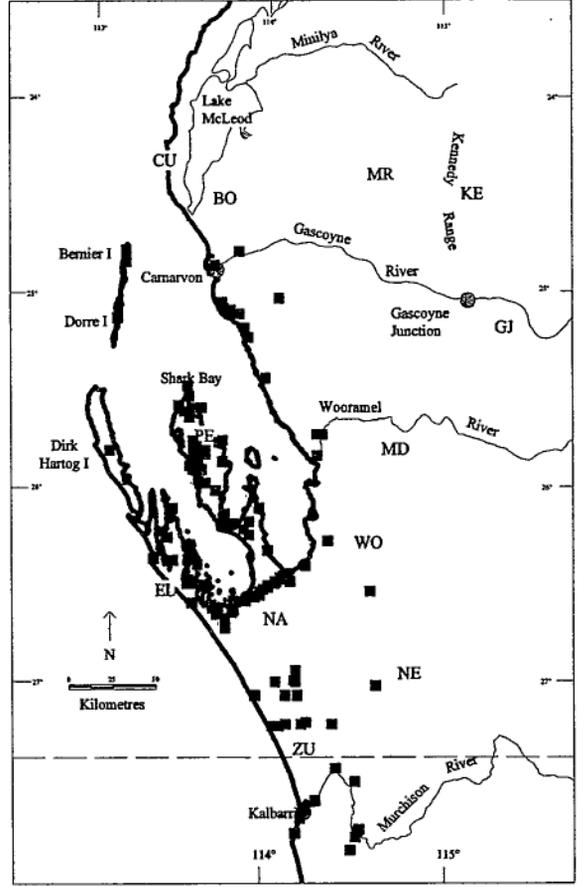
Thick-billed Grasswren



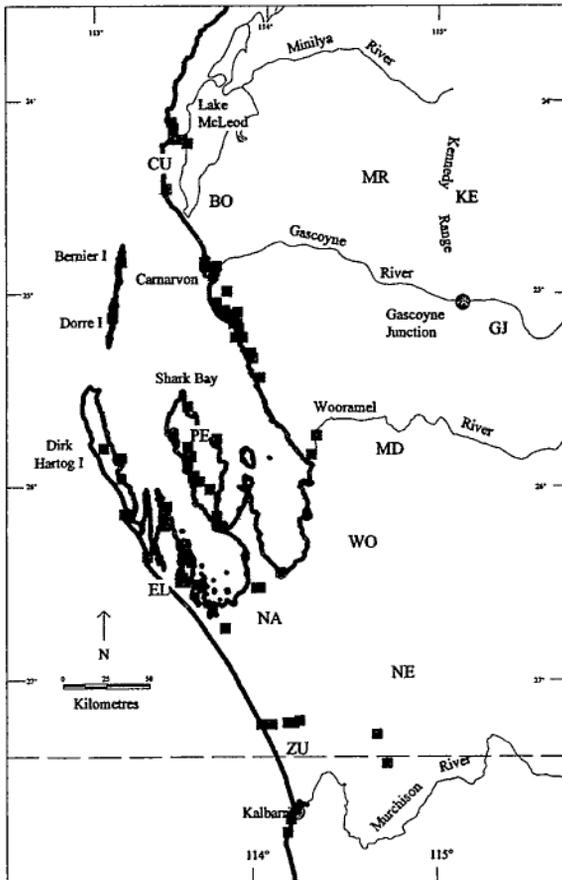
Red-browed Pardalote



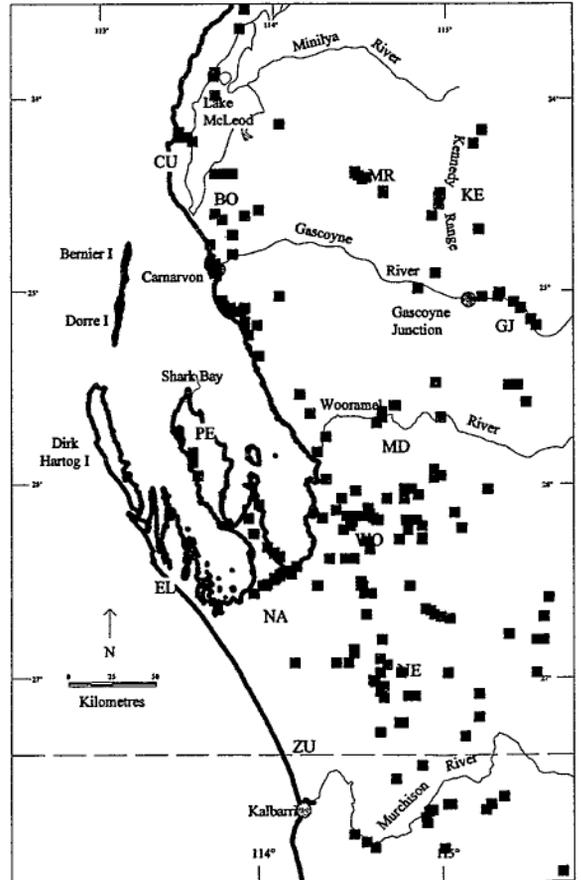
Striated Pardalote



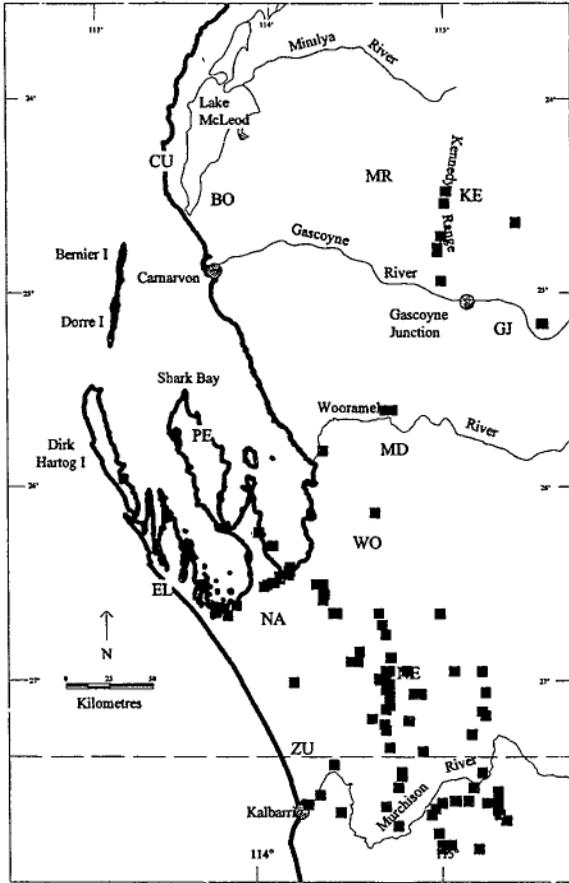
White-browed Scrubwren



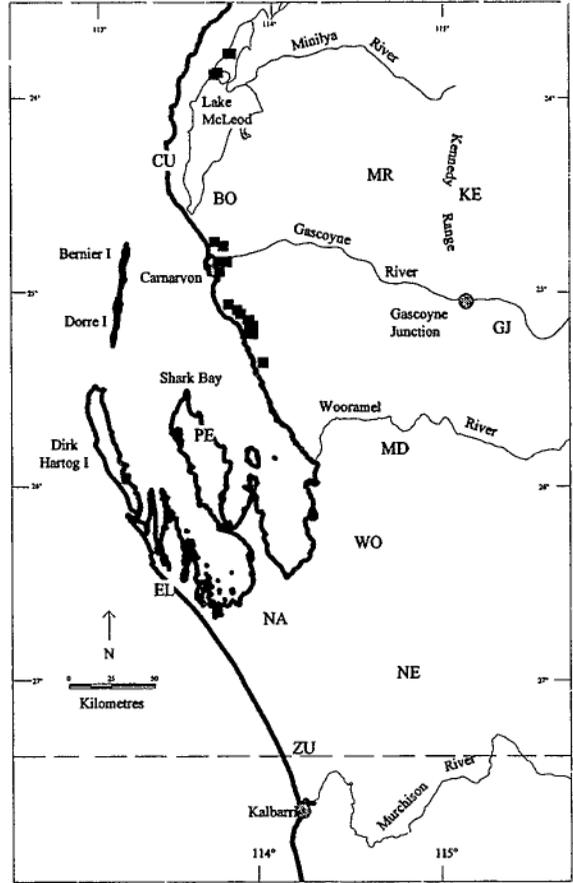
Rufous Fieldwren



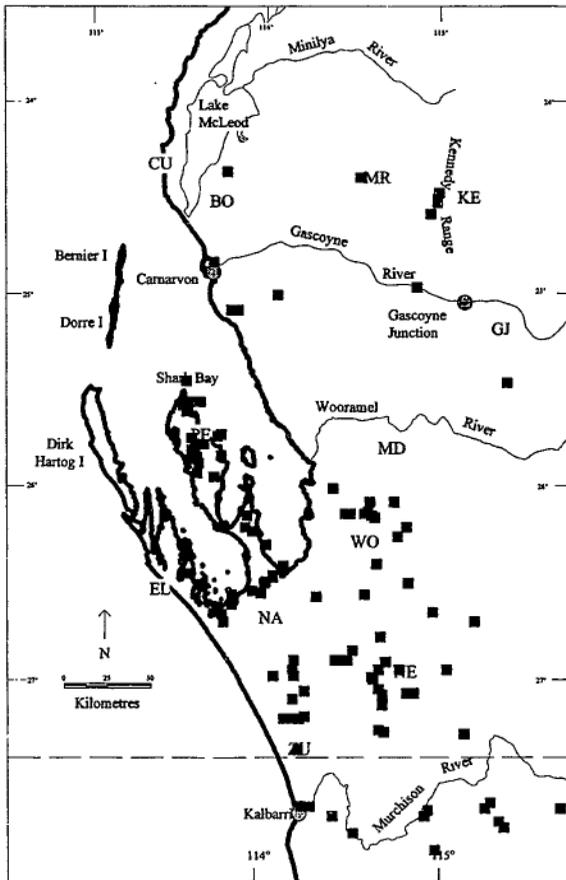
Redthroat



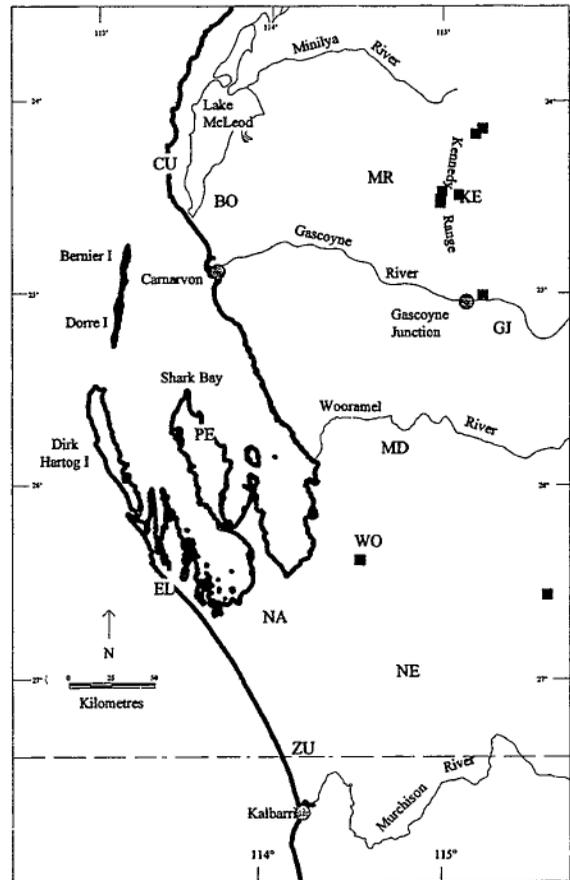
Weebill



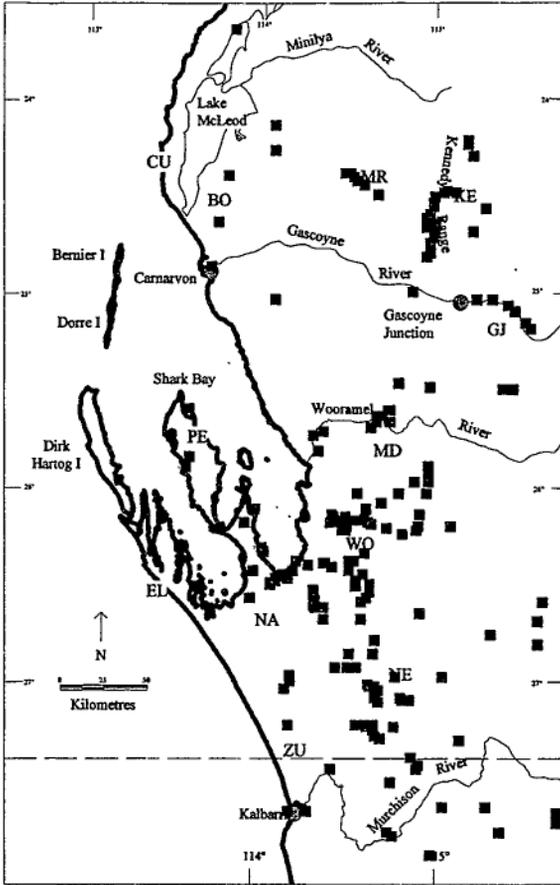
Dusky Gerygone



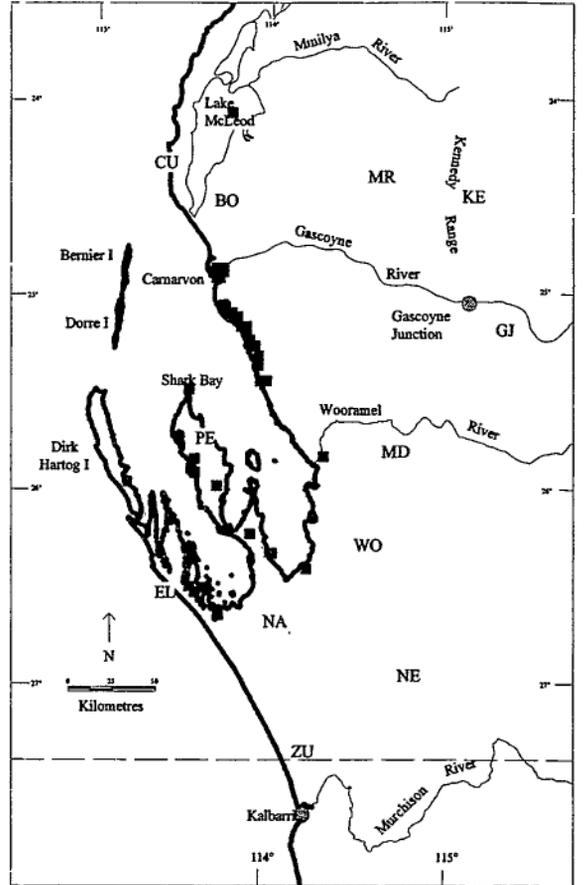
Broad-tailed Thornbill



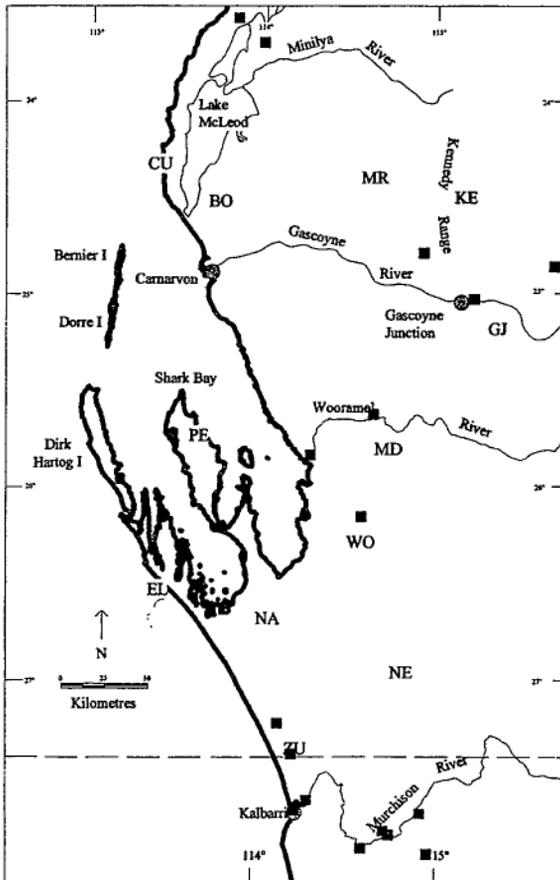
Slaty-backed Thornbill



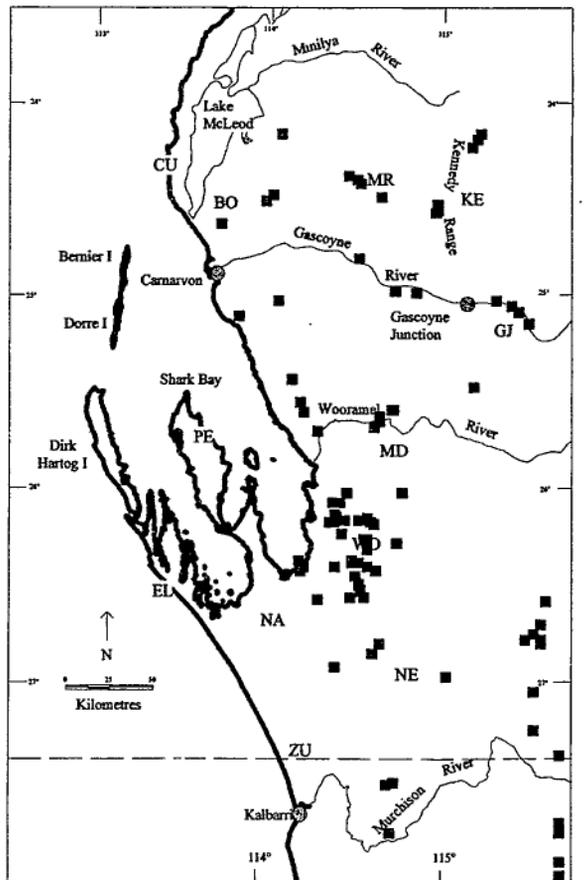
Chestnut-rumped Thornbill



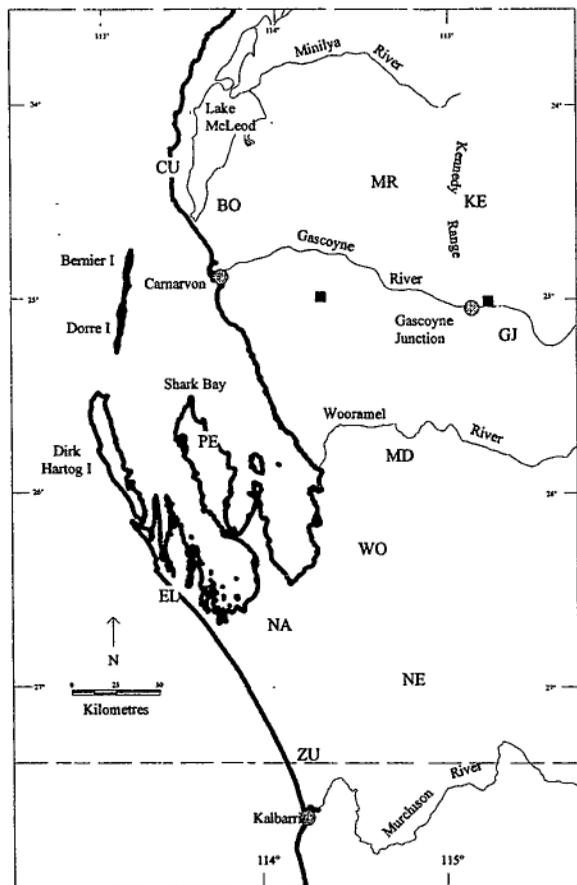
Sapphire Thornbill



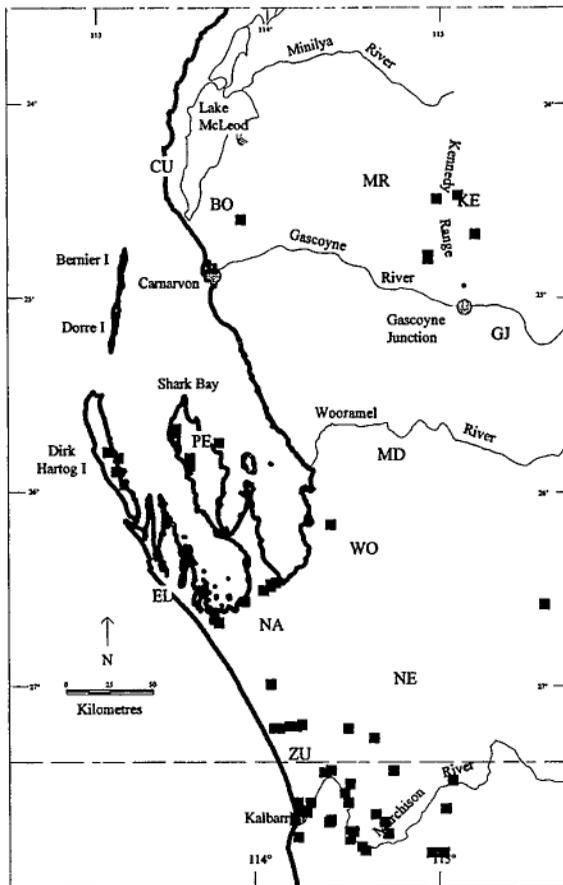
Yellow-rumped Thornbill



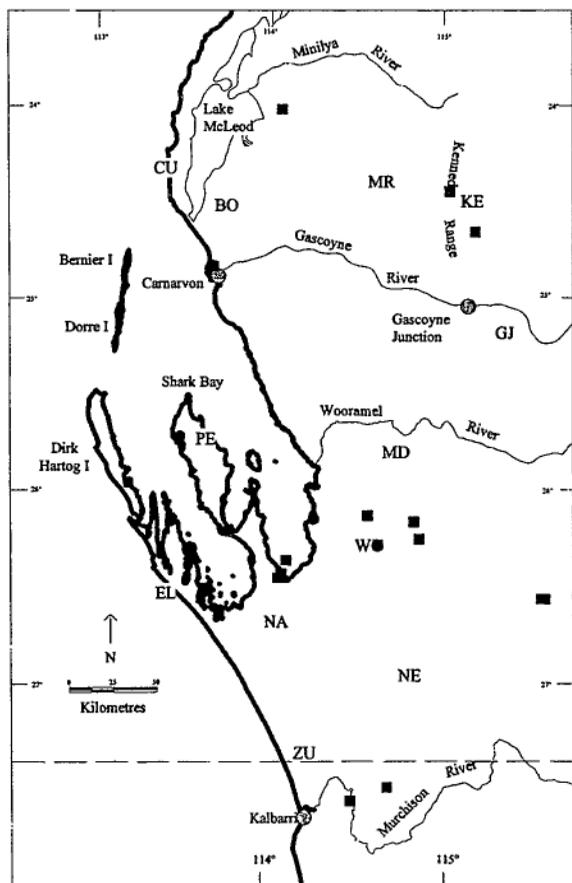
Southern Whiteface



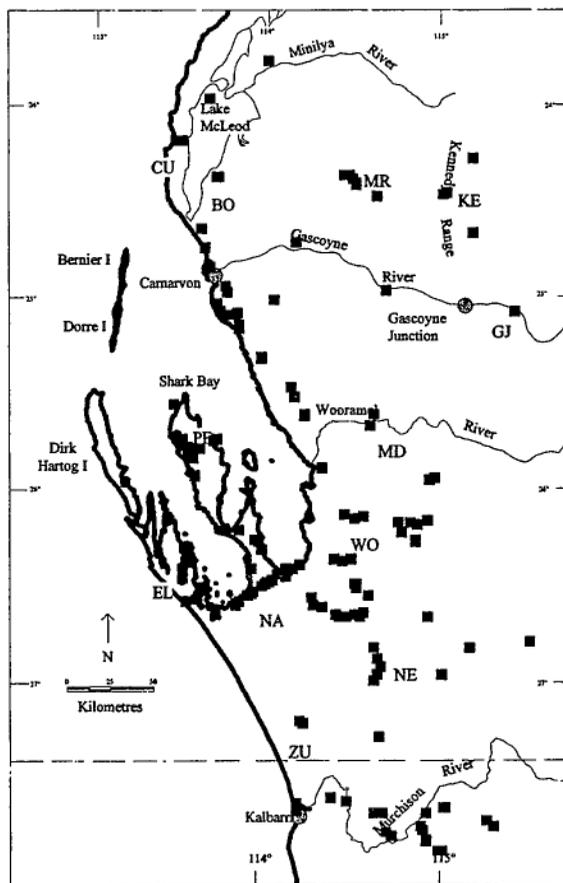
Banded Whiteface



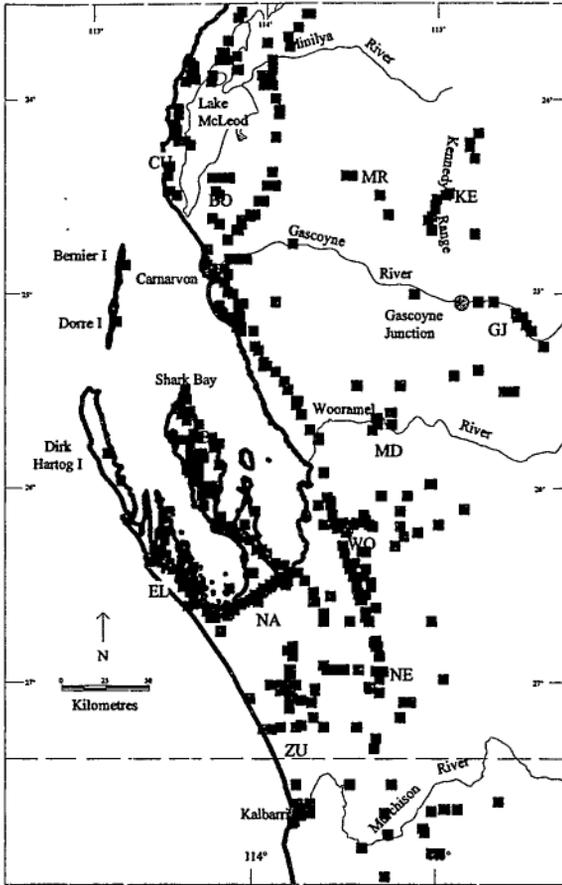
Brown Honeyeater



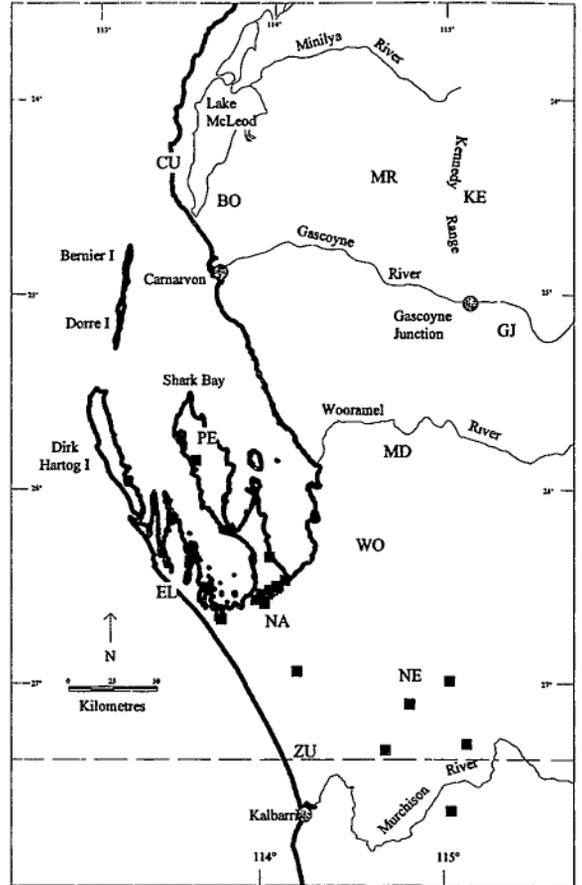
Black Honeyeater



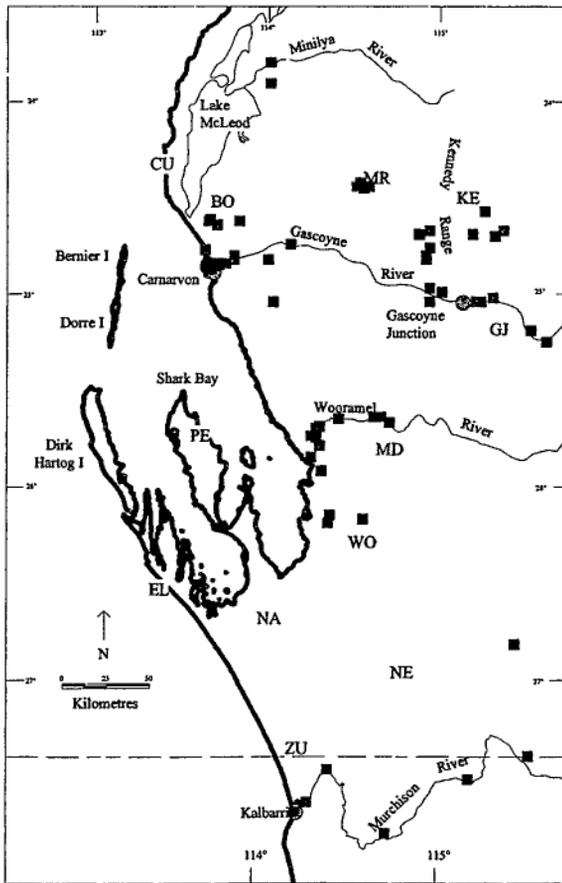
Pied Honeyeater



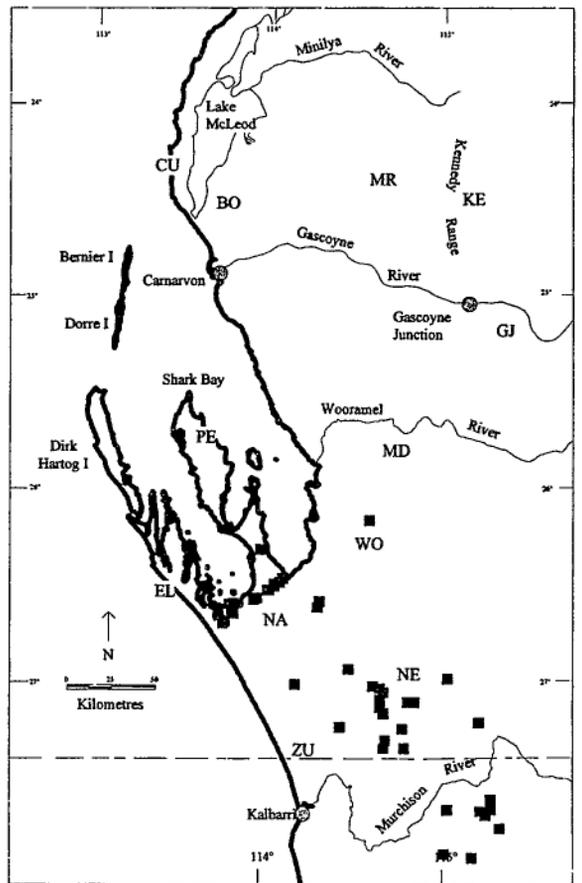
Singing Honeyeater



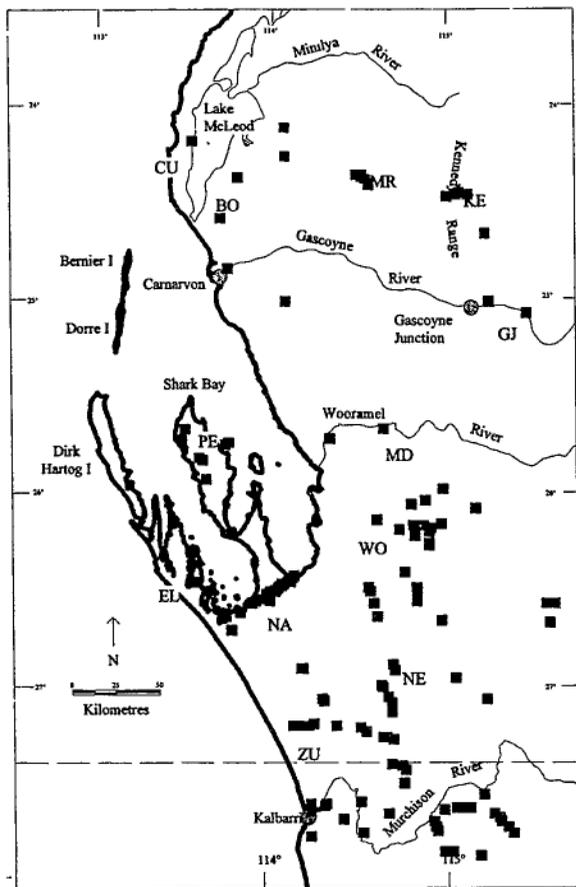
Grey-fronted Honeyeater



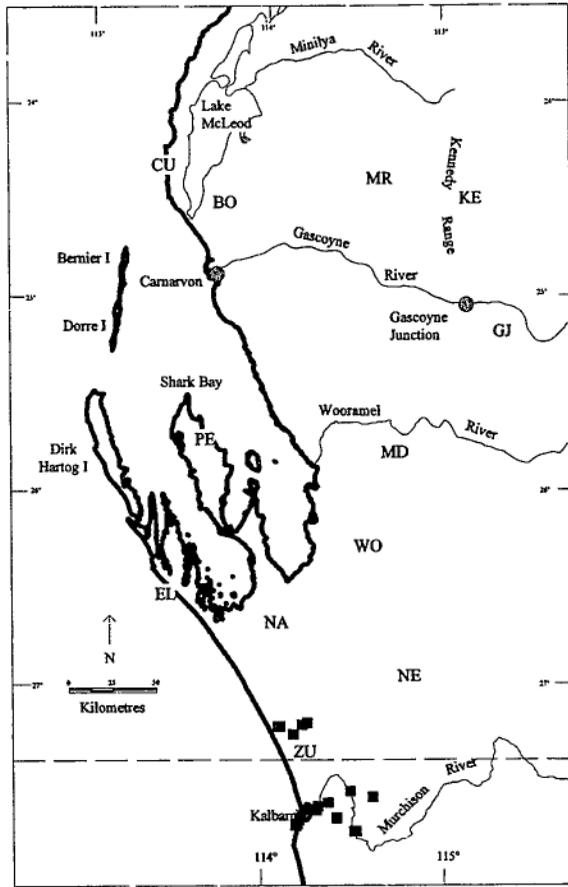
White-plumed Honeyeater



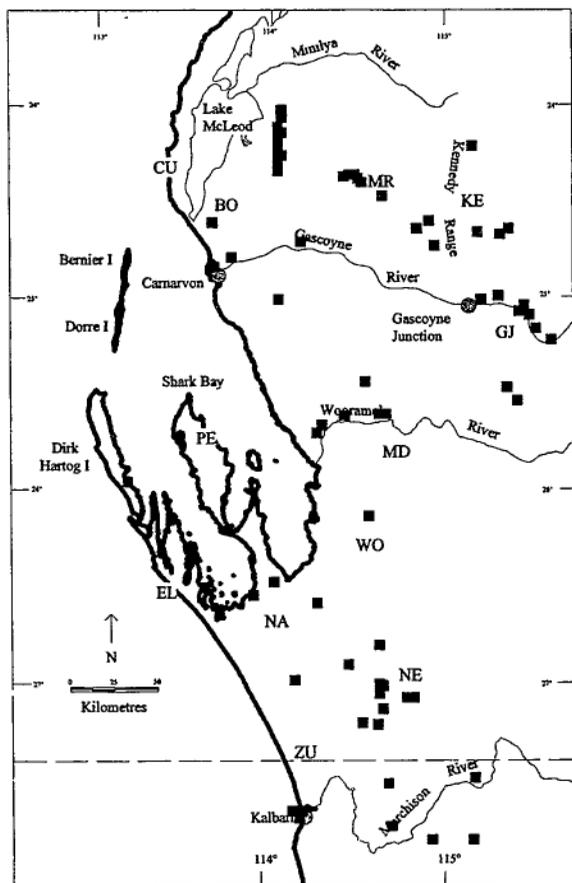
Brown-headed Honeyeater



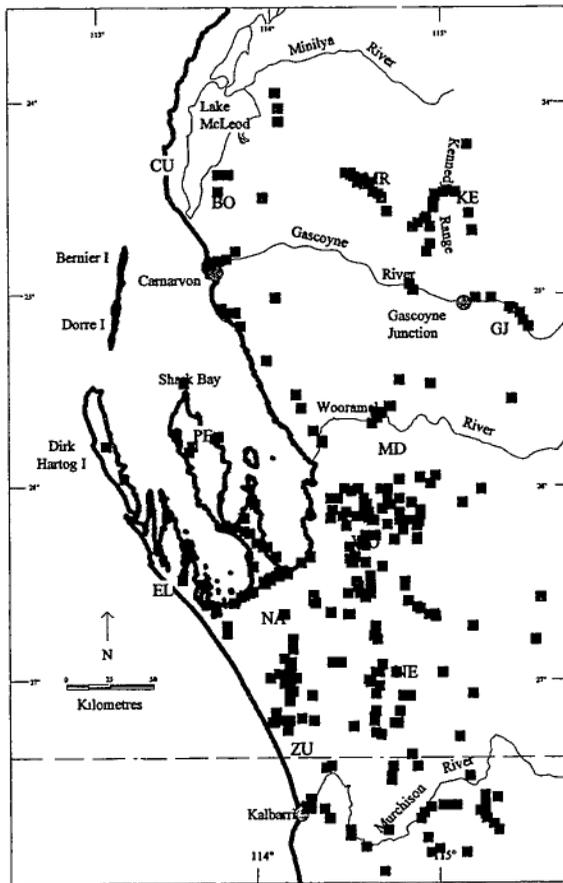
White-fronted Honeyeater



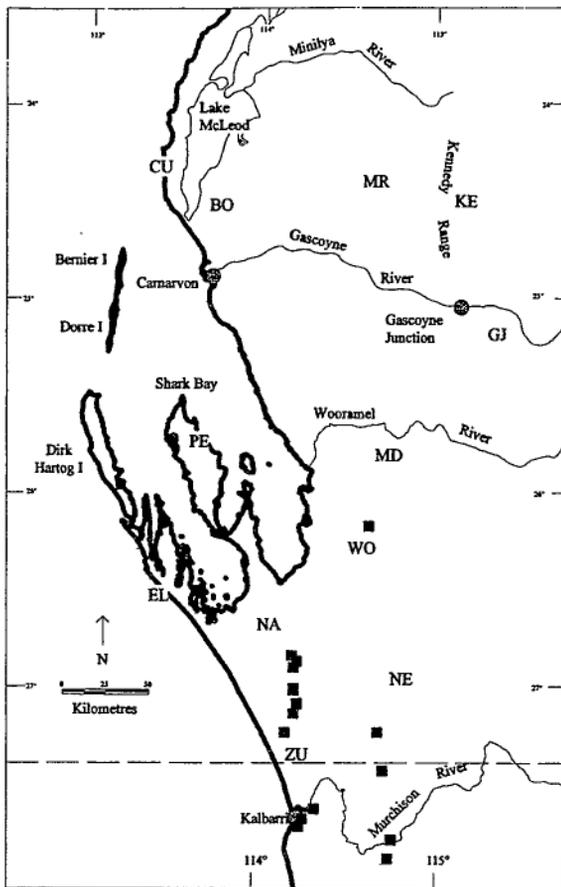
Tawny-crowned Honeyeater



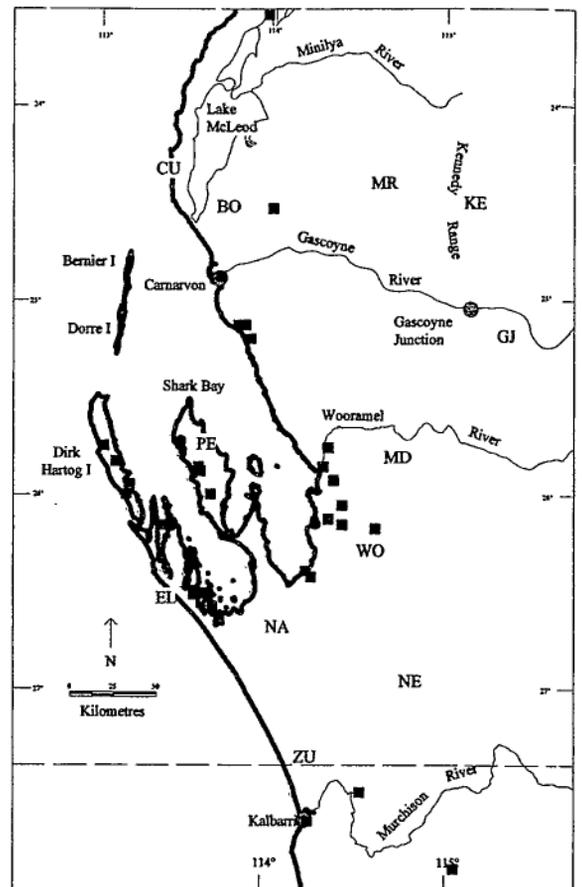
Yellow-throated Miner



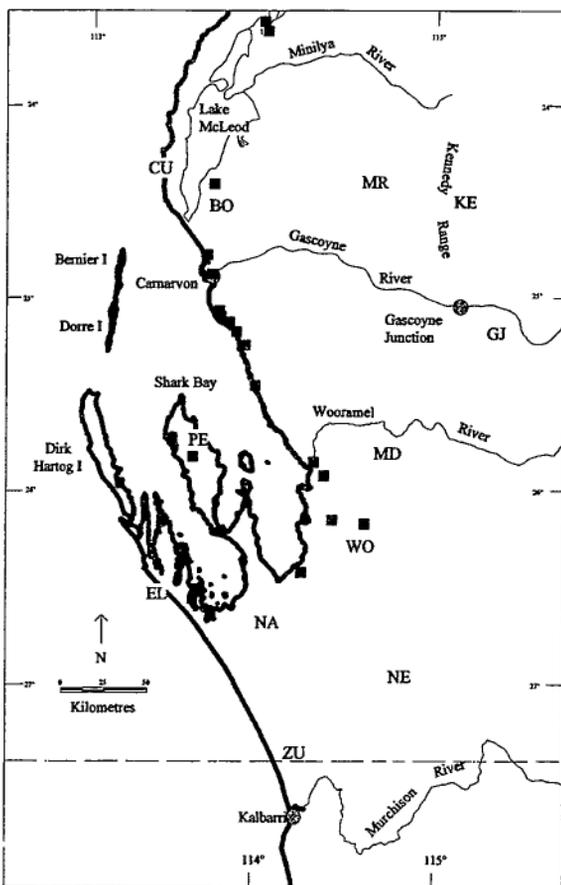
Spiny-cheeked Honeyeater



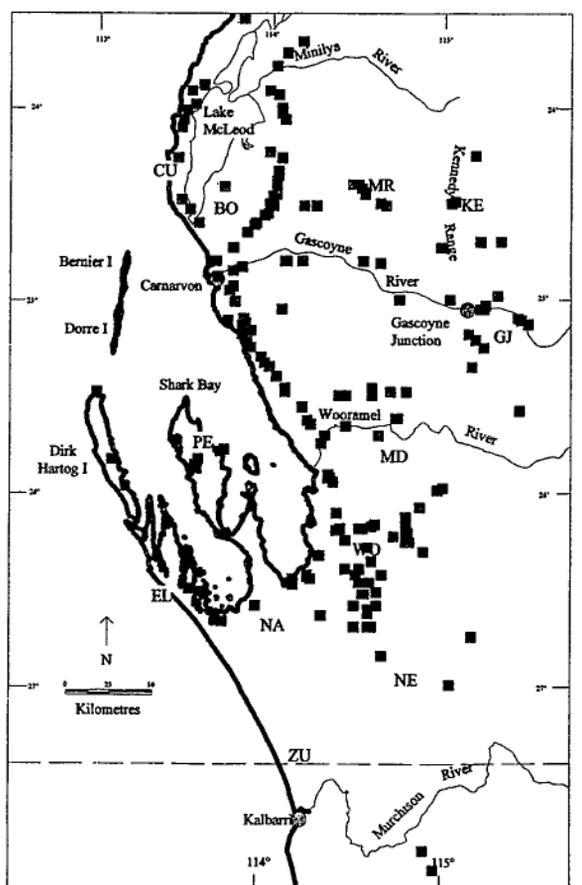
Red Wattlebird



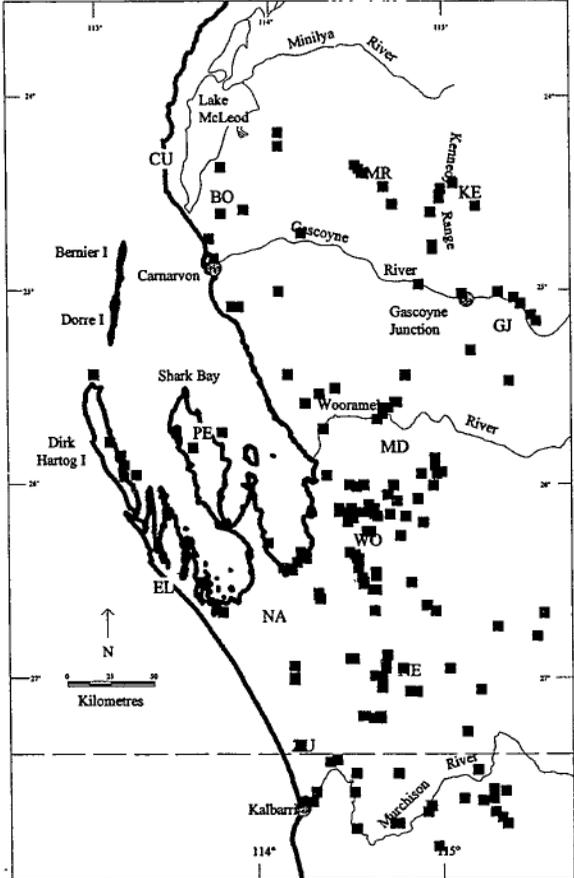
White-fronted Chat



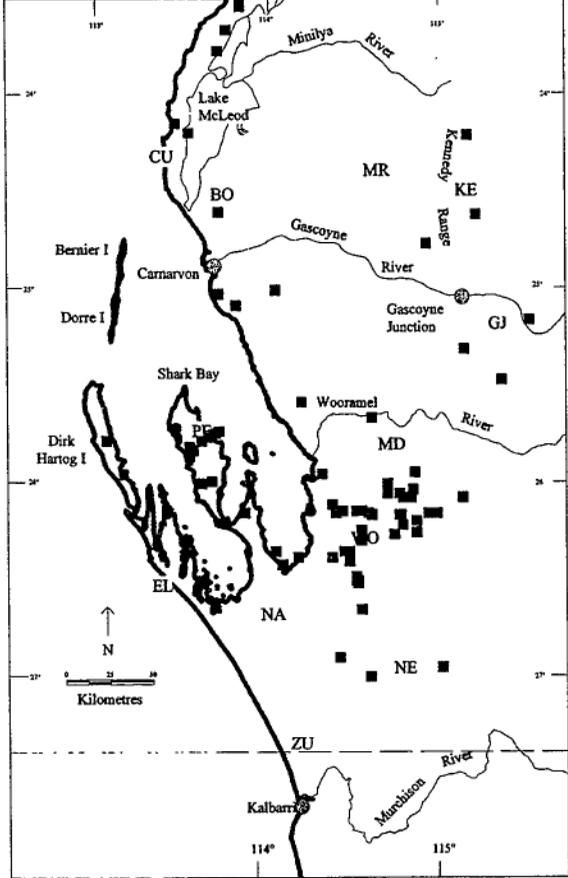
Orange Chat



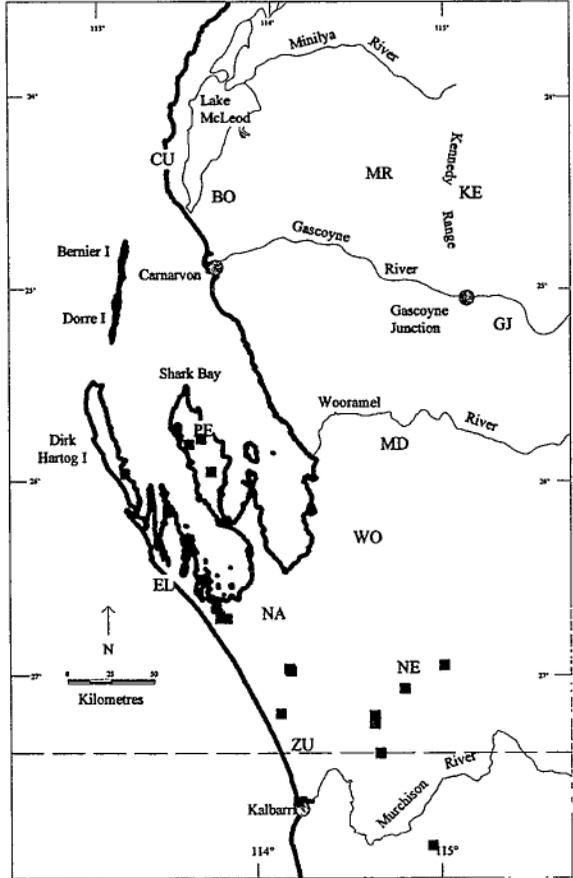
Crimson Chat



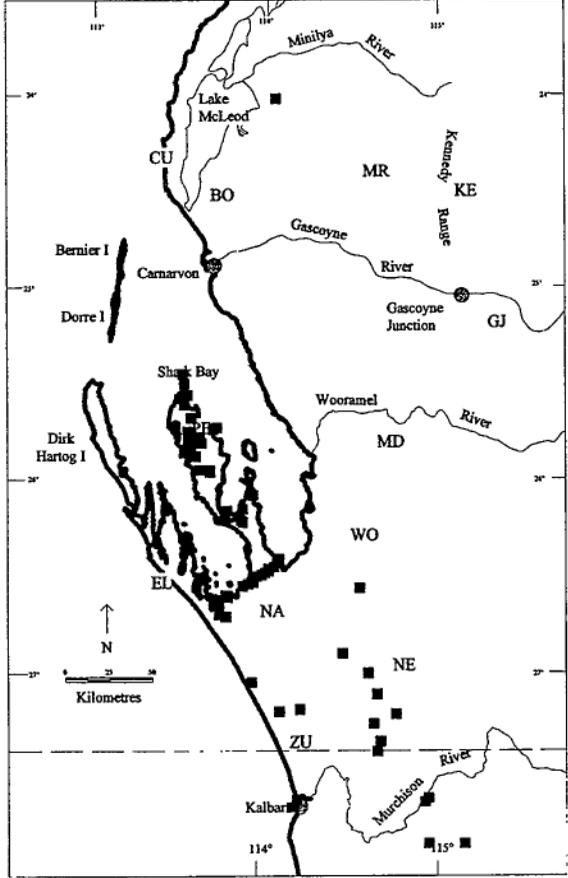
Red-capped Robin



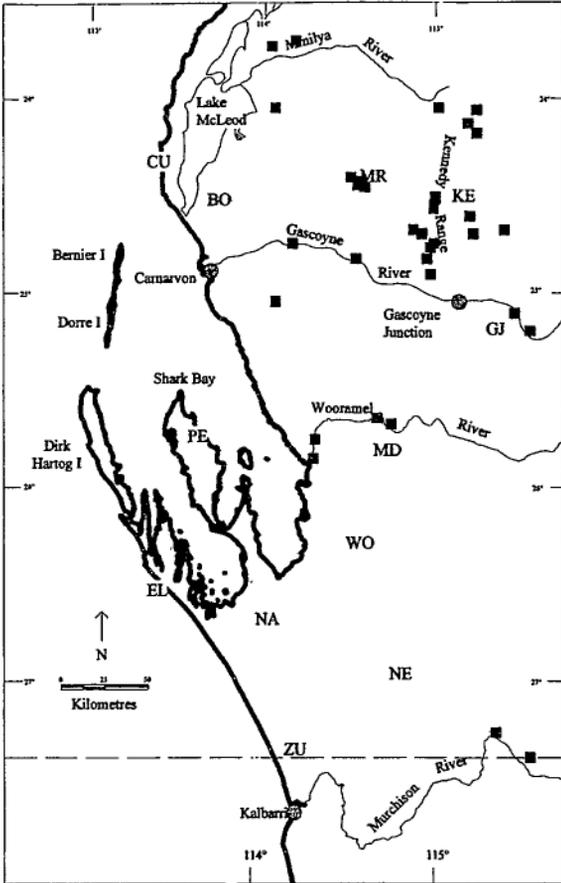
Hooded Robin



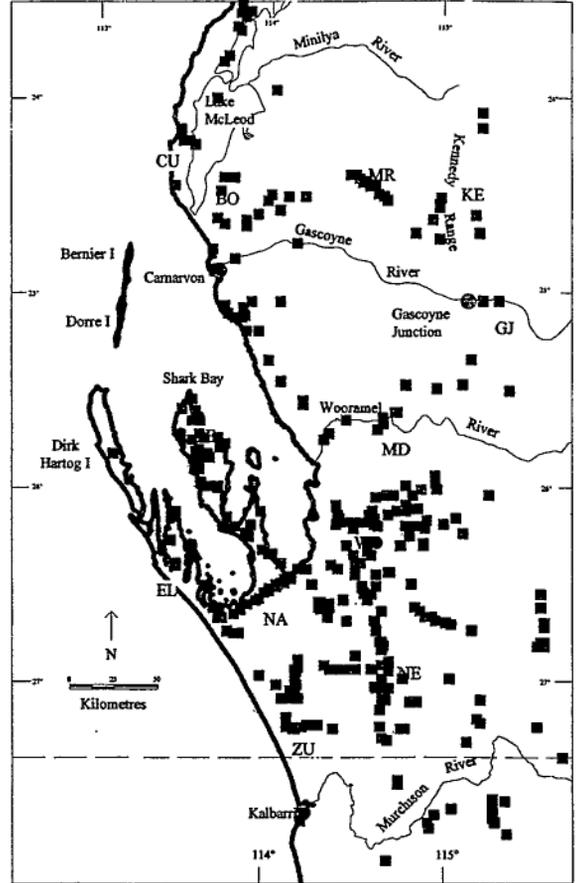
Western Yellow Robin



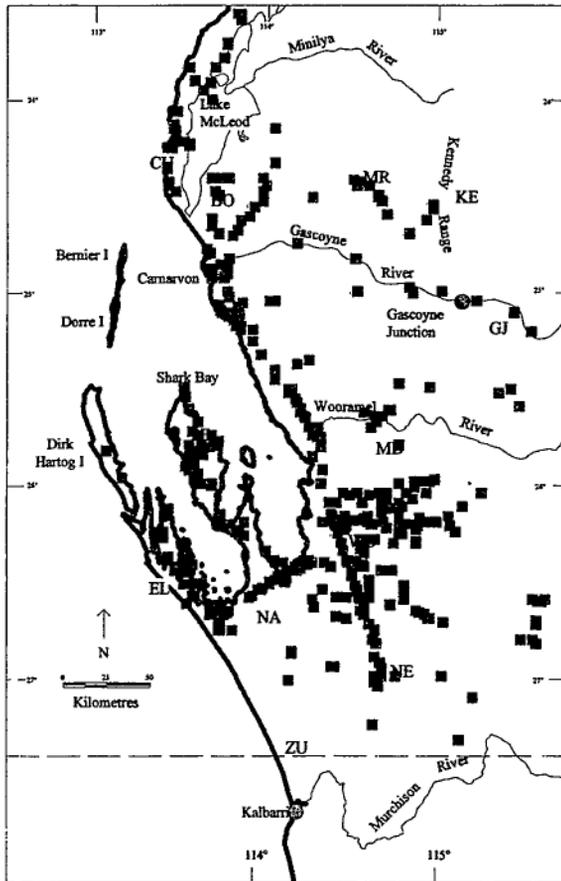
Southern Scrub-robin



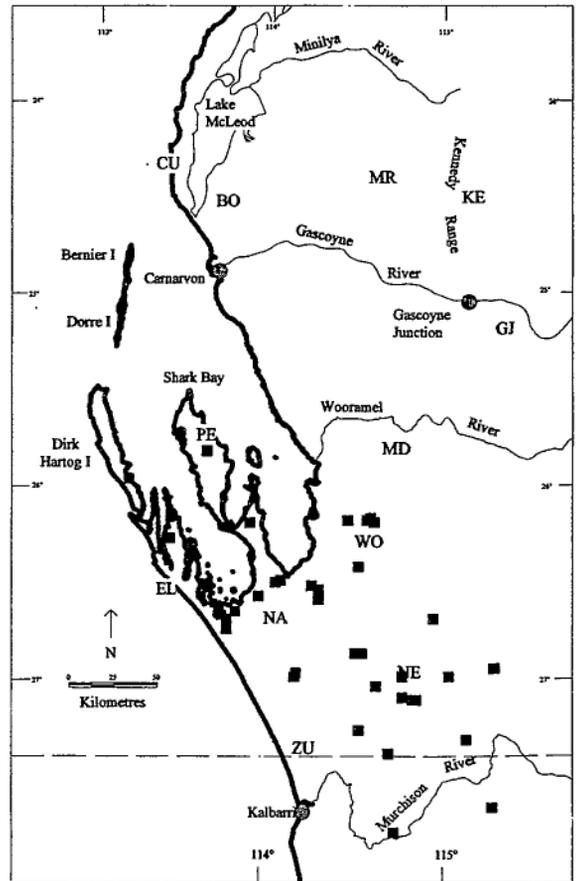
Grey-crowned Babbler



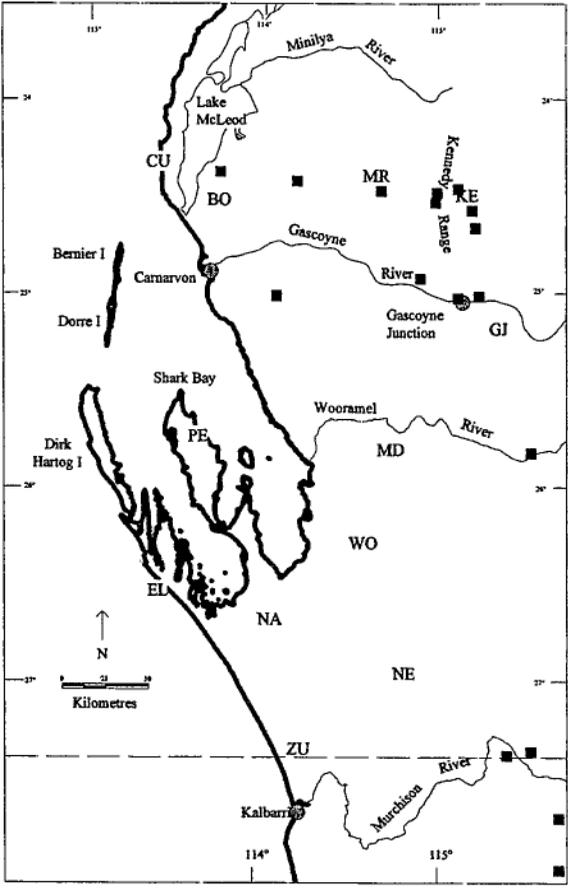
White-browed Babbler



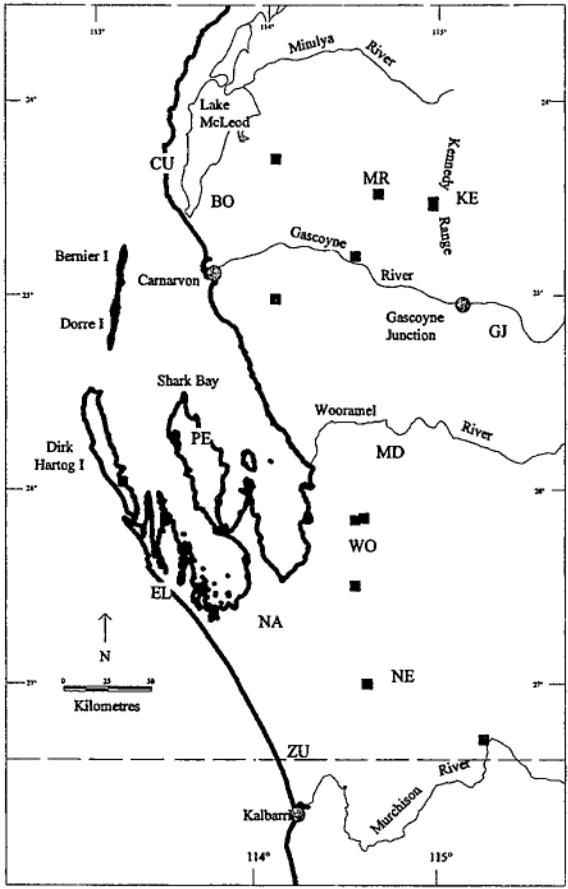
Western Wedgebill



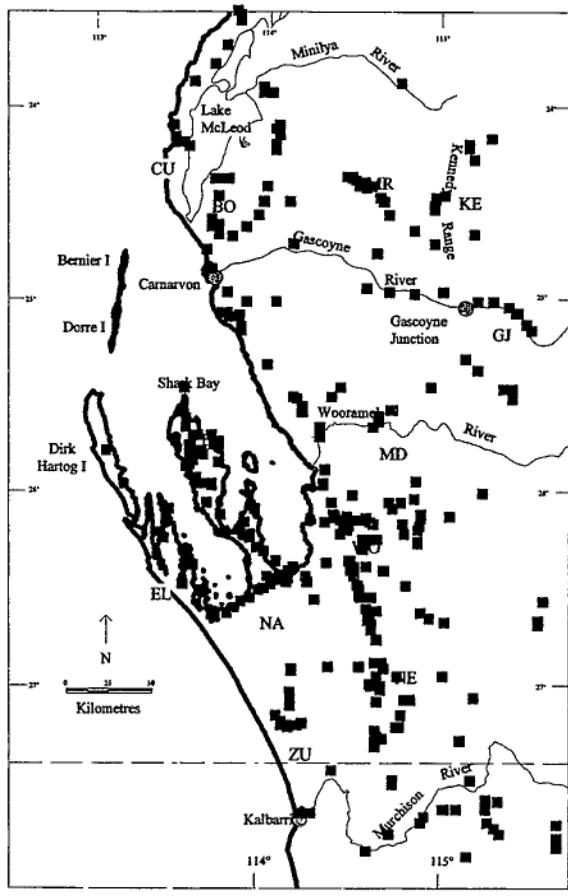
Chestnut Quail-thrush



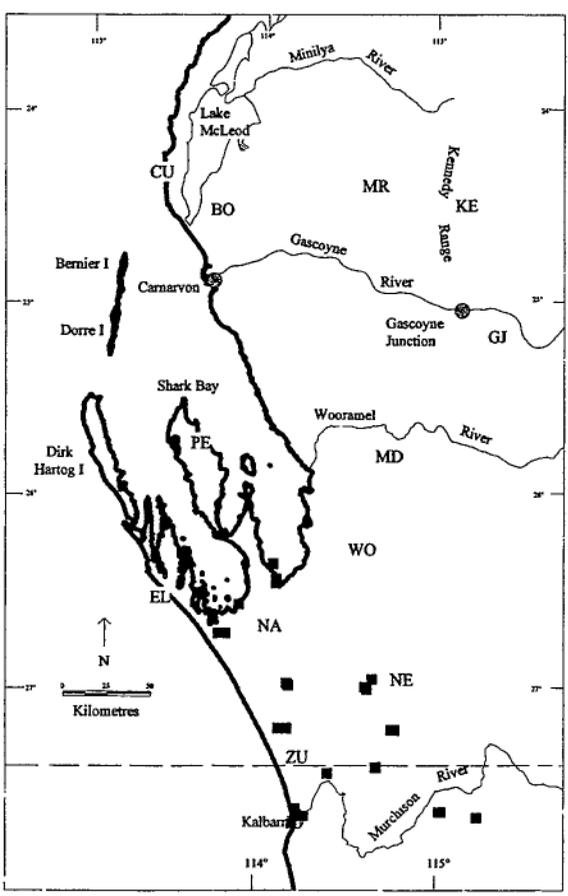
Chestnut-breasted Quail-thrush



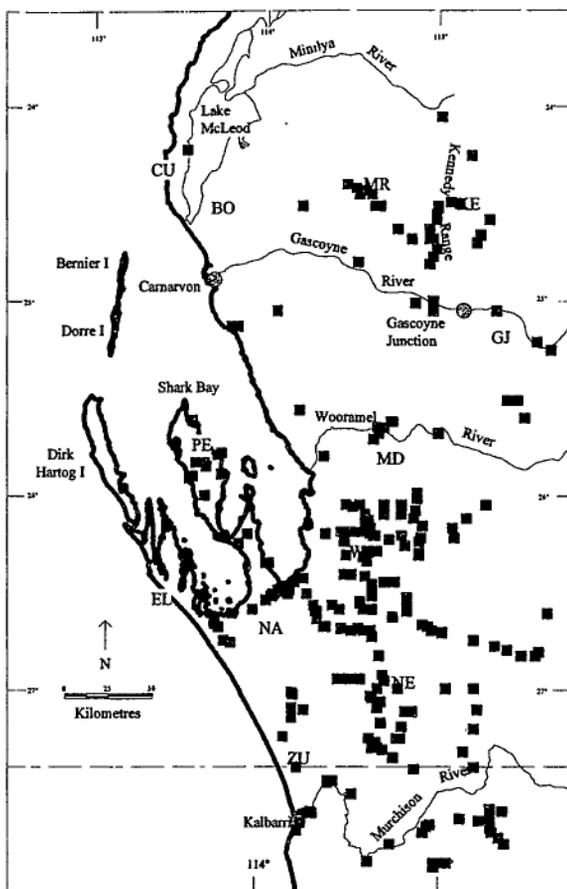
Varied Sittella



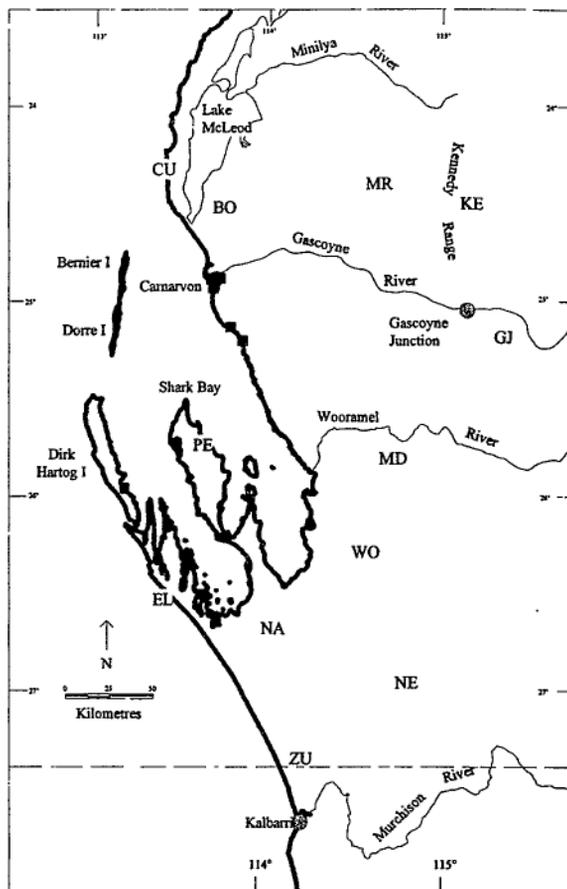
Crested Bellbird



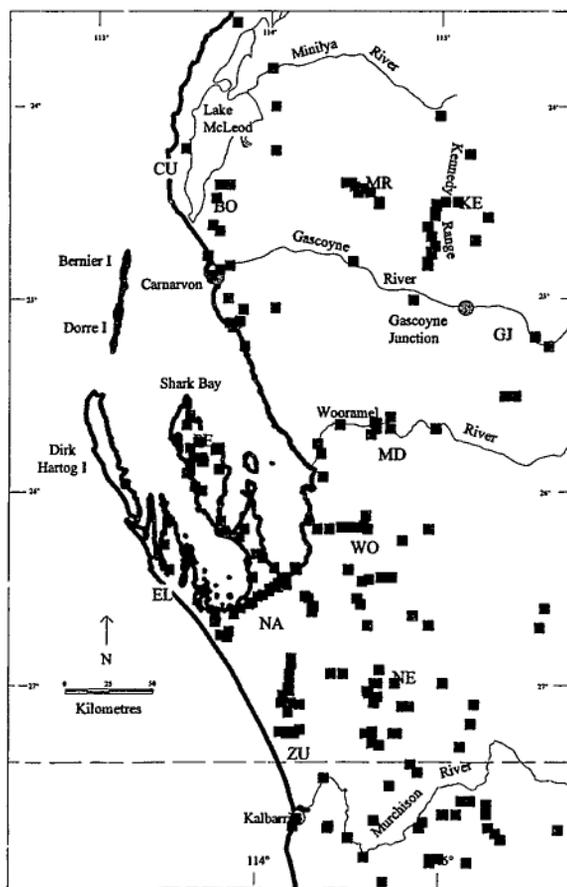
Golden Whistler



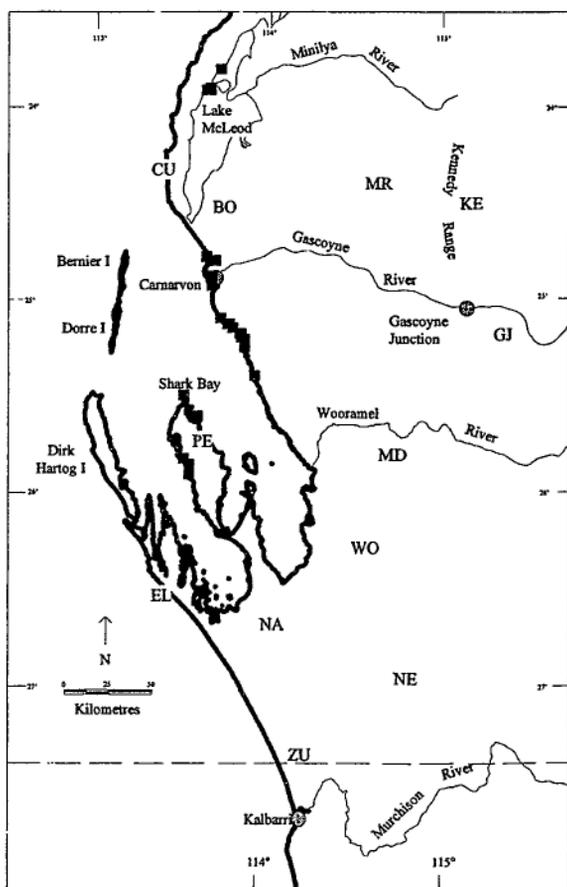
Rufous Whistler



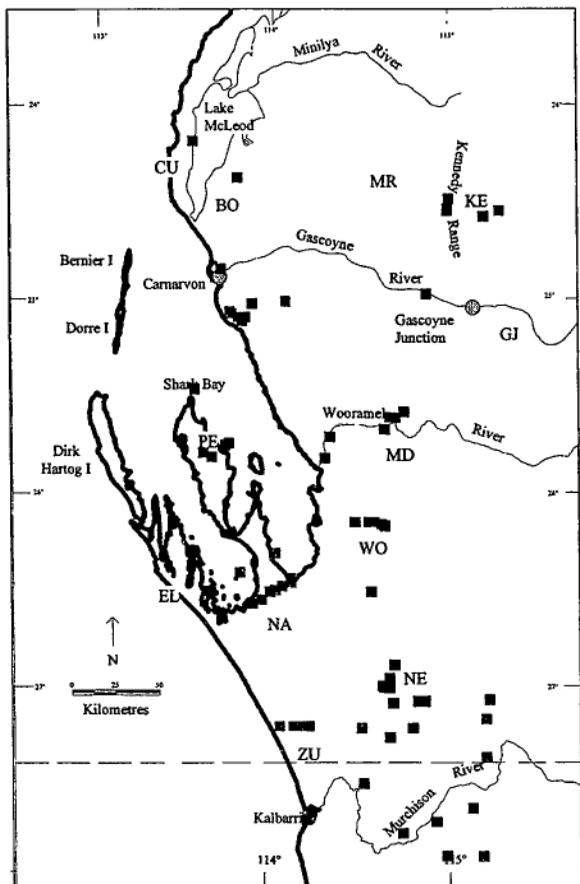
White-breasted Whistler



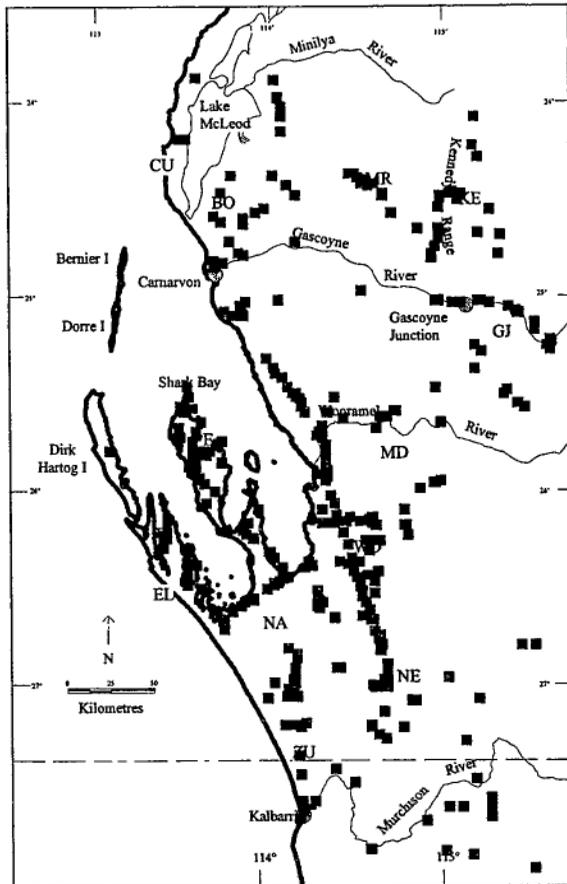
Grey Shrike-thrush



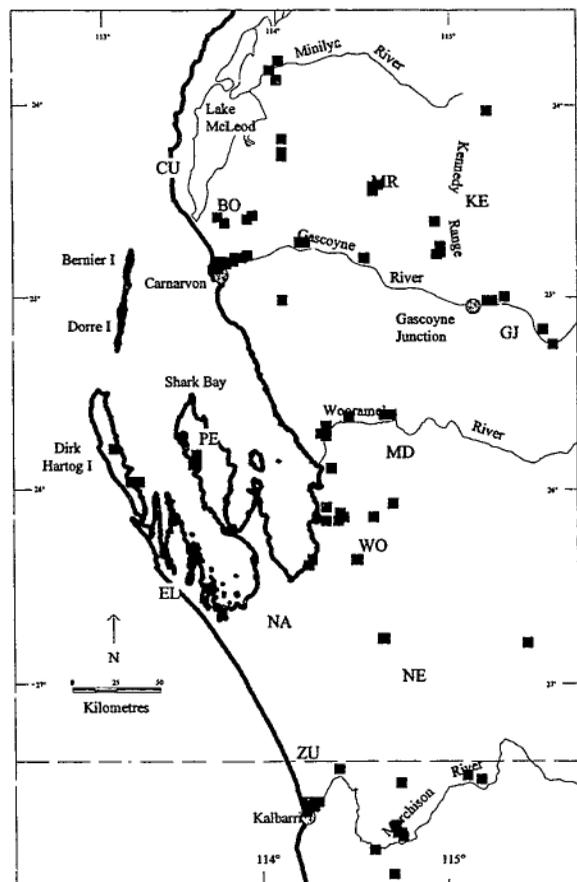
Mangrove Grey Fantail



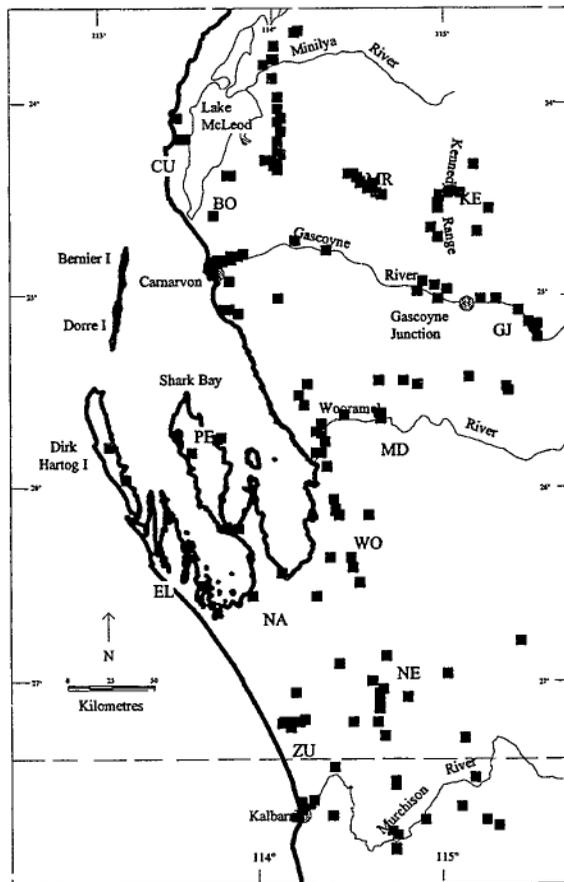
Grey Fantail



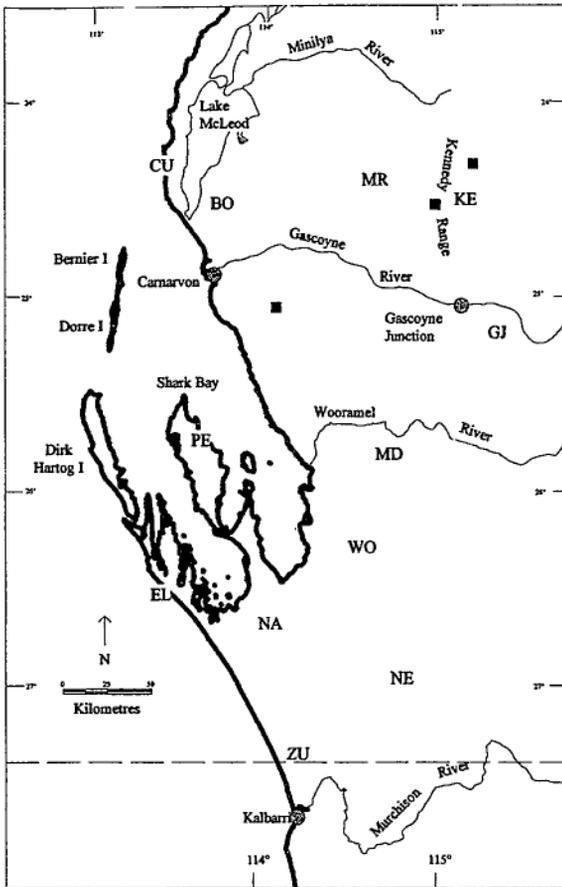
Willie Wagtail



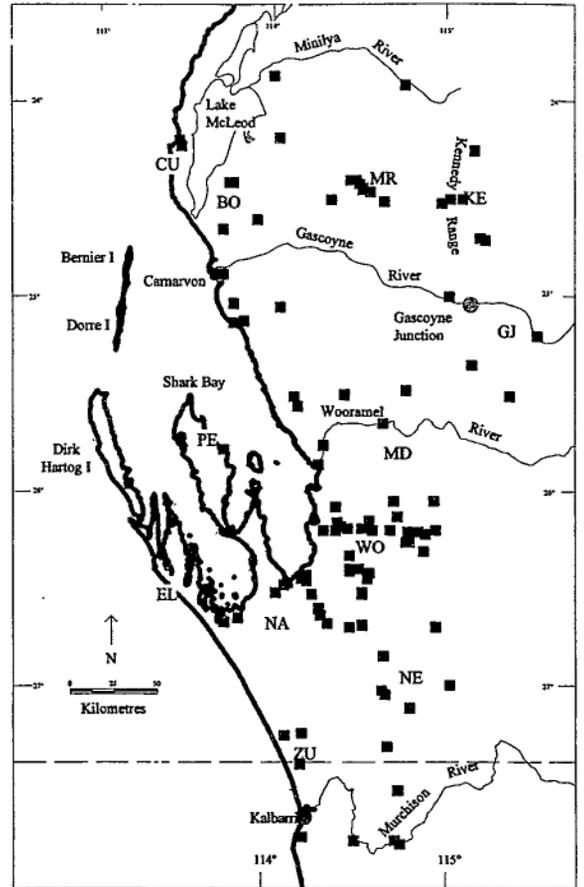
Magpie-lark



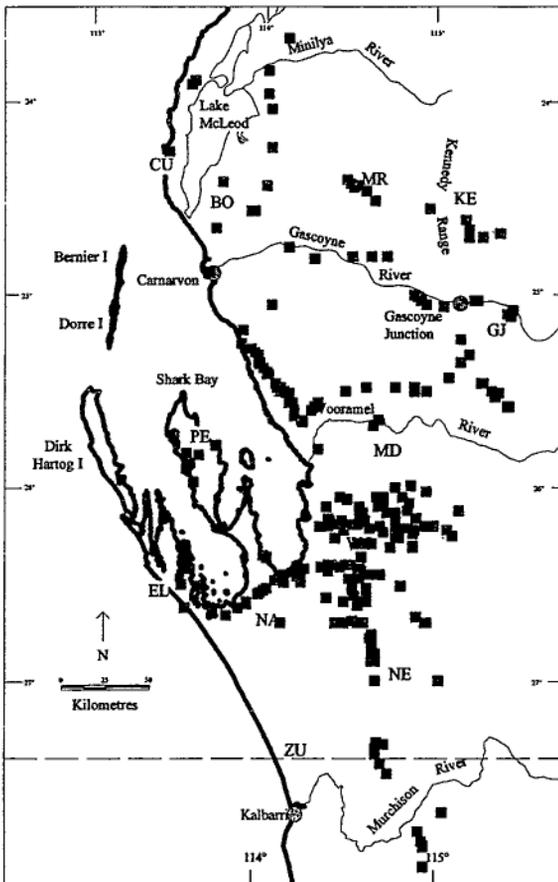
Black-faced Cuckoo-shrike



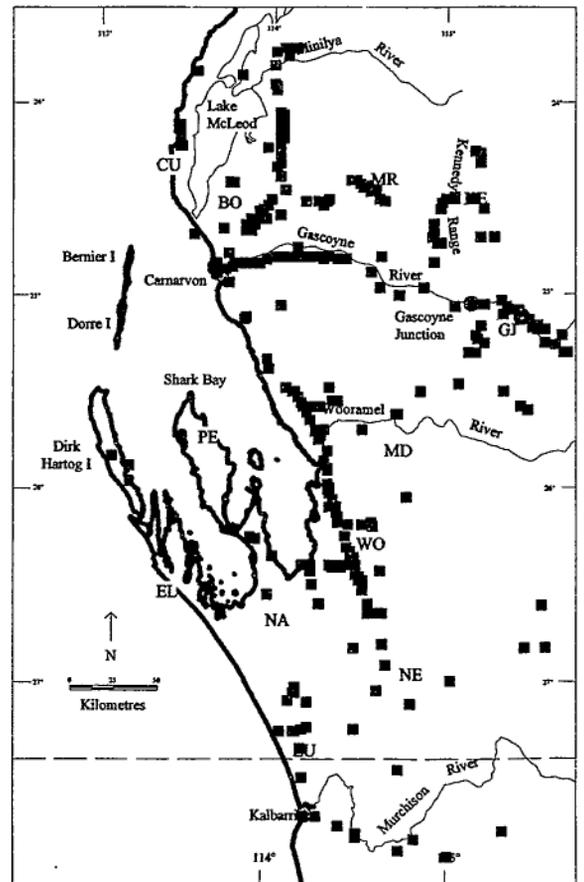
Ground Cuckoo-shrike



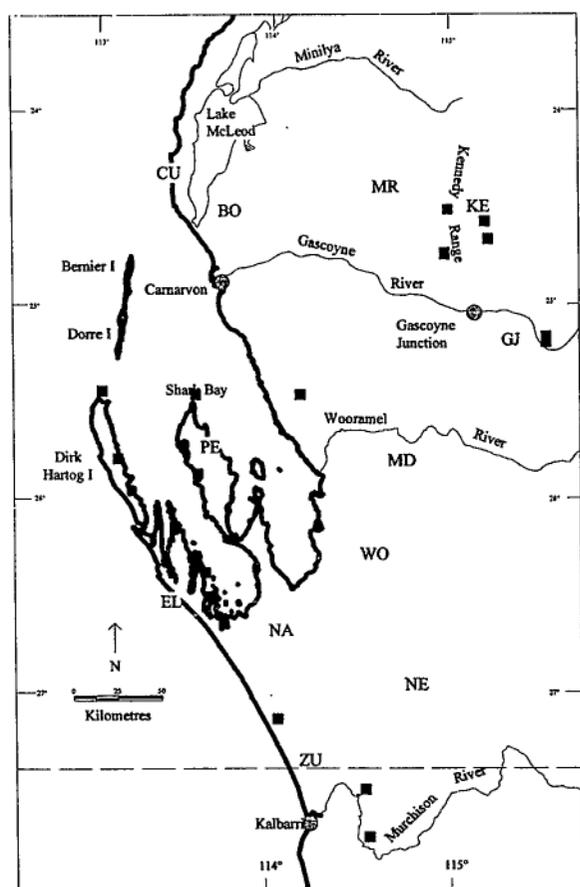
White-winged Triller



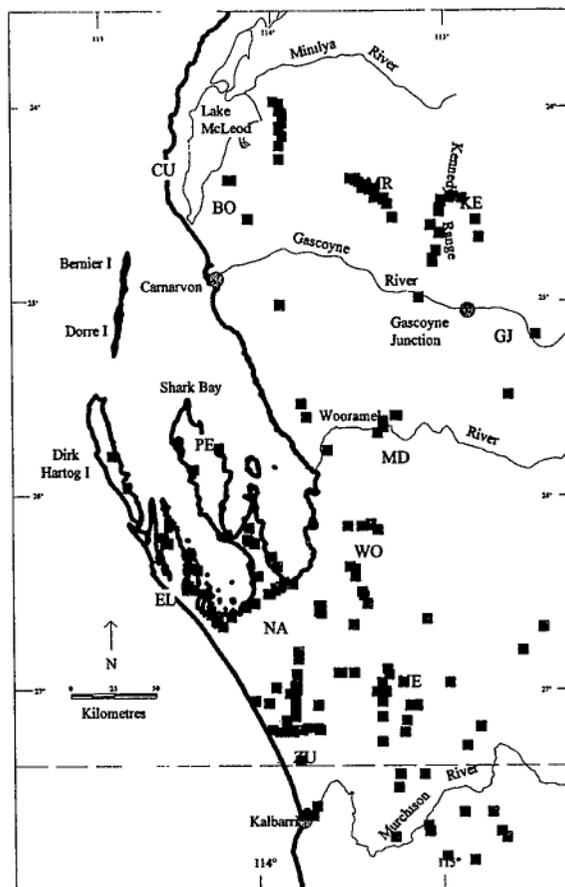
Masked Woodswallow



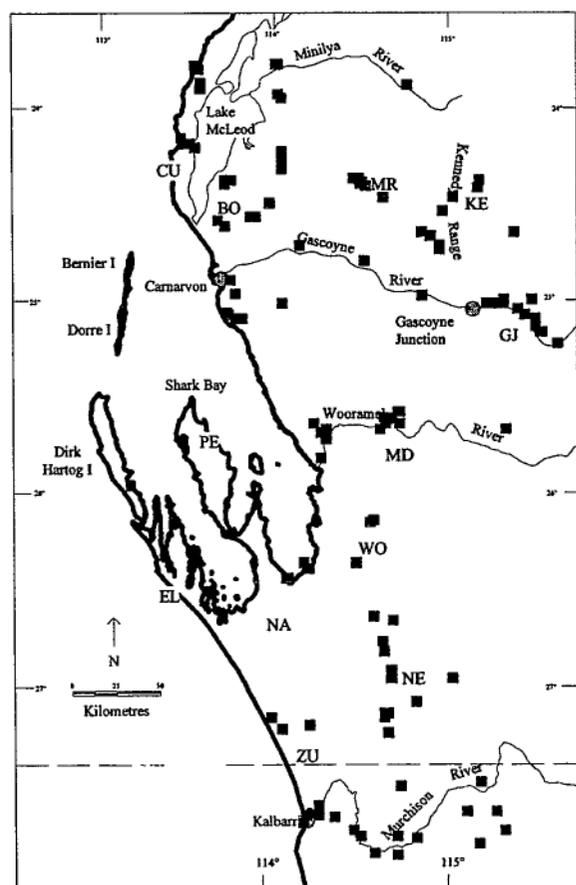
Black-faced Woodswallow



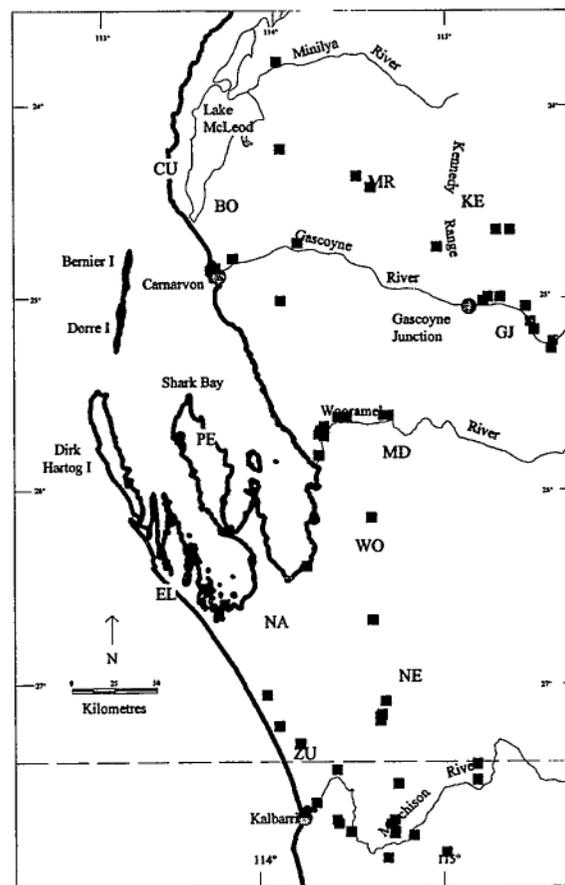
Little Woodswallow



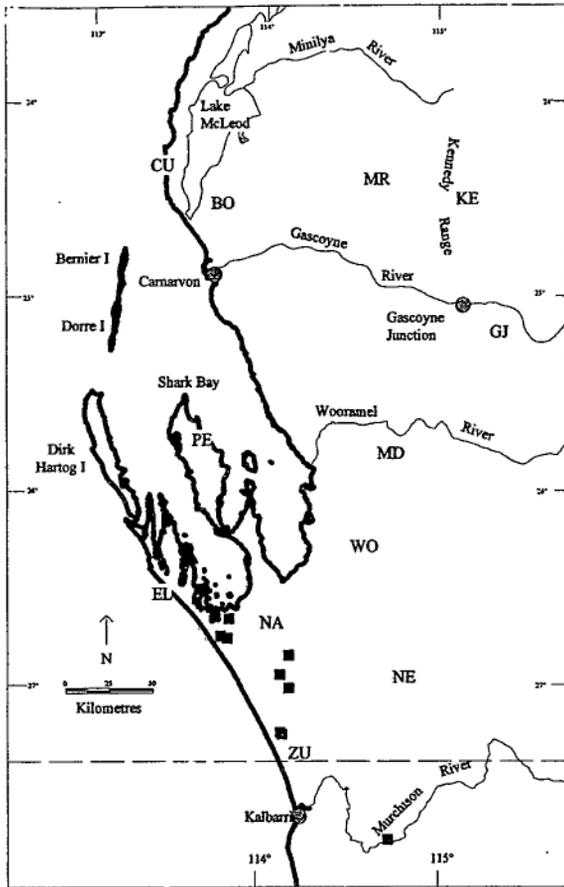
Grey Butcherbird



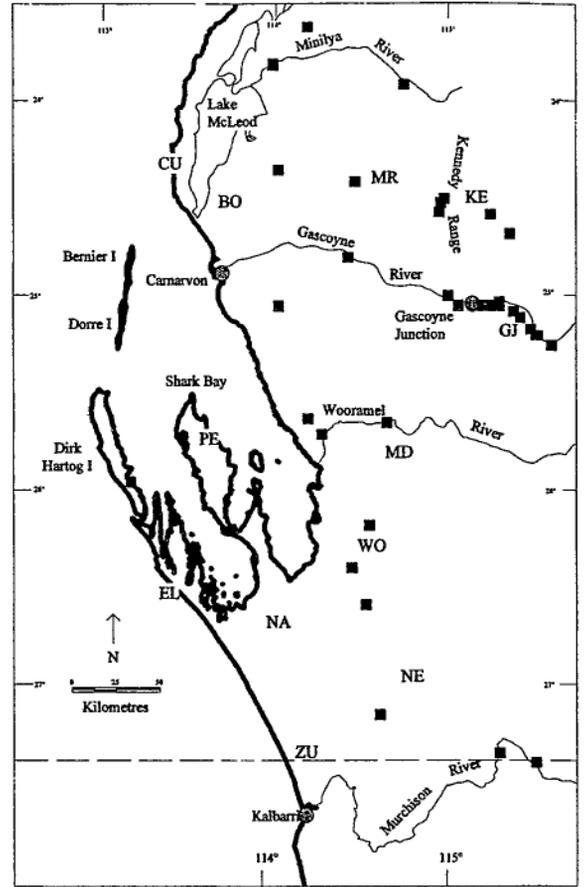
Pied Butcherbird



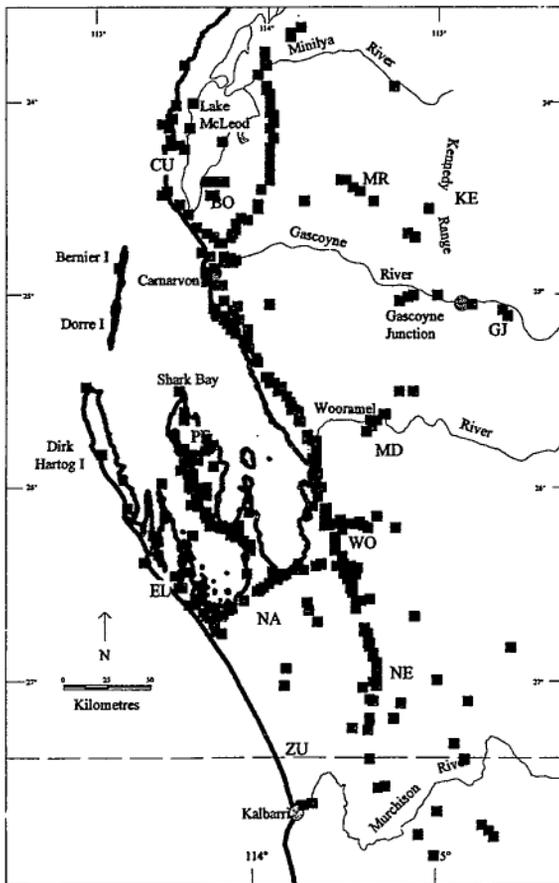
Australian Magpie



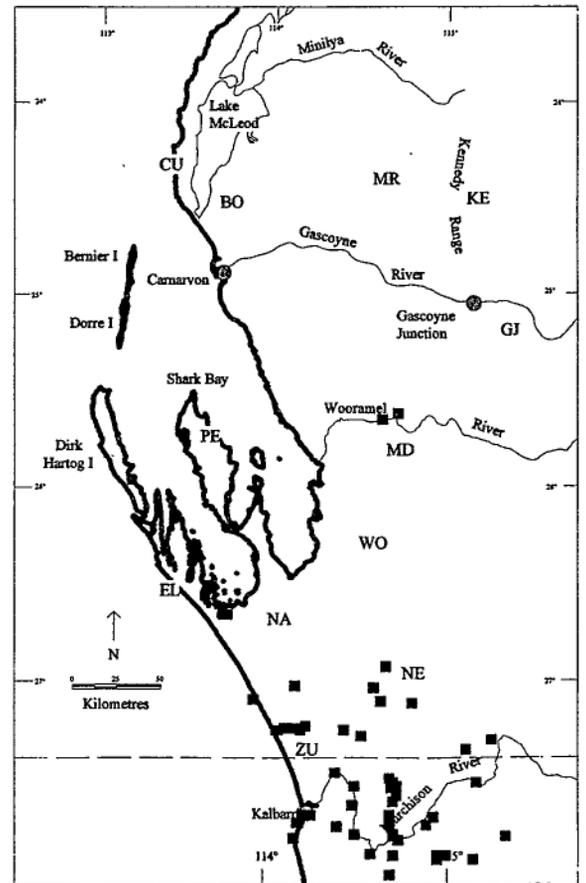
Grey Currawong



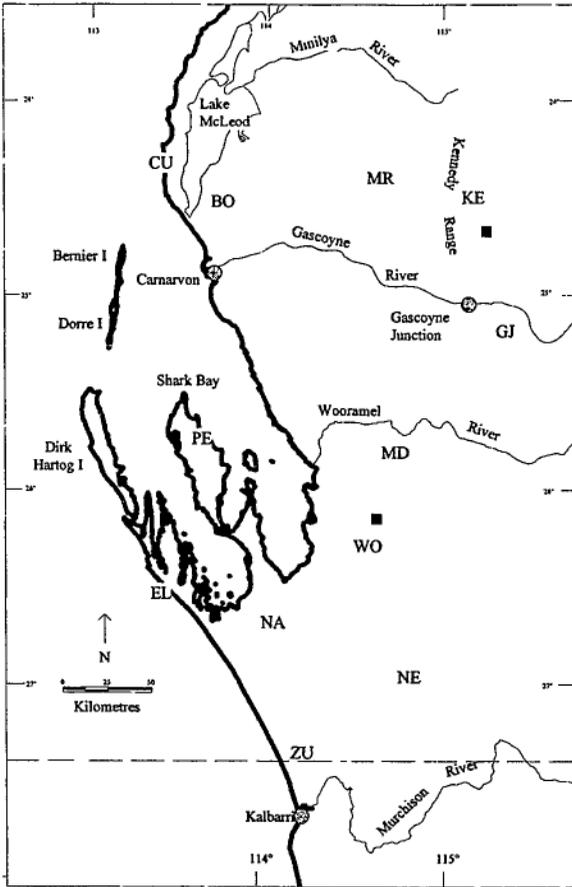
Torresian Crow



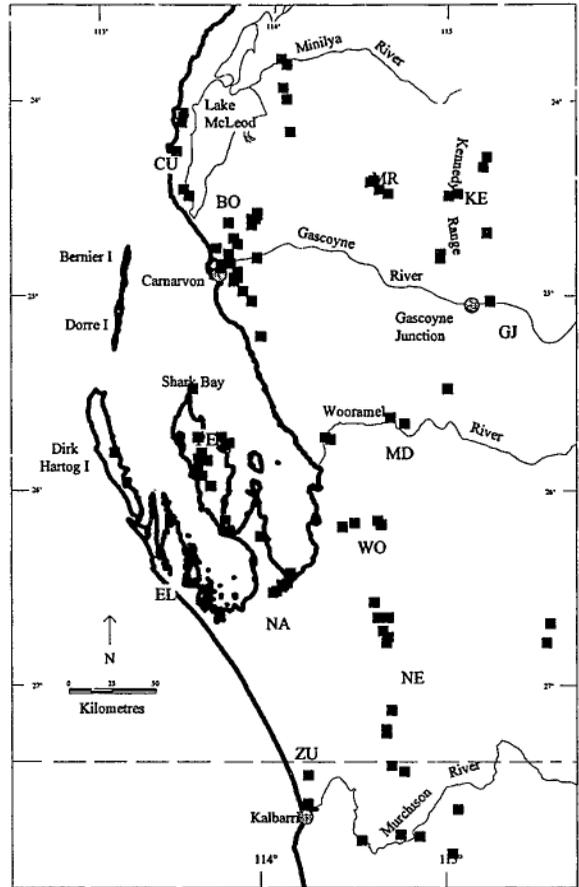
Little Crow



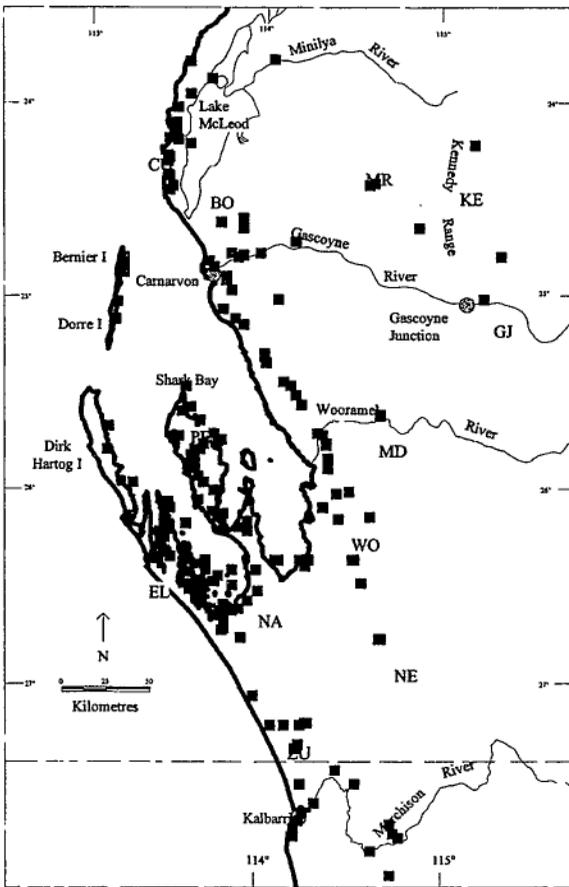
Australian Raven



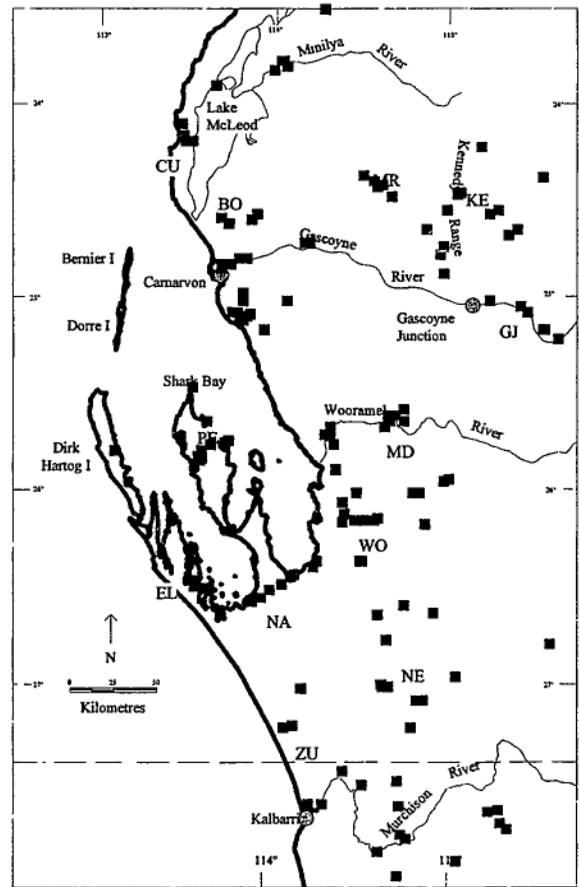
Spotted Bowerbird



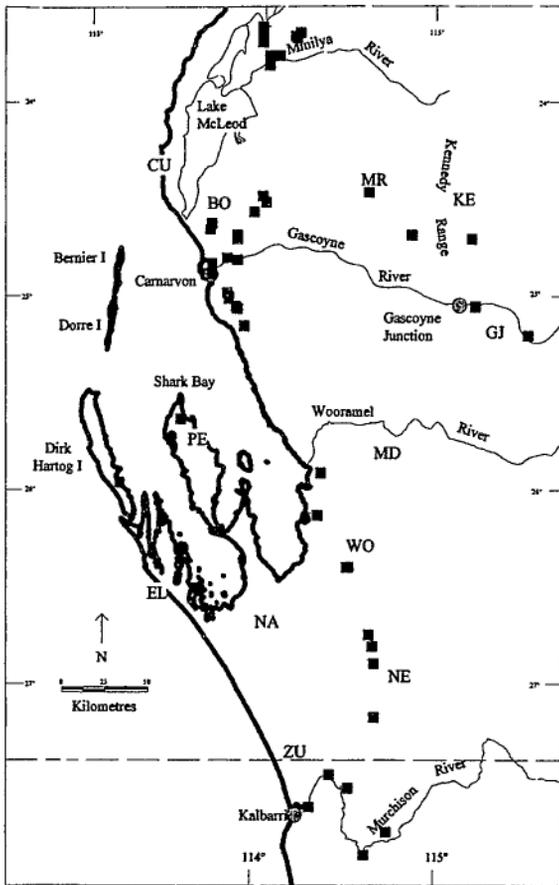
White-backed Swallow



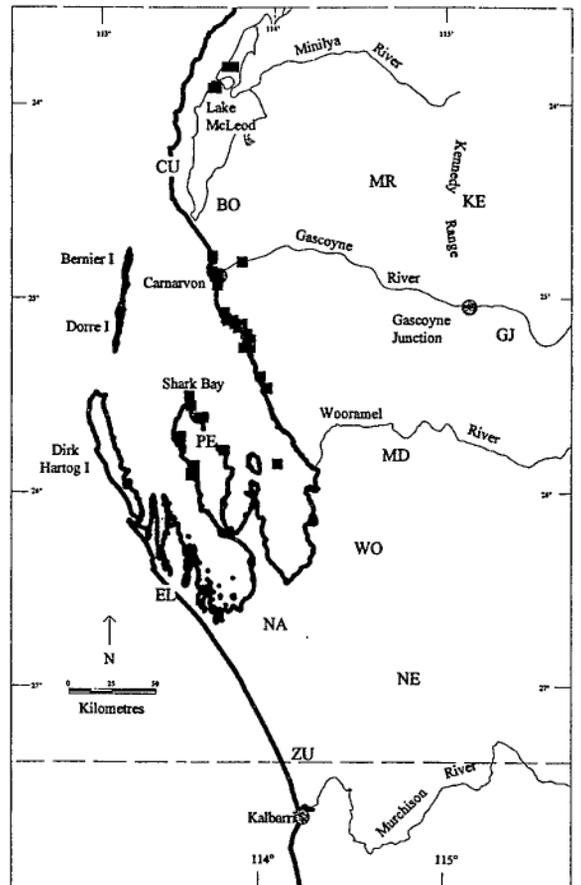
Welcome Swallow



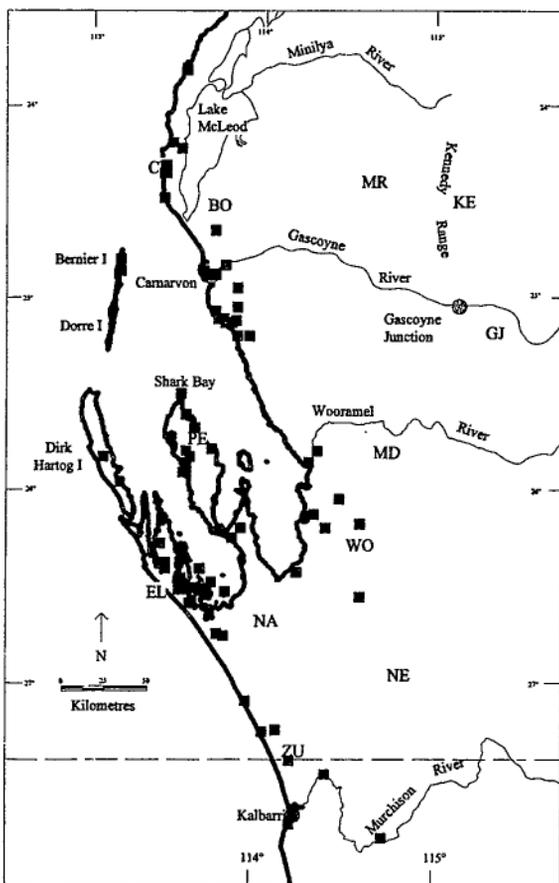
Tree Martin



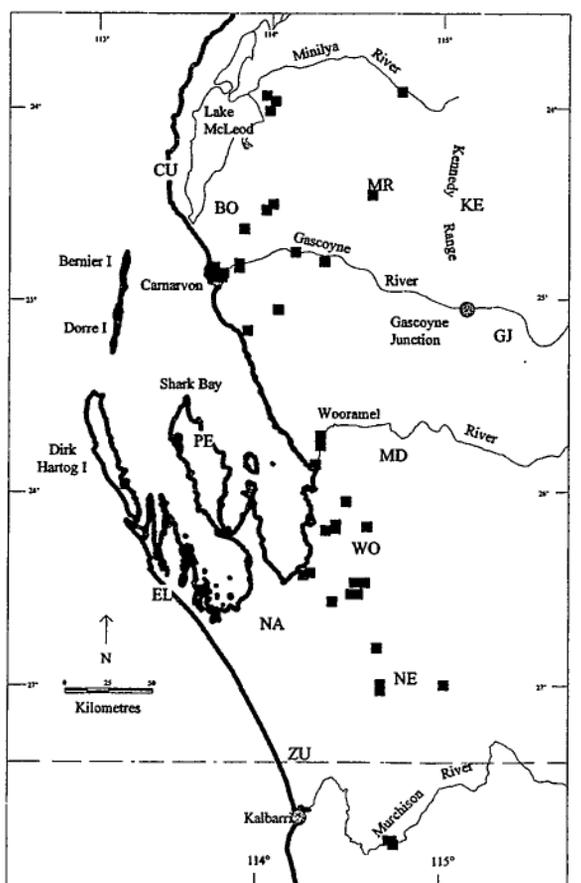
Fairy Martin



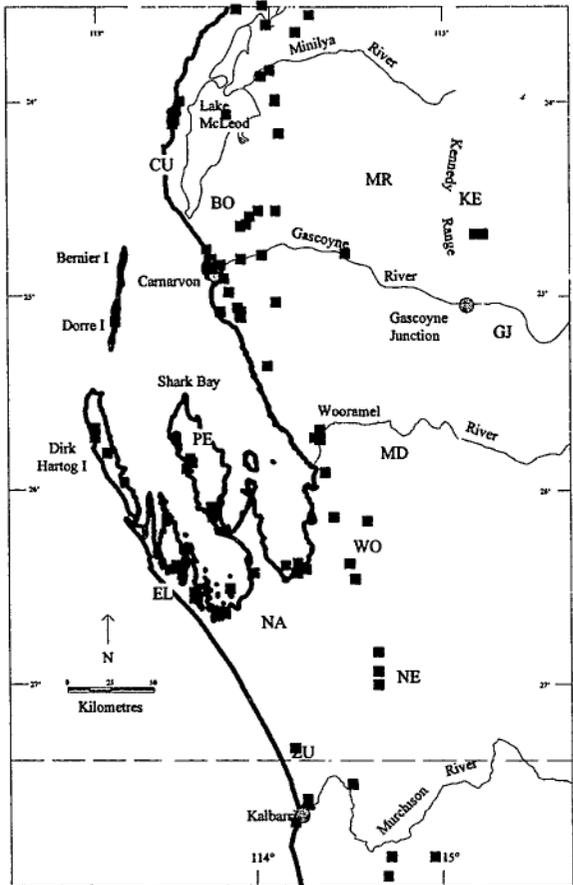
Yellow White-eye



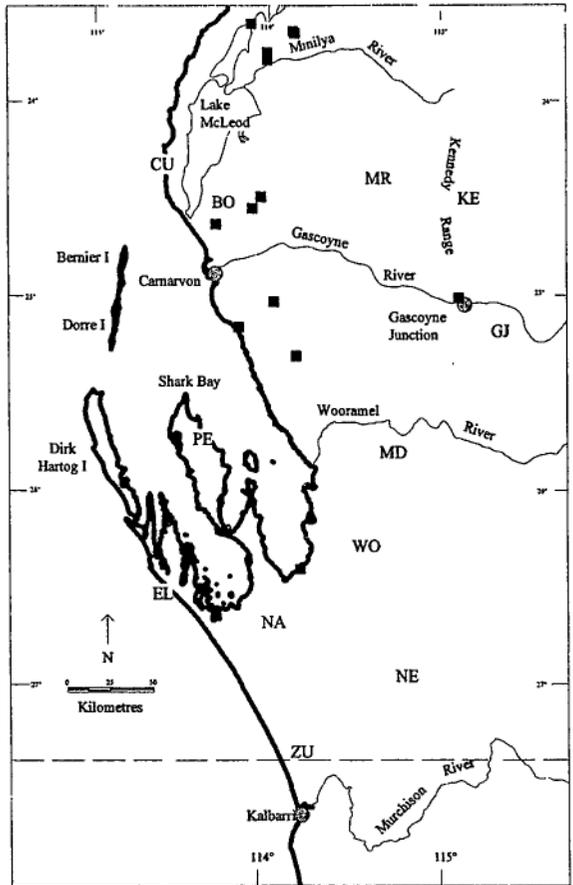
Grey-breasted White-eye



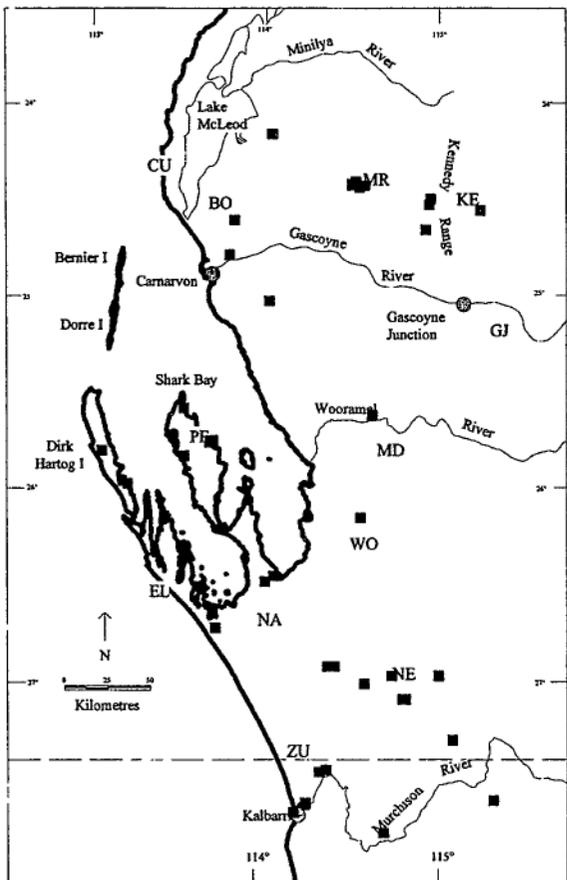
Rufous Songlark



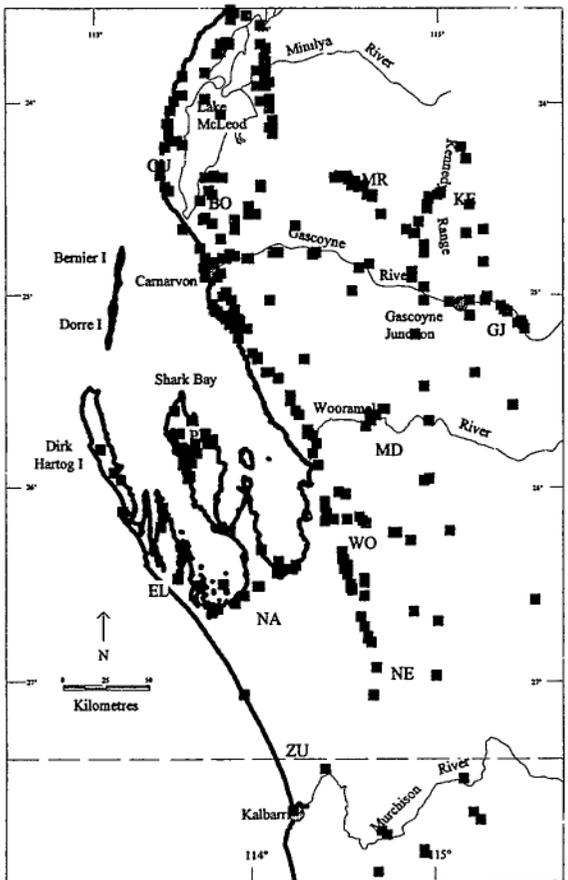
Brown Songlark



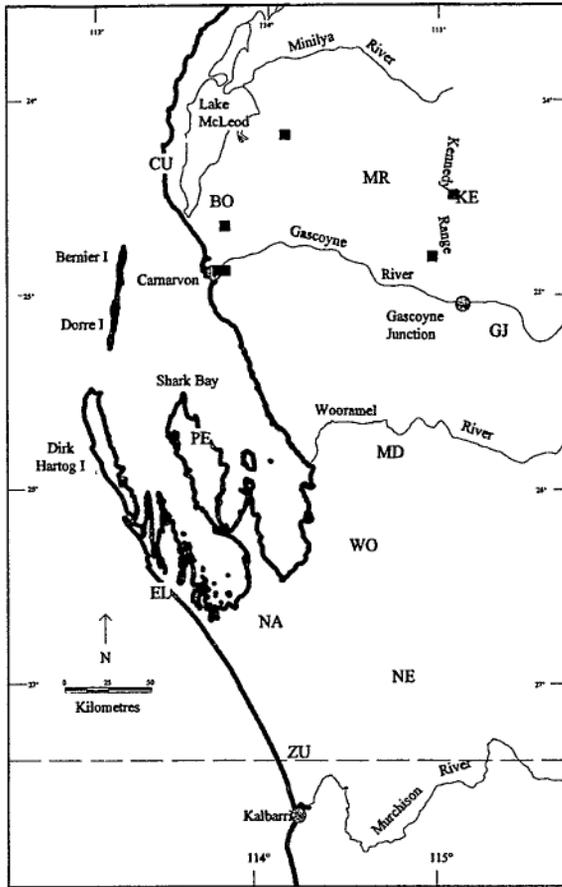
Singing Bushlark



Mistletoebird



Zebra Finch



Painted Finch