CALMScience 3(3):279–308(2000)

Impact of agricultural development and changed fire regimes on species composition of the avifauna in the Denmark region of south-west Western Australia, 1889–1999

IAN ABBOTT

CALMScience Division, Department of Conservation and Land Management, Locked Bag 104, Bentley Delivery Centre, Western Australia 6983.

SUMMARY

Records of bird species observed by F.L. Whitlock near Wilson Inlet in the period 1905–19 (mostly 1907, 1909 and 1910), hitherto unpublished, were collated from museum specimens and archives. Whitlock noted 94 species comprising 65 landbirds, 10 waterbirds, 7 seabirds, and 12 non-breeding waders. Records of bird species made by other ornithologists from 1889 to 1913 indicate that the original avifauna of this region comprised 81 landbird species. In the past century four of these species (*Burhinus grallarius, Pezoporus wallicus, Atrichornis clamosus* and *Dasyornis longirostris)*, as well as the waterbird *Ixobrychus flavicollis*, appear to have become locally extinct. Deforestation for agricultural development, with the subsequent creation of parkland and pasture, has allowed 10 landbird and 8 waterbird species to colonize the area. Whitlock's records of the seabird species *Eudyptula minor* and *Pterodroma macroptera* nesting on islands in Wilson Inlet are otherwise unreported in the literature.

A comprehensive synthesis of eyewitness accounts of Aboriginal burning practices in the period 1791–1840 indicates that anthropogenic fire was frequent, prevalent in summer, and spatially extensive but in patches varying in area from *c.* 10–2000 ha, with a tendency for riparian vegetation to be burnt less often than uplands. Such fires could be set at the hottest part of the day, with multiple ignitions on the one day, and under windy conditions. Three bird species that are sensitive to frequent fire and now considered to be extinct locally are presumed to have had patchy distributions confined to those limited parts of the landscape naturally protected from frequent burning (vegetation along higher order streams, on steep south-facing slopes, or surrounded by expanses of granite). In addition, some of these sites may have had totemic significance to Aborigines and were thus protected from more intense or frequent fire by periodic burning using low intensity fire in spring, late autumn or early winter. The vulnerability of naturally insularized populations to inappropriate intensity or frequency of fire may explain the early demise of these species following European settlement.

Few other parts of Western Australia have an avifauna so well documented at a time when agricultural development had only recently commenced. The Denmark area would therefore provide an appropriate focal region for documenting ongoing environmental change as indicated by the avifauna.

INTRODUCTION

The English ornithologist F.L. Whitlock (1860–1953) migrated to Western Australia (WA) in 1901 (Whittell 1954), and later settled near Tudor Siding, Wilson Inlet (Fig. 1), 'the house ["Chiltern", Jackson 1912–13 unpublished diary] being within half-a-mile [*c.* 800 m] of the eastern end of the inlet' (Whittell 1940) and 'a little over a mile [1.6 km]' from the siding (Jackson 1912–13, unpublished diary). Whitlock resided there from 1905 to *c.* 1924, though from 1908 he was often in remote parts of Australia collecting eggs for H.L. White and skins for G.M. Mathews. Whittell (1940) drew attention to the absence of a general account of Whitlock's collecting and observations near Wilson Inlet. This omission is difficult to explain, because Whitlock did publish on the bird species encountered on each of his 13 collecting expeditions; perhaps Wilson Inlet was not considered sufficiently remote or the avifauna of the region was regarded as uninteresting. The five papers published on the area treated only six species in varying degrees of detail (Whitlock 1911a, 1912, 1914, 1926, 1936). To my surprise, no remarks about the avifauna of the Denmark region were found in Mathews' 12 volume *Birds of Australia*, published between 1910 and 1927.

With the passage of time, Whitlock's specimens collected near Wilson Inlet have assumed a significance probably not envisaged by him. His specimens were collected following a period of timber getting at Torbay (1884–1896) and Denmark (1896–1905) (Gunzburg and Austin 1997) and the commencement of permanent clearing of vegetation in 1906 for potato farming (Jackson 1912–13, unpublished diary) and dairying (Cullity 1979).

Closer settlement was given impetus when in 1907 the Western Australian government purchased the Elleker-Denmark railway, built by Millar's, and adjacent lands (Gunzburg and Austin 1997). Whitlock's collections provide an important baseline for examining gross changes in species composition of the avifauna during the course of this century.

The aims of this paper are: (1) to collate all available records by Whitlock and make this important baseline historical information more readily accessible; (2) to combine this material with records of bird species observed by other ornithologists in the period 1889–1913 in the Denmark region, resulting in a definitive list of bird species of the Denmark region prior to intensive disturbance by European settlement; and (3) to provide context for evaluating the impact of clearing of native vegetation for farming and of changed fire regimes in native vegetation on bird species. Background information on the habitats present and presumably examined by Whitlock is also given.

METHODS

Sources

Information was collated from three sources, which in the following list of species are indicated as MS, Egg, and Specimen respectively. MS refers to annotations made by Whitlock on his personal copy of R. Hall's 1899 *A Key to the Birds of Australia and Tasmania with their Geographical Distribution in Australia* (held in the Public Records Office of WA). Egg refers to eggs collected for H.L. White and now held in the Museum of Victoria, or eggs lodged in the Australian Museum or Western Australian Museum. Specimen refers to specimens: collected for G.M. Mathews, now held in the collection of the American Museum of Natural History in New York; collected for H.L. White, now held in the Museum of Victoria, Melbourne; or deposited in the Australian Museum, Sydney or Western Australian Museum, Perth. These sources unfortunately contain very little information other than locality and date of collection.

Citation of records

The names and sequence of species follow the current Western Australian Museum list (Johnstone in press). The following convention is adhered to: 'Specimen: 1/11 (1)' signifies that one bird specimen was collected in January 1911 near Wilson Inlet. 'Egg 10/13 (8)' refers to a clutch of 8 eggs collected in October 1913 near Wilson Inlet. Eggs or specimens held in the H.L. White collection are prefixed HLW and those in the Australian Museum and Western Australian Museum are denoted AM and WAM respectively. Specimens without a prefix are lodged at the American Museum of Natural History (AMNH). Locality is cited only for material collected other than at Wilson Inlet. The HLW and AM egg records refer to a clutch.

Habitats visited by Whitlock

According to Churchward *et al.* (1988) three landform/soil units are present between Tudor Siding and Wilson Inlet. The most widely occurring is the Blackwater system, a flat, poorly drained plain vegetated by sedgeland and scattered thickets of *Melaleuca* and *Banksia* species. The Owingup system also consists of poorly drained plains of sedgeland and dense thickets of wattie (*Agonis juniperina*), with lunettes supporting woodland dominated by *Banksia* species and *Allocasuarina fraseriana*. The Collis system comprises low hilly terrain with relief < 20 m vegetated by jarrah (*Eucalyptus marginata*)/marri (*Corymbia calophylla*) forest with a dense shrub layer of *Bossiaea linophylla*.

East of Wilson Inlet the Blackwater system is most extensive. Several large patches of karri forest (Keystone unit) occurred until the 1890s. After clearfelling most of this land was taken up for agriculture, thus destroying the regenerating forest (Bradshaw *et al.* 1997). Smaller patches of jarrah forest (Collis) also occur in this sector. Lake William is surrounded by peppermint (*Agonis flexuosa*) woodland (Meerup dune system).

At and near Denmark, four landform/soil units are present. The Keystone system is characterized by hills and ridges >60 m relief supporting karri forest and jarrah forest/woodland. Most of this system is now on private land and has been cleared for dairying. The Trent system is made up of flat topped hills, < 40 m relief, supporting low jarrah/marri forest. The Fernley system is swampy terrain, with jarrah/bullich (*E. megacarpa*) on rises and kangaroo grass (*Evandra aristata*) sedgeland and tea tree (*Agonis parviceps*) and *A. linearifolia* heath in poorly drained areas. The Denmark River valley is classified as a major valley, with 20 m relief, supporting jarrah/marri forest on slopes and dense thickets of wattie/paperbark (*Melaleuca* spp.) on terraces.

Whitlock makes no mention of the habitats in which he collected, except for six species (Whitlock 1911a, 1912, 1914, 1926, 1936). Jackson (1912–13 unpublished diary) recorded on 9 October 1912 that Whitlock stated his intention of 'collecting up the Hay River in from Wilson's Inlet, not too far from his house at Tudor Siding...'.

Aboriginal burning practices in the period 1791–1840

The Denmark region is adjacent to the Albany region, which was first visited by Europeans in 1791. King George Sound, a commodious and safe harbour with a ready supply of firewood and water onshore, was an attractive landfall after the long sea voyage from Capetown, Sydney or Hobart. As a result the coastal parts of the Albany region were visited several times, before a small penal colony was established at Albany by the Governor of New South Wales in 1826. This was disbanded in 1831 when the area came under the administration of the Swan River colony, resulting in occupation by free settlers.

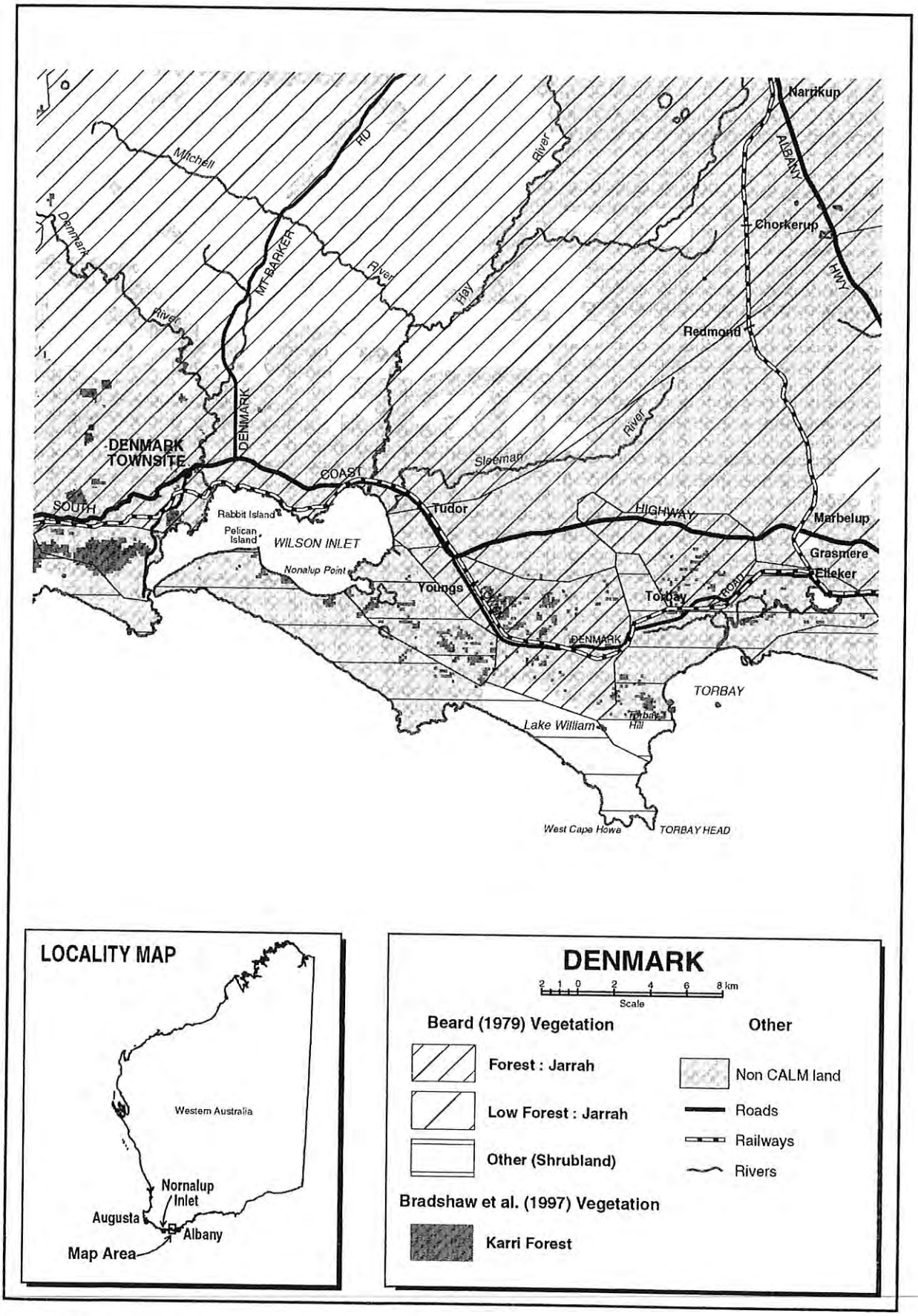

Figure 1. Denmark region, showing localities mentioned in text.

All available published and unpublished records made by naval, army and civilian personnel connected with these visits and later settlement have been searched for statements about fire and the density of vegetation. This information provides one of the most comprehensive accounts of Aboriginal burning practices before and just after European settlement for any locality in southern Australia. I have quoted verbatim all relevant remarks about fire and vegetation structure, taking particular care to avoid selective quotation in support of a particular view. By not paraphrasing these records, I have provided a clear demarcation between my interpretation and what was actually recorded. Scholars can then debate my interpretation, confident that the full background has been provided. All available eyewitness evidence about Aboriginal use of fire in the Denmark and Albany regions is presented in Appendix 1.

The area covered by these observations experiences a west–east rainfall gradient of 1000 mm (Denmark) to 800 mm (Mt Gardner) per annum, and a south–north gradient of 900 mm (Albany) to 750 mm (Mt Barker). Although Hallam (1975) provided quotations relating to this area, they are selective and not comprehensive, having been cited to demonstrate that burning was not an incidental activity of Aborigines. Furthermore, several additional contemporary accounts have become available since 1975.

RESULTS

Annotated list of bird species recorded by Whitlock

Whitlock accumulated 603 records of 103 bird species throughout his period of residence, with the last novel species of landbird, waterbird, and wader being recorded in 1917, 1917 and 1911 respectively (Fig. 2A). He eventually noted 65 landbird species, 10 waterbird species, 7 seabird species, and 12 non-breeding wader species. Most records were made in 1910, 1907, 1909, 1906 and 1911 (Fig. 2B). Whitlock collected 431 specimens (made up as museum skins), observed 55 clutches and made 33 dated annotations of landbirds in his copy of Hall's book. He collected 19 waterbird specimens and 36 wader specimens, recorded 11 clutches of waterbirds and annotated records of 14 waterbirds and 4 waders in his copy of Hall. His cumulative number of species recorded is closely related to his cumulative observation effort (Fig. 2C).

Landbirds

Coturnix novaezelandiae STUBBLE QUAIL
Specimen: 1/11 (1).

Coturnix ypsilophora BROWN QUAIL
MS: 2/06, 2/13.
Egg: HLW 10/13 (8), near Albany.

Accipiter fasciatus BROWN GOSHAWK
Egg: HLW 10/13 (3).
Specimen: 7/11 (1); HLW 10/13 (1).

Accipiter cirrocephalus COLLARED SPARROWHAWK
MS: 9/06
Specimen: WAM 3/07 (1); 12/08 (1), 3/09 (1), 5/10 (2); HLW 2/12 (1).

Haliaeetus leucogaster WHITE-BELLIED SEA-EAGLE
MS: 11/06 (nesting). Nesting in 1905 in a tree close to the beach of Wilson Inlet (Carter 1923).

Circus approximans SWAMP HARRIER
MS: No date given and evidently misidentified as *C. assimilis* (Spotted harrier) based on description supplied ('patch of white on upper tail coverts, wings in flight curved when out spread'). According to Storr (1991), *C. assimilis* did not originally occur west of Two Peoples Bay.
Specimen: HLW 10/16 (2).

Falco berigora BROWN FALCON
Specimen: WAM 3/07 (1); 4/10 (1).

Falco longipennis AUSTRALIAN HOBBY
Specimen: HLW 6/13 (1).

Turnix varia PAINTED BUTTON-QUAIL
Egg: HLW 11/12 (4), near Albany.
Specimen: WAM 3/07 (2); 12/09 (juvenile); HLW 11/12 (1).

Burhinus grallarius BUSH STONE-CURLEW
Egg: HLW 10/12 (2).

Phaps chalcoptera COMMON BRONZEWING
Specimen: 3/05 (1), Denmark.

Phaps elegans BRUSH BRONZEWING
Specimen: 11/11 (1).

Calyptorhynchus banksii RED-TAILED BLACK COCKATOO
Specimen: 10/10 (1), West Cape Howe; HLW 1/16 (1).

Calyptorhynchus baudinii BAUDIN'S COCKATOO
Specimen: HLW 1/16 (1), HLW 4/16 (1), HLW 3/17 (1).

Glossopsitta porphyrocephala PURPLE-CROWNED LORIKEET
Specimen: 2/10 (2), 3/10 (9), 4/10 (6), 5/10 (3), 7/10 (1); 5/10 (1), Denmark. One of Whitlock's specimens collected in 3/10 from Wilson Inlet served Mathews as the type of *G. p. whitlocki* (1912); however, this taxon has not been accepted.

Platycercus zonarius AUSTRALIAN RINGNECK
Specimen: 5/09 (1), 3/10 (2), 1/11 (1); 3/05 (2) and 5/10 (1), Denmark.

Platycercus spurius RED-CAPPED PARROT
MS: 1/06.
Specimen: 4/06 (1); WAM 3/07 (4); 12/08 (2), 4/09 (1), 6/10 (1); HLW 11/10 (1), West Cape Howe.

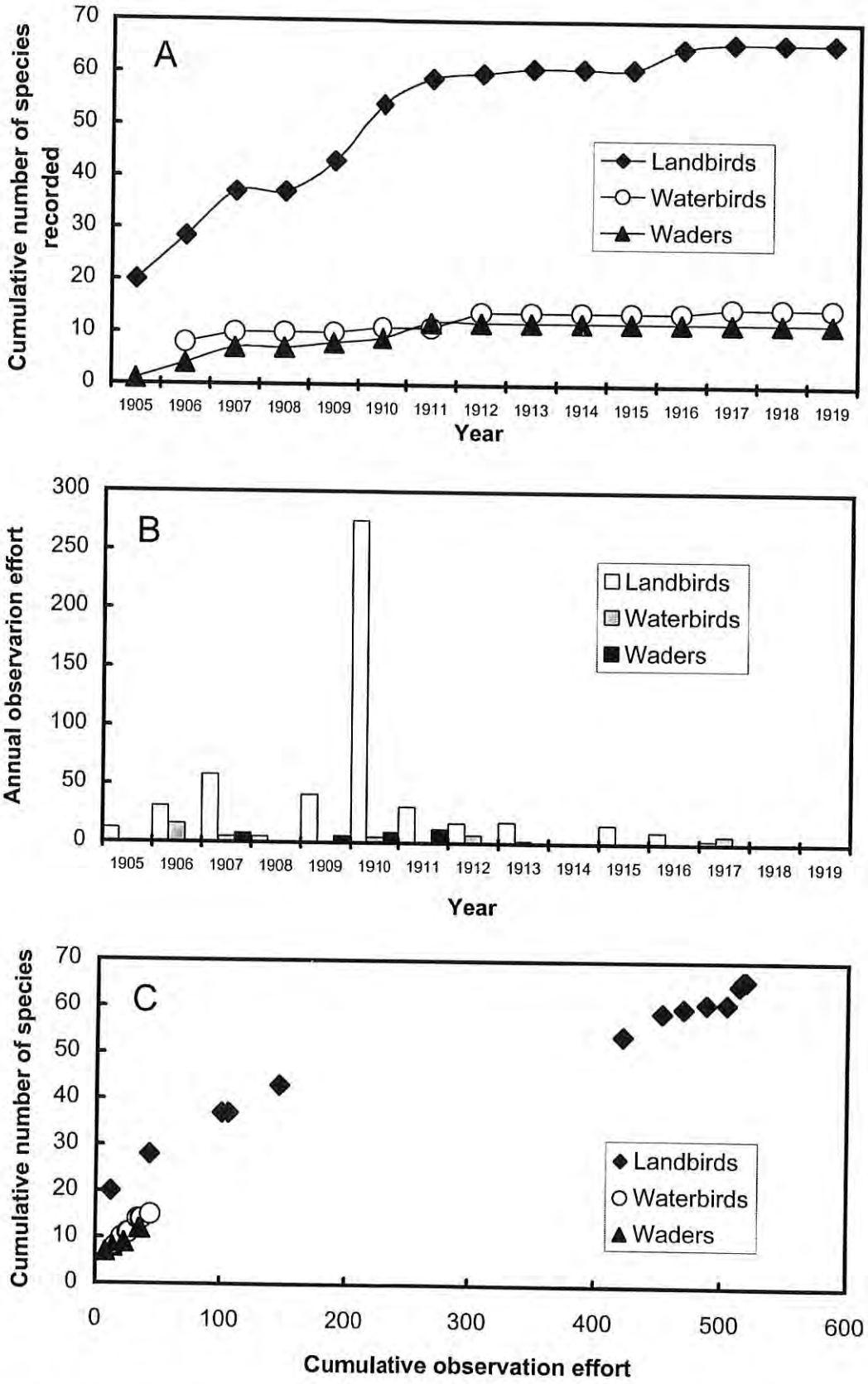

Figure 2A. Year in which each bird species was first recorded by Whitlock in the area shown in Fig. 1.
2B. Whitlock's annual observation effort, shown separately for landbirds, waterbirds and waders. Annual observation effort is the total number of records of annotations, eggs or specimens collected each year.
2C. Cumulative number of species recorded in relation to cumulative observation effort.
Seabird species have been combined with waterbird species in Figures 2A, B & C.

Platycercus icterotis WESTERN ROSELLA
Specimen: WAM 3/07 (1); 3/09 (1), 3/10 (4), 4/10 (2), 5/10 (4); HLW 9/12 (1); HLW 12/12 (1). One of Whitlock's specimens collected in 4/10 from Wilson Inlet served Mathews as the type of *P. i. salvadori* (1912), a taxon not since recognized.

Neophema elegans ELEGANT PARROT
Specimen: HLW 1/16 (5). This record is inconsistent with Storr's (1991) statement that this species colonized the Albany district in the 1960s.

Neophema petrophila ROCK PARROT
Specimen: 12/09 (1).

Pezoporus wallicus GROUND PARROT
Egg: HLW 11/13 (3). Whitlock (1914) also reported nesting 10/12. Serventy (1926, p. 68) mentions a personal communication from Whitlock that this species was seen near Wilson Inlet 7 miles [*c.* 11 km] from the open ocean.
Specimen: HLW 11/11 (2).

Chrysococcyx basalis
HORSFIELD'S BRONZE CUCKOO
Egg: HLW 11/16 (1), in nest of *Stipiturus malachurus* (1 egg). This record contradicts Storr's (1991) statement that this species does not occur west of Albany. (Storr 1991 is an otherwise authoritative and comprehensive synthesis of records.)

Chrysococcyx lucidus SHINING BRONZE CUCKOO
MS: 9 and 10/06, egg.
Egg: HLW 10/06 (1) (in *Acanthiza inornata* [1 egg] nest), HLW 11/11 (1) (in *Gerygone fusca* [1 egg] nest), HLW 11/13 (1) (in *Acanthiza chrysorrhoa* [3 eggs] nest).

Podargus strigoides TAWNY FROGMOUTH
Specimen: WAM 3/07 (1); 2/11 (1).

Aegotheles cristatus AUSTRALIAN OWLET-NIGHTJAR
Specimen: 5/10 (1).

Climacteris rufa RUFOUS TREECREEPER
Egg: HLW 12/09 (3).
Specimen: 3/09 (1), 2/10 (2), 3/10 (2), 4/10 (3), 6/10 (1); 5/10 (3), Denmark.

Malurus splendens SPLENDID FAIRY-WREN
Specimen: WAM 3/07 (3); 5/10 (1).

Malurus elegans RED-WINGED FAIRY-WREN
MS: 7/06, 10/06 (eggs).
Egg: HLW 11/12 (3), 'Mingerup, Wilson's Inlet'. The location of Mingerup is now untraceable (R. Properjohn[1] personal communication).
Specimen: WAM 3/07 (10); 12/05 (1), 12/09 (1), 4/10 (1), 6/10 (1); HLW 11/10 (1), Lake William [near Torbay]; HLW 11/12 (1).

Stipiturus malachurus SOUTHERN EMU-WREN
MS: 12/05, Torbay.
Egg: HLW 11/11 (1), HLW 11/12 (3), HLW 10/13 (3), HLW 11/13 (3), HLW 11/15 (2); AM 12/12, AM 10/15 Sphenura Camp [at] Wilson Inlet, AM 11/15, AM 10/16.
Specimen: WAM 3/07 (2), Torbay; WAM 3/07 (7); 11/11 (2); HLW 10/15 (3), HLW 11/13 (3), HLW 11/15 (2); AM no date, Tudor [on] Denmark line.

Pardalotus punctatus SPOTTED PARDALOTE
Specimen: WAM 3/07 (3); 2/10 (1), 3/10 (2); 5/10 (1), Denmark; HLW 11/10 (1), Torbay. One of these specimens from Wilson Inlet served Mathews as the type of *P. p. whitlocki* (1912), a taxon no longer recognized. Details of two unusual nesting sites are provided in Whitlock (1911a).

Pardalotus striatus STRIATED PARDALOTE
Specimen: 1/10 (1), 2/10 (2).

Dasyornis longirostris WESTERN BRISTLEBIRD
MS: 3/07. Whitlock (1936) collected this, a female, which he speculated had been driven from the east by extensive fires at the end of summer 1906/07. He returned to the area in 11/07 and discovered an empty nest in an unburnt patch of vegetation. In 9/08 he found another nest, containing an infertile egg. This species was last recorded in the region in 1912 (caption to photograph in Whitlock 1936). Carter (in Whitley 1971) searched unsuccessfully for this species in 1919 and 1922 in the same area where Whitlock collected it. He noted that 'a good deal' of the coastal vegetation had been 'recently burnt off'.
Specimen: WAM 3/07 (1), -/07 (2).

Sericornis frontalis WHITE-BROWED SCRUBWREN
MS:11/05, Torbay.
Specimen: WAM 3/07 (1), Torbay; 4/10 (2), 5/10 (2).

Gerygone fusca WESTERN GERYGONE
Specimen: WAM 3/07 (2); 12/09 (1), 3/10 (1), 4/10 (2).

Acanthiza apicalis BROAD-TAILED THORNBILL
MS: 9/06, eggs; 10/06, young.
Egg: HLW 9/12 (2).
Specimen: WAM 3/07 (1); 4/10 (12), 5/10 (3), 3/11 (1); 5/10 (2), Denmark; HLW -/11 (1), HLW 3/11 (5), HLW 4/11 (1).

Acanthiza inornata WESTERN THORNBILL
MS: 9 & 10/06, nesting in jarrah sapling 6 m above ground.
Egg: HLW 11/10 (2), Torbay Hill; HLW 11/11 (3), HLW 10/13 (3); AM 11/13, AM 1/16.
Specimen: 12/08 (1), 11/09 (1), 12/09 (6), 1/10 (1), 3/10 (2), 4/10 (4), 5/10 (5), 6/10 (1); 5/10 (2), Denmark; HLW 5/05 (1), HLW 5/09 (1), HLW 3/11 (2).

[1] Information Management Branch, CALM, Kensington WA.

Acanthiza chrysorrhoa YELLOW-RUMPED THORNBILL
MS: 8/06, building nest, eggs.
Specimen: WAM 3/07 (1); 12/09 (2), 1/10 (1), 3/10 (1), 4/10 (1), 5/10 (2); HLW 3/11 (1), HLW 5/11 (2). One of these specimens from Wilson Inlet served Mathews as the type of *A. c. multi* (1912), a taxon no longer recognized.

Lichmera indistincta BROWN HONEYEATER
Specimen: 5/10 (1), Denmark.

Meliphaga virescens SINGING HONEYEATER
MS: 7/06 (1 male).

Melithreptus chloropsis WESTERN WHITE-NAPED HONEYEATER
MS: 12/05, juvenile male collected and misidentified as *M. brevirostris.*
Specimen: WAM 3/07 (3); 12/08 (1), 12/09 (2), 2/10 (3), 3/10 (5), 4/10 (1), 5/10 (2); 5/10 (3), Denmark. One of Whitlock's specimens from Wilson Inlet served Mathews as the type of *M. lunatus whitlocki* (1909), a taxon no longer recognized.

Phylidonyris novaehollandiae NEW HOLLAND HONEYEATER
MS: 11/05, Torbay.
Egg: HLW 12/05 (3); AM 11/15.
Specimen: WAM 3/07 (1), Torbay; WAM 3/07 (1); 3/10 (3), 4/10 (3); 5/10 (1), Denmark.

Phylidonyris melanops TAWNY-CROWNED HONEYEATER
Egg: WAM 10/11 (4); HLW 12/14 (3); AM 10/15.
Specimen: 12/09 (1), 4/10 (3). One of Whitlock's specimens from Wilson Inlet served Mathews as the type of *P. m. westernensis* (1912), a taxon no longer recognized.

Acanthorhynchus superciliosus WESTERN SPINEBILL
Egg: HLW 11/13 (2); AM 11/16.
Specimen: 3/10 (1), 4/10 (9), 5/10 (4); 5/10 (2), Denmark. One of these specimens from Wilson Inlet served Mathews as the type of *A. s. wilsoni* (1912), a taxon no longer accepted.

Anthochaera lunulata WESTERN LITTLE WATTLEBIRD
MS: 12/05.
Egg: AM 11/12.
Specimen: 1/06 (1); WAM 3/07 (3).

Anthochaera carunculata RED WATTLEBIRD
Egg: AM 7/12.
Specimen: 3/10 (1).

Epthianura albifrons WHITE-FRONTED CHAT
Specimen: 3/10 (2), 4/10 (1). One of these specimens from Wilson Inlet served Mathews as the type of *E. a. westralensis* (1912), a taxon no longer regarded as valid.

Petroica multicolor SCARLET ROBIN
MS: 10/06 (eggs).
Egg: HLW 10/06 (2); AM 11/15.
Specimen: 4/10 (8), 5/10 (2), 6/10 (1).

Eopsaltria australis YELLOW ROBIN
MS: 12/06; 12/06, Torbay.
Specimen: 12/09 (5), 1/10 (2), 2/10 (1), 4/10 (8), 5/10 (2); 5/10 (2), Denmark.

Eopsaltria georgiana WHITE-BREASTED ROBIN
MS: 10/06 young on wing. Nest 5 m above ground; 11/06 (eggs).
Specimen: 3/10 (1).

Daphoenositta chrysoptera VARIED SITTELLA
Specimen: 1/10 (2), 2/10 (2), 3/10 (1), 4/10 (2), 5/10 (1); 5/10 (1) Denmark.

Falcunculus frontatus CRESTED SHRIKE-TIT
MS: no details.
Specimen: WAM 2/06 (1).

Pachycephala pectoralis GOLDEN WHISTLER
MS: 10/06 nest; 11/06 eggs.
Egg: HLW 12/10 (2) Torbay Hill; AM 11/15.
Specimen: WAM 3/07 (1); 2/10 (3), 3/10 (4), 4/10 (9); 3/05 (1) and 5/10 (1), Denmark.

Pachycephala rufiventris RUFOUS WHISTLER
Specimen: 4/10 (3).

Colluricincla harmonica GREY SHRIKE-THRUSH
Specimen: 5/09 (1), 12/09 (5), 1/10 (1), 2/10 (1), 5/10 (4), 6/10 (2).

Myiagra inquieta RESTLESS FLYCATCHER
Specimen: 2/10 (1), 4/10 (3).

Rhipidura fuliginosa GREY FANTAIL
Egg: AM 11/12, AM 12/13.
Specimen: 12/09 (1), 3/10 (1), 4/10 (9), 5/10 (2), 6/10 (1), 10/11 (1).

Coracina novaehollandiae BLACK-FACED CUCKOO-SHRIKE
MS: 11/06, 'carrying twigs'.
Specimen: no details; this specimen from Wilson Inlet served Mathews as the type of *C. n. westralensis* (1912), a taxon no longer recognized.

Artamus cyanopterus DUSKY WOODSWALLOW
MS: 7/06.
Egg: HLW 11/09 (4); WAM 10/18 (2).
Specimen: WAM 3/07 (1); 4/10 (6), 5/10 (2), 6/10 (2).

Strepera versicolor GREY CURRAWONG
Specimen: 3/09 (2), 3/10 (1); HLW 3/12 (1), HLW 4/15 (2).

Anthus australis AUSTRALIAN PIPIT
MS: 10/06 eggs.
Egg: WAM 10/19 (3).
Specimen: 4/10 (2), 5/10 (1), 6/10 (1). One of these specimens from Wilson Inlet served Mathews as the type of *A. n. bilbali* (1912), a taxon no longer recognized as valid.

Stagonopleura oculata RED-EARED FIRETAIL
MS: 2/06.
Egg: AM 10/15 (6); HLW 11/15.
Specimen: WAM 3/07 (3); 4/10 (3); 5/10 (2), Denmark; HLW 11/10 (1) near West Cape Howe; HLW 11/12 (1).

Acrocephalus australis AUSTRALIAN REED WARBLER
Specimen: HLW 2/17 (2).

Megalurus gramineus LITTLE GRASSBIRD
MS: 11/06. Details of habitat and nesting are provided in Whitlock (1912).
Egg: HLW 10/11 (4), HLW 12/11 (4), HLW 12/12 (4), HLW 10/13 (3); AM 11/11, AM 12/11.
Specimen: 1/11 (1); HLW 11/11 (2), HLW 12/11 (1).

Cincloramphus cruralis BROWN SONGLARK
Specimen: WAM 3/07 (1), Torbay.

Zosterops lateralis GREY-BREASTED WHITE-EYE
MS: 12/06 eggs.
Egg: HLW 11/10 (3), Torbay; HLW 11/10 (3), west of Albany; AM 10/10, north of Albany.
Specimen: 12/09 (3), 3/10 (1), 4/10 (7), 5/10 (1), 6/10 (1); HLW 11/10 (1), near Albany; HLW 11/10 (3) Lake William [near Torbay]; HLW 11/10 (1), near West Cape Howe.

Waterbirds

Cygnus atratus BLACK SWAN
Egg: HLW 10/12 (6).

Tadorna tadornoides AUSTRALIAN SHELDUCK
MS: 9/06, Rabbit Island (flock).

Poliocephalus poliocephalus HOARY-HEADED GREBE
MS: 5/06, 9/06.

Phalacrocorax melanoleucos LITTLE PIED CORMORANT
MS: 9/06 (egg). Whitlock (1926) mentions that this species 'breeds in numbers within a quarter of a mile [400 m] of my late home'. Jackson (1912–13 unpublished diary) noted that this swamp was 'below' Whitlock's house.
Egg: HLW 9/13 (5), 'Nornalup Swamp [? = wetland near Nonalup Point], Wilson's Inlet'.

Nycticorax caledonicus RUFOUS NIGHT HERON
Specimen: WAM 3/07 (1).

Ixobrychus flavicollis BLACK BITTERN
Egg: WAM 11/12 (1).

Porzana pusilla BAILLON'S CRAKE
Specimen: HLW 1/17 (1), HLW 2/17 (1).

Porzana tabuensis SPOTLESS CRAKE
Egg: HLW 11/13 (4). Whitlock (1914) records nesting in 3/05 near Torbay Junction [Elleker].
Specimen: HLW 12/10 (1), near Albany; HLW 2/17 (4), HLW 3/17 (1).

Porphyrio porphyrio PURPLE SWAMPHEN
Egg: HLW 10/12 (4), near Albany. See also Whitlock (1914).
Specimen: HLW 2/16 (1).

Charadrius ruficapillus RED-CAPPED PLOVER
MS: 7/06; 10/06 (egg).
Egg: HLW 12/10 (2); WAM 12/10 (2).
Specimen: 3/10 (1).

Seabirds

Eudyptula minor LITTLE PENGUIN
MS: 4/-, breeding on Rabbit Island.

Pterodroma macroptera GREAT-WINGED PETREL
MS: 4/-, breeding on Rabbit Island.

Larus pacificus PACIFIC GULL
MS: 10/06 (immature).

Larus novaehollandiae SILVER GULL
MS: 12/06, Pelican Rock (eggs); 12/06, Murphys Rocks (egg). Neither of these localities is identified on modern maps.
Egg: HLW 12/06 (3), HLW 11/12 (3); AM 12/12.

Sterna caspia CASPIAN TERN
MS: 1/06; 10/06, Rabbit Island (egg); 12/06 Murphys Rocks (egg); 12/06 Rabbit Rock.
Egg: AM 12/10, Pelican Island in Wilson Inlet.
Specimen: HLW 12/06 (2), near Albany; WAM 3/07 (1).

Sterna bergii CRESTED TERN
MS: 1/07 Pelican Rock (addled egg).

Sterna nereis FAIRY TERN
MS: 11/06.
Specimen: WAM 3/07 (2); 1/11 (1); HLW 12/12 (2).

Non-breeding waders

Limosa lapponica BAR-TAILED GODWIT
Specimen: 11/11 (1).

Tringa nebularia COMMON GREENSHANK
MS: 8/06.
Specimen: WAM 3/07 (2); 2/10 (1), 4/10 (1).

Tringa hypoleucos COMMON SANDPIPER
MS: 9/06.

Tringa breviceps GREY-TAILED TATTLER
Specimen: 11/11 (2).

Calidris ruficollis RED-NECKED STINT
Specimen: WAM 3/07 (3); 3/09 (1), 5/09 (3), 1/11 (1).

Calidris acuminata SHARP-TAILED SANDPIPER
Specimen: WAM 3/07 (1); 1/11 (1), 11/11 (2); HLW 11/12 (2).

Calidris ferruginea CURLEW SANDPIPER
Specimen: 5/09 (2), 3/10 (3), 11/11 (1).

Pluvialis squatarola GREY PLOVER
Specimen: 11/11 (1).

Pluvialis fulva PACIFIC GOLDEN PLOVER
Specimen: WAM 7/07 (1), Torbay; 11/11 (1); HLW 3/07 (1), HLW 3/17 (1).

Pluvialis dominica AMERICAN GOLDEN PLOVER
MS: 12/06.

Charadrius bicinctus DOUBLE-BANDED PLOVER
Specimen: 3/10 (2).

Charadrius rubricollis HOODED PLOVER
MS: 12/05.
Specimen: 1/10 (2), Torbay. Another specimen, collected 11/10 at Torbay (Greenway 1978), served Mathews as the type of *C. r. torbayi* (1912), a taxon no longer recognized.

Landbird species considered to be present, though not recorded by Whitlock

With few exceptions, the species listed below were either recorded by others in the period 1889–1913 in or near the Denmark region or were presumably overlooked by Whitlock.

Landbirds

Dromaius novaehollandiae EMU
Noted in 1899 3 miles [*c.* 5 km] east of Denmark (Hall 1902b) and in 1910 in karri forest near Denmark (Carter 1923).

Pandion haliaetus OSPREY
Noted in 1905 at Wilson Inlet (Carter 1923).

Haliastur sphenurus WHISTLING KITE
Noted once by S.W. Jackson in 1912 *c.* 40 km west of Wilson Inlet (Abbott 1998). Presumed to be present in the Denmark area in Whitlock's time.

Aquila morphnoides LITTLE EAGLE
Noted by S.W. Jackson in 1913 *c.* 40 km west of Wilson Inlet (Abbott 1998). Presumed to be present in the Denmark area in Whitlock's time.

Aquila audax WEDGE-TAILED EAGLE
Noted by S.W. Jackson in 1912 *c.* 40 km west of Wilson Inlet (Abbott 1998). Presumed to be present in the Denmark area in Whitlock's time.

Falco peregrinus PEREGRINE FALCON
No records located, but presumed to be present in the Denmark area in Whitlock's time.

Cuculus pallidus PALLID CUCKOO
Noted in 1899 and 1911 near Albany (Hall 1902a; Carter 1920, 1923). Presumed to be present in the Denmark area in Whitlock's time.

Cacomantis flabelliformis FAN-TAILED CUCKOO
Nestling collected in 1899 at Denmark (Hall 1902a).

Ninox novaeseelandiae BOOBOOK OWL
Recorded in 1899 at Denmark (Hall 1902b).

Todiramphus sanctus SACRED KINGFISHER
Recorded by G. C. Shortridge at Chorkerup, 1/05 (Ogilvie-Grant 1909), and by S. W. Jackson at Denmark River and near Whitlock's house at Wilson Inlet, 2/13 (Abbott 1998).

Atrichornis clamosus NOISY SCRUB-BIRD
Collected by A. J. Campbell in 1889 in karri forest near Torbay (Campbell 1890). J.T. Tunney also searched unsuccessfully for this species in his extensive travels in the south-west (letter in WA Museum archives dated 9 August 1900), particularly Denmark (29 June 1904) and Albany (15 December 1904, 29 March 1906). Relevant extracts from these letters are summarized in Appendix 2. E. B. Nicholls (1905) also searched without success for this species between February and June 1905.

Pomatostomus superciliosus WHITE-BROWED BABBLER
Hall (1902a) recorded a flock 'some six miles [c. 10 km] up the [Denmark] river from the town [Denmark]', in karri forest.

Rhipidura leucophrys WILLIE WAGTAIL
Although noted as not seen at Denmark or Albany in 1899 (Hall 1902a), this species was recorded at Albany before 1910 (Carter 1923) and by S. W. Jackson at Denmark, 2/13 (Abbott 1998).

Corvus coronoides AUSTRALIAN RAVEN
Recorded by S. W. Jackson near Whitlock's house at Wilson Inlet, 2/13 (Abbott 1998).

Hirundo neoxena WELCOME SWALLOW
Recorded at Albany (breeding) in 1909 (Carter 1923) and by S. W. Jackson at Denmark, 2/13 (Abbott 1998).

Hirundo nigricans TREE MARTIN
Recorded in 1899 at Denmark (Hall 1902a).

DISCUSSION

Changes in the avifauna since 1889

Parts of the area surveyed by Whitlock were examined by ornithologists in 1889, 1899, 1905, 1980 and 1986–1999 (Table 1). Before these bird lists can be used as a legitimate basis for examining changes in the landbird fauna, it is essential to decide which records represent vagrants, and evaluate whether failure to list any species indicates genuine absence or negligence in recording particular species. This procedure will eliminate any spurious instances of local extinction or local establishment ('pseudoturnover').

Whitlock recorded 65 landbird species and failed to record an additional 16 landbird species, nearly all of which were recorded by other contemporary ornithologists. Thus the landbird fauna in the period 1889–1919 comprised 81 species. Currently, 87 species of landbird occur in the Denmark region. Since 1889 four species appear to have become extinct locally and 10 species have colonized the region. This is similar to the Irwin Inlet–Broke Inlet–Mt Frankland region, *c.* 40 km west of Wilson Inlet, where two (possibly three) landbird species appear to have become extinct locally and 16 species have colonized (Abbott 1998).

The four landbird species that appear to have become locally extinct are *Burhinus grallarius* (Bush stone-curlew), *Pezoporus wallicus* (Ground parrot), *Atrichornis clamosus* (Noisy scrub-bird) and *Dasyornis longirostris* (Western bristlebird). *B. grallarius* is a ground-nesting species susceptible to predation by foxes (Storr 1991; Abbott 1999). *P. wallicus* is also a ground-nesting species and is susceptible to the effects of frequent burning (Burbidge *et al.* 1997). It has not been recorded in the region since 1913 (Serventy and Whittell 1976), though there are unsubstantiated reports in the period 1971–83 from Torbay (Watkins 1985). *A. clamosus* has not been recorded locally since 1889 (Campbell 1890). *D. longirostris* was last recorded in the area in 1912.

Atrichornis clamosus was probably already extinct in the Denmark area by the time Whitlock settled there, as the diligent collector J.T. Tunney searched for it unsuccessfully there. Nicholls (1905) also searched for it between Port Harding and Wilgie Hill in dense tea tree, dwarfed peppermint and other vegetation entangled with dodder, and karri undergrowth near where Campbell had obtained his specimen. This karri regrowth, being 15 years old, would have been about half way through the so-called juvenile phase (Bradshaw and Rayner 1997), thus consisting of *c.* 2000 stems per ha, *c.* 15 m tall, with dense thickets of fireweeds. If not locally extinct, *A. clamosus* may have occurred in only one or two small populations, as Abbott (1999) suggested that probably only five populations of this species occurred between Wilson Inlet and Torbay. These remnants, through bad luck, may have been overlooked by Tunney, Nicholls and Whitlock.

Seven bird species found in open country (woodland, parkland or pasture) appear to have been absent from the region (Fig. 1) in 1905–19, even though settlement was well advanced. These species are *Elanus caeruleus* (Black-shouldered kite), *Hamirostra isura* (Square-tailed kite), *Falco cenchroides* (Australian kestrel), *Tyto alba* (Barn owl), *Grallina cyanoleuca* (Magpie-lark), *Cracticus torquatus* (Grey butcherbird) and *C. tibicen* (Australian magpie).

One species, *Dacelo novaeguineae* (Laughing kookaburra), was introduced to WA and was first recorded in the Denmark area in 1927 (Storr 1991). Two other species, *Ocyphaps lophotes* (Crested pigeon) and *Cacatua roseicapilla* (Galah), did not originally occur in the South West Land Division (Storr 1991). Four other open country species (*Circus assimilis* Spotted harrier, *Polytelis anthopeplus* Regent parrot, *Merops ornatus* Rainbow bee-eater[2] and *Lalage tricolor* White-winged triller), although listed by WA Bird Notes (1985, No. 33, p. 3), WA Group RAOU (1994) or Birds Australia WA Group (1999), have apparently not yet established (L. Broadhurst[3] personal communication). In addition, the population of Galahs in the region may have derived from escaped cagebirds (L. Broadhurst, personal communication). Indeed, a pair observed in 1999 were eastern Australian birds (R. Johnstone[4] personal communication).

Because the status of six species in the Denmark area is unknown, they have not been listed in Table 1. Four of these species (*Tyto novaehollandiae* Masked owl, *Eurostopodus argus* Spotted nightjar, *Psophodes nigrogularis* Western whipbird, and *Rallus pectoralis* Lewin's rail) were not recorded there by Whitlock, contemporary ornithologists or later ornithologists. Although *Ninox connivens* (Barking owl) was heard or seen several times in jarrah forest in 1998 *c.* 8 km west of Redmond, on farmland adjacent to Redmond forest block (R. Walker[5] personal communication), its presence requires confirmation by an experienced ornithologist. The Spotted nightjar was noted once by S. W. Jackson in 1912 *c.* 40 km west of Wilson Inlet (Abbott 1998). The claim that the Western whipbird occurred 'along the coast as far west as Denmark' (Smith 1977) has not been substantiated.

Last century *Cacatua pastinator* (Western Long-billed corella) was distributed extensively throughout south-west WA, excluding the karri and denser jarrah forests. It was recorded near Albany in the 1820s and 1830s (Nind 1831; Clark 1994), and extended north to near Lynton, Morawa and Mt Kenneth, north-west to Bridgetown (and down the Blackwood River to Nannup and Augusta), Lake Muir, Darkan and Toodyay, east to Lake Barlee, Merredin, Broomehill, Mongup, Bremer Bay and Esperance, and on the Swan Coastal Plain from Gingin to Busselton (Roe 1836; Austin 1855; Gregory and Gregory 1884; Curr 1886;

[2] Whillock (1911b: 316) noted that this species occurred 'almost as far south as Mt. Barker...Though our coastal sand-hills would seem to present an attractive haunt to this species, I have only once met with it there. I refer, of course, to our south coast, east and west of Albany'. My interpretation of these remarks is that this species was only vagrant south of Mt Barker, and that it is unclear if the coastal record came from the area shown in Fig. 1.

[3] Lola Broadhurst, Albany WA.

[4] Ron Johnstone, Western Australian Museum, Perth WA.

[5] Dick Walker, Albany WA.

TABLE 1

Bird species recorded in the Denmark region at various times since 1889

Species	1889 Torbay (1)	1899 Denmark–Torbay (2)	1905 Torbay–Denmark–Wilson Inlet (3)	1905 Chorkerup (4)	1905–19 Denmark–Wilson Inlet–Torbay (5)	1980 Mitchell River area (6)	1986–99 Denmark–Wilson Inlet–Torbay (7)
LANDBIRDS							
Dromaius novaehollandiae		•			#	•	•
Coturnix novaezelandiae					•	•	•
C. ypsilophora			•		•		•
Pandion haliaetus					#		•
Elanus caeruleus							•
Hamirostra isura							•
Haliastur sphenurus						•	•
Accipiter fasciatus					•	•	•
A. cirrocephalus					•		•
Aquila morphnoides							•
A. audax						•	•
Haliaeetus leucogaster					•		•
Circus assimilis							•
C. approximans					•		•
Falco berigora					•	•	•
F. cenchroides						•	•
F. longipennis					•		•
F. peregrinus							•
Turnix varia					•	•	•
Burhinus grallarius					•		
Phaps chalcoptera					•		•
P. elegans					•	•	•
Ocyphaps lophotes							•
Calyptorhynchus banksii		•	•		•	•	•
C. baudinii		•	•		•	•	•
Cacatua roseicapilla							•
Glossopsitta porphyrocephala		•			•	•	•
Polytelis anthopeplus							•
Platycercus zonarius		•	•		•	•	•
P. spurius		•	•		•	•	•
P. icterotis		•	•		•	•	•
Neophema elegans					•	•	•
N. petrophila					•		•
Pezoporus wallicus					•		
Cuculus pallidus		•			#	•	•
Cacomantis flabelliformis		•			#		•
Chrysococcyx basalis					•		•
C. lucidus					•		•
N. novaeseelandiae		•					•
Tyto alba							•
Podargus strigoides					•	•	•
Aegotheles cristatus					•	•	•
Dacelo novaeguineae						•	•
Todiramphus sanctus				•	#		•
Merops ornatus							•
Atrichornis clamosus	•						
Climacteris rufa		•	•		•		•
Malurus splendens					•	•	•
M. elegans		•			•		•
Stipiturus malachurus				•	•		•
Pardalotus punctatus					•	•	•
P. striatus					•		•
Dasyornis longirostris					•		
Sericornis frontalis					•	•	•

TABLE 1 (continued)

Species	1889 Torbay (1)	1899 Denmark–Torbay (2)	1905 Torbay–Denmark–Wilson Inlet (3)	1905 Chorkerup (4)	1905–19 Denmark–Wilson Inlet–Torbay (5)	1980 Mitchell River area (6)	1986–99 Denmark–Wilson Inlet–Torbay (7)
Gerygone fusca		•			•		•
Acanthiza apicalis		•			•	•	•
A. inornata		•			•	•	•
A. chrysorrhoa		•		•	•	•	•
Lichmera indistincta					•	•	•
Meliphaga virescens					•		•
Melithreptus chloropsis		•		•	•	•	•
Phylidonyris novaehollandiae		•			•	•	•
P. melanops	•				•		•
Acanthorhynchus superciliosus	•	•			•	•	•
Anthochaera lunulata					•		•
A. carunculata					•	•	•
Epthianura albifrons					•		•
Petroica multicolor		•			•	•	•
Eopsaltria australis		•			•	•	•
E. georgiana	•				•	•	•
Pomatostomus superciliosus		•					•
Daphoenositta chrysoptera		•			•	•	•
Falcunculus frontatus					•		•
Pachycephala pectoralis		•	•		•	•	•
P. rufiventris					•	•	•
Colluricincla harmonica		•	•	•	•	•	•
Myiagra inquieta		•			•	•	•
Rhipidura fuliginosa		•		•	•	•	•
R. leucophrys					#	•	•
Grallina cyanoleuca						•	•
Coracina novaehollandiae		•			•	•	•
Lalage tricolor							•
Artamus cyanopterus				•	•	•	•
Cracticus torquatus							•
C. tibicen						•	•
Strepera versicolor		•		•	•	•	•
Corvus coronoides					#	•	•
Anthus australis					•	•	•
Stagonopleura oculata		•		•	•	•	•
Acrocephalus australis					•		•
Megalurus gramineus					•		•
Hirundo neoxena					#	•	•
H. nigricans		•			#		•
Cincloramphus cruralis					•		•
Zosterops lateralis		•			•	•	•
WATERBIRDS							
Oxyura australis			•				•
Biziura lobata			•				•
Cygnus atratus			•		•		•
Tadorna tadornoides					•		•
Chenonetta jubata							•
Anas gracilis							•
A. castanea							•
A. superciliosa			•			•	•
A. rhynchotis							•
Malacorhynchus membranaceus							•
Aythya australis							•
Tachybaptus novaehollandiae							•
Poliocephalus poliocephalus					•		•
Podiceps cristatus							•
Anhinga melanogaster							•

TABLE 1 (continued)

Species	1889 Torbay (1)	1899 Denmark–Torbay (2)	1905 Torbay–Denmark–Wilson Inlet (3)	1905 Chorkerup (4)	1905–19 Denmark–Wilson Inlet–Torbay (5)	1980 Mitchell River area (6)	1986–99 Denmark–Wilson Inlet–Torbay (7)
Phalacrocorax carbo			•				•
P. sulcirostris							•
P. melanoleucos					•	•	•
Pelecanus conspicillatus							•
Ardea pacifica							•
A. novaehollandiae						•	•
A. alba						•	•
A. garzetta							•
A. sacra							•
A. ibis							•
Nycticorax caledonicus					•		•
Ixobrychus minutus							•
I. flavicollis					•		
Botaurus poiciloptilus							•
Threskiornis aethiopicus							•
T. spinicollis							•
Platalea regia							•
P. flavipes							•
Gallirallus philippensis							•
Porzana pusilla					•		•
P. fluminea							•
P. tabuensis					•		•
Porphyrio porphyrio					•		•
Gallinula ventralis			•				•
G. tenebrosa							•
Fulica atra							•
Haematopus longirostris							•
H. fuliginosus							•
Himantopus himantopus							•
Cladorhynchus leucocephalus							•
Recurvirostra novaehollandiae							•
Vanellus tricolor							•
Charadrius ruficapillus					•		•
C. melanops							•
C. rubricollis					•		•
Erythrogonys cinctus							•
Sterna hybrida							•
SEABIRDS							
Eudyptula minor					•		•
Pterodroma macroptera					•		•
Puffinus carneipes							•
Phalacrocorax varius							•
Larus pacificus					•		•
L. novaehollandiae			•		•		•
Sterna caspia					•		•
S. bergii					•		•
S. nereis					•		•
WADERS (non-breeding visitors)							
Limosa limosa							•
L. lapponica					•		•
Numenius madagascariensis							•
Tringa stagnatilis							•
T. nebularia					•		•
T. glareola							•

TABLE 1 (continued)

Species	1889 Torbay (1)	1899 Denmark–Torbay (2)	1905 Torbay–Denmark–Wilson Inlet (3)	1905 Chorkerup (4)	1905–19 Denmark–Wilson Inlet–Torbay (5)	1980 Mitchell River area (6)	1986–99 Denmark–Wilson Inlet–Torbay (7)
T. hypoleucos					•		•
T. brevipes					•		•
Arenaria interpres							•
Calidris canutus							•
C. tenuirostris							•
C. alba							•
C. ruficollis					•		•
C. subminuta							•
C. acuminata					•		•
C. ferruginea					•		•
Limicola falcinellus							•
Pluvialis squatarola					•		•
P. fulva					•		•
P. dominica					•		•
Charadrius bicinctus					•		•
C. leschenaultii							•

(1) October 1889, based at Millar's Torbay karri timber mill. Campbell (1890, 1900).
(2) September – November 1899, 3 miles [*c.* 5 km] east of Denmark, Denmark, Denmark River, between Albany and Denmark. Hall (1902a, b).
(3) February–June 1905. Torbay, Denmark and Wilson Inlet. (Nicholls 1905).
(4) January 1905. Chorkerup. Ogilvie-Grant (1909).
(5) This paper. Contemporaneous records of species not collected by Whitlock but recorded in the Denmark region by Jackson and Carter are marked #
(6) Autumn 1980. Mitchell River *c.* 10–20 km inland from Wilson Inlet. Christensen *et al.* (1985).
(7) *Western Australian Bird Notes* No. 38 onwards (1986–99); Jaensch *et al.* (1988) for Grasmere Lake; EPA (1988) for Wilson Inlet; Storr (1991); WA Group RAOU (1994); Birds Australia WA Group (1999) (A. H. Burbidge, personal communication). Non-breeding seabirds have not been listed. The presence of *Hylacola cauta, Calamanthus fuliginosus, Microeca fascinans, Hirundo ariel* and *Cincloramphus mathewsi* requires confirmation before these species should be listed.

Taunton 1903; Bates unpublished[6]; North 1912; Abbott 1999). Outside the breeding season this species visited the coastal plain west of Point D'Entrecasteaux (Abbott 1999). There is no evidence, however, that this species was present near Wilson Inlet. Early observers noted that Western Long-billed corellas were most numerous 'not far from water' and 'on the best lands' (TWH 1833, p. 211) and that 'Where these birds are found, the traveller in the bush may generally rely upon finding water' (Moore 1884, p. 50). West of Albany this species should thus have occurred near the Denmark, Hay and Sleeman Rivers. Neither Wilson in December 1829 nor Barker in February 1830 mention the species there (Wilson 1835, pp. 236–271). Wilson, however, was clearly aware of the species as he provided the King George Sound Aboriginal name for 土*Maniet* (Wilson 1835, p. 322).

It seems likely that one species of waterbird, *Ixobrychus flavicollis* (Black bittern), is now extinct in the Denmark region. Some waterbird species now present in farm dams or pastures in the Denmark region did not occur or were only vagrant in the south-west in the early days of European settlement. These include *Chenonetta jubata* (Australian wood duck), *Malacorhynchus membranaceus* (Pink-eared duck), *Poliocephalus poliocephalus* (Hoary-headed grebe), *Podiceps cristatus* (Great crested grebe), *Ardea alba* (Great egret), *Threskiornis aethiopicus* (Sacred ibis), *T. spinicollis* (Straw-necked ibis), *Platalea regia* (Royal spoonbill), *P. flaviceps* (Yellow-billed spoonbill), *Gallirallus philippensis* (Buff-breasted rail), and *Gallinula tenebrosa* (Dusky moorhen).

Hall (1902b, p.168) mentions an apparent hearsay report of 'Wedge-tailed Petrels, *Puffinus chlororhynchus*' [now known as *P. pacificus*] nesting in November on 'a small island at the entrance to the Denmark River (Lake Wilson)...about 30 miles [48 km] from Denmark and about 20 miles [32 km] from Albany...'. Although the locational information provided is self-contradictory, Hall is evidently referring to a nesting population of *Puffinus carneipes* (Fleshy-footed shearwater) on Shelter [Muttonbird] Island and the adjacent mainland in Torbay (Storr 1991).

The list of visiting (non-breeding) waders should not be regarded as complete. One species, *Limosa limosa* (Black-tailed godwit), was not recorded in the South West Land Division until after Whitlock's era. Storr's (1991) claim that *Limosa lapponica* (Bar-tailed godwit) was not recorded in the South West Land Division until 1931 is incorrect as it overlooks a specimen collected by Whitlock in 1911.

Most of the remaining species not listed by Whitlock were probably simply missed because they were vagrants, irregular visitors, rare or highly localized residents, cryptic, or just too common or uninteresting to merit the trouble of collecting them. Judged by the paucity of museum specimens (see Table 1), Whitlock appears to have put little effort into collecting waterbirds. Perhaps he only collected waterbirds occurring on the wetland within 400 m of his residence.

[6] Aboriginal vocabularies collected under the authority of the Western Australian Government in 1904 for Daisy Bates, now lodged with her papers in the National Library of Australia, Canberra.

Changes in the environment since 1840

The Denmark region has experienced extensive anthropogenic change since 1907–19. The most dramatic has been deforestation in order to promote agricultural development (Fig. 1). Wildfires, caused by increased fuel loads following reduced Aboriginal fire management in the period 1860–90 as well as the clearing burns of the new settlers, should have become more frequent. The last full blood Aborigine in the Torbay and Denmark district died about 1909 (Bates 1985, p. 51), though until the 1920s a group of Aborigines from inland visited the coastal areas and burnt patches of vegetation (D. Wolfe[7] personal communication). The rabbit and red fox arrived from eastern Australia in *c.* 1926 and *c.* 1930 respectively (Long 1988). Logging commenced in State forest (shown in the north-west sector of Fig. 1) in the 1950s and has continued to the 1980s.

Europeans (the Young family) first settled the region in the 1840s, near the eastern edge of Wilson Inlet, apparently because there was no karri forest to clear there (Denmark Historical Society 1995). At first the rate of clearing was slow – a family took one year to deforest 5 acres [2 ha] (Conochie 1989). From the 1840s horses, cattle and sheep were grazed in the region. Graziers from Tenterden used the coastal part of the region (then a commonage but now reserved as national park) for the depasturing of cattle in summer, when the inland pastures dried off. Coastal areas received summer rainfall and thus offered nutritious feed. Graziers adjacent to the coast also grazed their sheep there briefly each summer, until the end of the 1960s (D. Coombe[8] personal communication). Graziers burnt the coastal vegetation after the first rains of autumn or in early spring, in patches of *c.* 50 ha, to provide green pick later in the year (D. Coombe, personal communication).

Although intense fires presumably escaped from the clearing burns as part of the agricultural development of the region, intense fires did occur before settlement, as evidenced by the following eyewitness accounts: 'the loftiest timbers had the topmost of their branches burned' near King George Sound in 1791 (Lamb 1984, p. 355); an extensive forest crownfire driven by a strong easterly wind on 1 February 1818 was visible from sea at night north of West Cape Howe (Hordern 1997, p. 68); and 'the fire spreads with astonishing rapidity, reaching to the highest branches and charring the trees all over, so you return from a walk in the bush completely blackened' (Quoy in October 1826 at King George Sound; see Rosenman 1987, p. 47).

Studies of Aboriginal burning in the period 1750–1829 in jarrah forest well to the west of Wilson Inlet indicate that only *c.* 5 per cent of all fires recurred once in 10 years (Ward and Van Didden 1997). Fires at this relatively low frequency (the lowest recorded) are presumed to have been the most intense. Most burning by Aborigines took place in January and February, whereas fires started by lightning peak in December (Appendix 3).

[7] Des Wolfe, Kronkup WA.
[8] Dennis Coombe, Kronkup WA.

Relevant here is the fact that in southern jarrah forest, the soil dryness index (SDI) first exceeds 1200 in mid December, whereas in karri forest, SDI first exceeds 1200 in February (Burrows 1987). Even above this threshold, however, a great variety of fire intensities is possible, with an 'extreme' fire danger rating (the highest) on 2 per cent of days. On 54 per cent of days the fire danger rating is either 'very low' or 'low' (Burrows 1987). A fire danger rating of 'moderate' occurred on 22 per cent of days and is considered to be ideal for prescribed burning for fuel reduction. Because the purpose of Aboriginal burning was not fuel reduction but capture of game, they may have set fires on days of 'high', 'very high' and 'extreme' fire danger: 24 per cent of days with SDI > 1200.

In October 1912 Jackson (unpublished diary) noted that the country near the Torbay railway line had 'changed considerably owing to settlement all about, and numerous bushfires year after year when selectors were clearing the land for cultivation'. Similar observations about extensive fires were recorded by Whitlock and Carter (see *Dasyornis longirostris* in the species list above). In February 1913 Jackson recorded that black peat swamps had been converted to 'fine crops of potatoes'. Hosking and Burvill (1938) provided detailed information about agricultural utilization west of Denmark; this appears generalizable to the area immediately east of Wilson Inlet. After the Great War agricultural activity increased further following release of land to soldier settlers (CALM 1995).

Figure 1 indicates that *c.* 60 per cent of the area mapped is not under public ownership via CALM. Recent aerial photographs (1:25 000) taken in colour in October 1997 or January 1998 reveal that *c.* 80 per cent of this non-CALM managed land has been cleared for agriculture, with most of the remnants of native vegetation small and widely separated. However, with the large area of State forest to the north-west, West Cape Howe National Park to the south, and the smaller Down and Lake Powell Nature Reserves to the east, the avifauna of the region appears to be secure from further habitat loss.

Given that intense fires occurred in the region before European settlement (as detailed above), how did the fire-sensitive species *Pezoporus wallicus, Atrichornis clamosus* and *Dasyornis longirostris* manage to persist until late last century or early this century? Several explanations appear possible. First, widespread Aboriginal use of fire should have restricted these species to refuges in higher rainfall areas naturally protected from frequent burning, namely vegetation along higher order streams (Abbott 1999, p. 71), vegetation on steep south-facing slopes (Abbott 1999, p. 23), and vegetation surrounded by large expanses of sheet rock (Smith 1977). Second, intense (crown-scorching) fires may have occurred sufficiently infrequently to allow recolonization of burnt habitat from unburnt patches. Third, all three species were known to Aborigines, as evidenced by their Noongar names having been recorded at Albany (Serventy and Whittell 1976). If these species had totemic significance, local Aborigines with custody of totemic sites may have burned around the habitats of these species with frequent, low intensity (early spring, late autumn or early winter) fires, much as Aborigines in Arnhem Land protect rainforest patches from destructive wildfires (Haynes 1991). Hammond (1933) refers to Aborigines in south-western Australia burning breaks around vegetation in order to secure the supply of berries, without specifying the locality.

Contemporary evidence of patch burning by Aborigines near King George Sound was first published by Nind (1831, p. 28), who noted 'The violence of the fire is frequently very great, and extends over many miles of country; but this is generally guarded against by their burning it in consecutive portions'. Patch burning was also recorded in a 274.5 cm x 18 cm hand coloured etching and aquatint of a panorama from Mt Clarence (Dale 1834) and by an eyewitness account in November 1840 (Stokes 1846, p. 228). There is a wealth of published and unpublished information (Appendix 1) describing patch burning at scales of *c.* 10–2000 ha, burning at the hottest time of the day, multiple ignitions on the same day, and burning under windy conditions.

Recent studies of the fire ecology of *Atrichornis clamosus, Dasyornis longirostris* and *Pezoporus wallicus* along the southern coast of WA confirm that frequent burning is detrimental to the long-term persistence of these species. *A. clamosus* requires a period of 4–10 years before vegetation is suitable for successful breeding (Smith 1985a). In wetter gullies this period is 4–6 years, whereas in drier areas up to 10 years is needed before regeneration is suitable (Smith 1985b). Heath may become suitable (*c.* 1–1.5 m tall) for *D. longirostris* 3 years after fire in higher rainfall areas, whereas in drier areas it may take 5–10 years (Smith 1985a; McNee and Newbey 1998). *P. wallicus* appears to be able to utilize heath *c.* 0.5 m tall (in drier areas) 7 years after fire (Burbidge 1998). It needs to be emphasized that these rates of recolonization would be reduced if source populations were distant from recently burnt areas. Clearly, given the widespread use of fire made by Aborigines at the hottest time of the year, the conjunction of suitable vegetation next to a source population is considered unlikely to have been satisfied, except in sites naturally protected from frequent burning.

FURTHER RESEARCH

Because the Denmark region of south-west WA has an historically well documented avifauna, relative to other parts of WA, this baseline information could be used to monitor ongoing environmental change. Current ornithological activity there could be focused on developing a regional atlas showing the location of all records of bird species once every 10 years. A small subset of species selected as indicators of environmental change could be monitored annually.

ACKNOWLEDGEMENTS

I am most grateful to Mary LeCroy (American Museum of Natural History, New York), Rory O'Brien (Museum of Victoria, Melbourne), Walter Boles (Australian Museum, Sydney) and Ron Johnstone (Western Australian Museum,

Perth) for so readily supplying details of material collected by Whitlock and lodged in these institutions. I also thank Allan Burbidge (CALM) and Tina Smith (Denmark) for providing modern bird lists for Denmark region, Lola Broadhurst (Albany) and Dick Walker (Albany) for advice about the local status of some species, Dennis Coombe and Des Wolfe of Kronkup for information about land use, Melissa Robinson (CALM) for preparing the map, Allan Wills (CALM) for compiling the graphs, Andy Cottier (Art Gallery of Western Australia) for allowing me to view Dale's panorama, Allan Burbidge for commenting on a draft, Neil Burrows, Lachlan McCaw, Rick Sneeuwjagt and David Ward for checking my interpretation of the data presented in Appendix 1, and John Vodopier (CALM*fire*) for providing official statistics about lightning-caused fires.

REFERENCES

Abbott, I. (1998). Avifauna of the Irwin Inlet-Broke Inlet-Mt Frankland region of south-west Western Australia, 1912–1913. *CALMScience* **2**, 373–386.

Abbott, I. (1999). The avifauna of the forests of south-west Western Australia: Changes in species composition, distribution, and abundance following anthropogenic disturbance. *CALMScience* Supplement **5**, 1–175.

Austin, R. (1855). *Journal of...Expedition...to explore the Interior of Western Australia, North and East of the Settled Districts...* Government Printer, Perth.

Bates, D. (ed. White, I.) (1985). *The Native Tribes of Western Australia*. National Library of Australia, Canberra.

Beard, J. S. (1979). *The Vegetation of the Albany and Mt. Barker areas Western Australia*. Vegmap Publications, Perth.

Birds Australia WA Group (1999). Database of Western Australian Birds. Extract. Birds of the Denmark-Torbay area. Perth.

Bradshaw, F. J. and Rayner, M. E. (1997). Age structure of the karri forest: 1. Defining and mapping structural developmental stages. *Australian Forestry* **60**, 178–187.

Bradshaw, F. J., Collins, P. M. and McNamara, P. J. (1997). Forest mapping in the south west of Western Australia. Department of Conservation and Land Management, Como.

Burbidge, A. (1998). Possible effects of recent fires on Western ground parrots. *Eclectus* **4**, 15–16.

Burbidge, A. H., Blyth, J., Danks, A., Gillen, K. and Newbey, B. (1997). Western Ground Parrot Interim Recovery Plan 1996 to 1999. Department of Conservation and Land Management, Como.

Burrows, N. D. (1987). The soil dryness index for use in fire control in the south-west of Western Australia. Department of Conservation and Land Management *Technical Report* **17**.

CALM (1995). West Cape Howe National Park Management Plan 1995–2005. Department of Conservation and Land Management, Como.

Campbell, A. J. (1890). A naturalist in Western Australia, Part II: Around Albany. *The Australasian* [newspaper], Melbourne. March 8, p. 492.

Campbell, A. J. (1900). *Nests and Eggs of Australian Birds*. Author, Sheffield.

Campbell, A. J. (1928). The ornithology of H. L. White. *Emu* **27**, 198–200.

Carter, T. (1920). On some Western Australian birds collected between the North-West Cape and Albany (950 miles apart). *Ibis* **2** (series 11), 679–719; **3**, 48–81.

Carter, T. (1923). Birds of the Broome Hill district. *Emu* **23**, 125–142, 223–235, 306–318.

Christensen, P., Annels, A., Liddelow, G. and Skinner, P. (1985). Vertebrate fauna in the southern forests of Western Australia: a survey. Forests Department of Western Australia, *Bulletin* **94**.

Churchward, H. M., McArthur, W. M., Sewell, P. L. and Bartle, G. A. (1988). Landforms and soils of the south coast and hinterland, Western Australia: Northcliffe to Manypeaks. CSIRO Division of Water Resources, *Divisional Report* 88/1.

Clark, D. (transl. & ed.) (1994). *Baron Charles von Hügel New Holland Journal November 1833–October 1834*. Melbourne University Press, Melbourne.

Conochie, I. (1989). *Denmark: An Outline History*. 2nd edn. Denmark Historical Society, Denmark, Western Australia.

Cullity, M. (1979). *A History of Dairying in Western Australia*. University of Western Australia Press, Nedlands.

Curr, E. M. (1886). *The Australian Race...* Volume 1. Government Printer, Melbourne.

Dale, R. (1834). *Descriptive Account of the Panoramic View, &c. of King George's Sound and the Adjacent Country*. Cross, London.

Denmark Historical Society Inc.(1995). Selections from Denmark's First Century 1895–1995. *Koorabup* No. 21.

EPA (1988). Estuaries and coastal lagoons of South Western Australia: Wilson Inlet. Irwin Inlet, Parry Inlet. Estuaries of the Denmark Shire, Estuarine Studies Series No. 3. Environmental Protection Authority, Perth.

Greenway, J. C. (1978). Type specimens of birds in the American Museum of Natural History. *Bulletin of the American Museum of Natural History* **161**, 1–306.

Gregory, A. C. and Gregory, F. T. (1884). *Journals of Australian Explorations*. Government Printer, Brisbane.

Gunzburg, A. and Austin, J. (1997). *Rails through the Bush: Timber and Firewood Tramways and Railway Contractors of Western Australia*. Light Railway Research Society of Australia, Melbourne.

Hall, R. (1902a). On a collection of birds from Western Australia. *Ibis* **8** (series 2), 121–206.

Hall, R. (1902b). Among the birds of Western Australia. *Victorian Naturalist* **18**, 164–168, 175–181.

Hallam, S. J. (1975). *Fire and Hearth: A Study of Aboriginal Usage and European Usurpation in South-western Australia*. Australian Institute of Aboriginal Studies, Canberra.

Hammond, J. E. (1933). *Winjan's People: The Story of the South-West Australian Aborigines*. Imperial Printing Co., Perth.

Haynes, C. D. (1991). Use and impact of fire. In *Monsoonal Australia: Landscape, Ecology and Man in the northern Lowlands* (eds C.D. Haynes, M.G. Ridpath and M.A.J. Williams), pp. 61–71. Balkema, Rotterdam.

Hordern, M. (1997). *King of the Australian Coast: The Work of Phillip Parker King in the Mermaid and Bathurst 1817–1822*. Miegunyah Press, Melbourne.

Hosking, J. S. and Burvill, G. H. (1938). A soil survey of part of the Denmark Estate, Western Australia. Council for Scientific and Industrial Research, *Bulletin* No. 115.

Jackson, S. W. (1912–13). Unpublished diary of a visit to South-west Western Australia. Photocopy lodged in CALM Library, Woodvale.

Jaensch, R. P., Vervest, R. M. and Hewish, M. J. (1988). Waterbirds in nature reserves of South-Western Australia 1981–1985. *RAOU Report* No. 30.

Johnstone, R. E. (in press). Checklist of the Birds of Western Australia. *Records of the Western Australian Museum, Supplement*.

Lamb, W. K. (ed.) (1984). *George Vancouver: A Voyage of Discovery to the north Pacific Ocean and round the World 1791–1795*. Volume 1. Hakluyt Society, London.

Long, J. L. (1988). Introduced birds and mammals in Western Australia 2nd edn. Agriculture Protection Board of Western Australia, Technical Series 1, Perth.

McNee, S. A. and Newbey, B. J. (1998). Western bristlebird survey 1998: Fitzgerald River National Park. Unpublished report; copy held in CALM library, Woodvale.

Moore, G. F. (1884). Descriptive Vocabulary. In *Diary of Ten Years Eventful Life of an Early Settler in Western Australia*... Walbrook, London.

Mulvaney, J. and Green, N. (1992). *Commandant of Solitude: The Journals of Captain Collet Barker 1828–1831*. Melbourne University Press, Melbourne.

Nicholls, E. B. (1905). A trip to the west. *Emu* **5**, 78–82.

Nind, S. (1831). Description of the natives of King George's Sound (Swan River Colony) and adjoining country. *Journal of the Royal Geographical Society London* **1**, 21–51.

North, A. J. (1912). *Nests and Eggs of Birds found breeding in Australia and Tasmania*. Volume 3. F.W. White, Sydney.

Ogilvie-Grant, W. R. (1909). On a collection of birds from Western Australia. *Ibis* **3** (series 3), 650–689.

Roe, J.S. (1836). Journal of the explorations eastward of York to Welcome Hill, and thence to Lake Brown, Wongan Hills, Moore River and Upper Swan. Typescript copy, Battye Library, Perth.

Rosenman, H. (1987). *An Account in two volumes of Two Voyages to the South Seas by ... Dumont D'Urville ...* Volume 1. Melbourne University Press, Melbourne.

Serventy, D.L. (1926). Birds of Pallinup Estuary, Western Australia. *Emu* **26**, 64–69.

Serventy, D. L. and Whittell, H. M. (1976). *Birds of Western Australia*. University of Western Australia Press, Nedlands.

Smith, G. T. (1977). The effect of environmental change on six rare birds. *Emu* **77**, 173–179.

Smith, G. T. (1985a). Fire effects on populations of the Noisy scrub-bird *(Atrichornis clamosa)*, Western bristle-bird *(Dasyornis longirostris)* and Western whip-bird *(Psophodes nigrogularis)*. In *Fire Ecology and Management in Western Australian Ecosystems* (ed. J.R. Ford), pp. 95–102. Western Australian Institute of Technology, Perth.

Smith, G. T. (1985b). The Noisy scrub-bird *Atrichornis clamosus*: Does its past suggest a future? In *Birds of Eucalypt Forests and Woodlands: Ecology, Conservation, Management* (ed. A. Keast, H.F. Recher, H. Ford and D. Saunders), pp. 301–308. RAOU/Surrey Beatty, Sydney.

Stokes, J. L. (1846). *Discoveries in Australia; with an Account of the Coasts and Rivers Explored and Surveyed during the Voyage of H.M.S. Beagle, in the Years 1837-38-39-40-41-42-43...* Volume 2. Boone, London.

Storr, G. M. (1991). Birds of the South-West Division of Western Australia. *Records of the Western Australian Museum*, Supplement **35**.

Taunton, H. (1903). *Australind: Wanderings in Western Australia and the Malay East*. Edward Arnold, London.

TWH (1833). Journal of an expedition over General Darling's Range, 100 miles east from Swan River. Pp. 207–221 in Cross, J. (comp.) (1833). *Journals of several Expeditions made in Western Australia, during the years 1829, 1830, 1831, and 1832*...Cross, London.

WA Group RAOU (Royal Australasian Ornithologists Union) (1994). Birdwatching around Denmark [brochure] and Denmark district bird list [brochure]. Privately Published, Perth.

Ward, D. and Van Didden, G. (1997). Reconstructing the fire history of the jarrah forest of south-western Australia. Report prepared for the WA Regional Forest Agreement.

Watkins, D. (1985). Report on the RAOU ground parrot survey in Western Australia. *RAOU Report* **15.**

Whitley, G. P. (1971). Field notes on birds by Thomas Carter. *Western Australian Naturalist* **12**, 41–44.

Whitlock, F. L. (1911a). Nesting site of pardalote. *Emu* **10**, 340.

Whitlock, F. L. (1911b). In the Stirling Ranges, Western Australia. *Emu* **10**, 305–317.

Whitlock, F. L. (1912). Notes on Megalurus striatus (Milligan). *Emu* **11**, 244–245.

Whitlock, F. (1914). Notes on the Spotless crake and Western ground-parrot. *Emu* **13**, 202–205.

Whitlock, F. L. (1926). Cormorants in the north of Western Australia. *Emu* **25**, 223.

Whitlock, F. L. (1936). Field notes on the Western bristle-bird *(Dasyornis longirostris). Emu* **35**, 199–201.

Whittell, H. M. (1940). Frederick Lawson Whitlock. *Emu* **39**, 279–286.

Whittell, H. M. (1954). *The Literature of Australian Birds: A History and a Bibliography of Australian Ornithology*. Paterson Brokensha, Perth.

Wilson, T. B. (1835). *Narrative of a Voyage round the World*... Sherwood, Gilbert & Piper, London.

APPENDIX 1

Summary of remarks about Aboriginal usage of fire near King George Sound in the period 1791 to 1840.

Note: KGS = King George Sound; PRH = Princess Royal Harbour. Any mis-spellings are as in the original documents. Explanatory interpolations by me are indicated by brackets and omissions of irrelevant material are indicated by the conventional ellipsis dots.

REMARKS	IMPLICATION	REFERENCE
Vancouver **27 September – 11 October 1791**		
'...we could no where perceive any smoke' [between Point Nuyts and Irwin Inlet]	No burning by Aborigines in September or October (frequent rains before or during this period would prevent burning)	Lamb 1984, vol. 1, p. 334
'...the vegetation had recently undergone the action of fire; the largest of the trees had been burnt, though slightly; every shrub had some of its branches completely charred; and the plants lying close to the ground had not escaped without injury' [western shore of KGS].	Burning in previous summer Partial crown scorch indicative of low intensity fire	p. 336
'This spot was intersected with several small streams of water, yet the same marks of fire were evident on all the vegetable kingdom... this general fire was of a less recent date...' [south-west shore of PRH].	Riparian areas burnt, but not in previous summer	p. 339
'...the same effects of fire were evident' [between Oyster Harbour and Mt Gardner]	Extensive burning	p. 341
'...nor were any smokes to be seen over the extensive country we beheld' [Kalgan R]	No burning by Aborigines in September/ October in drier sector of region	p. 353
'The larger trees in the vicinity of both villages had been hollowed out by fire...'	Some past fires intense (e.g. one intense fire preceded or followed by many low intensity fires)	p. 355
'...the very extraordinary devastation by fire, which the vegetable productions had suffered throughout the whole country we had traversed'.	Extensive burning in dry season	p. 355
'...in our excursion on Shore, we did not see a spot that produced any vegetables [plants], which had not visibly felt its [fire's] effects. Where the country was well wooded, the loftiest timbers had the topmost of their branches burned.'	Aboriginal burning extensive and sufficiently intense to scorch crowns of forest trees	p. 355
Menzies **27 September – 11 October 1791**		
'...the place [near Point Possession] had been recently burnt down here & there, particularly about the stems of the Gum Plant *[Xanthorrhoea preissii]* which bore its marks more than any other'	Patch burning in previous summer	Menzies 1791, folio 44
'There were but few places [Flinders Peninsula] I travelled over this day but which bore evident marks of having been set on fire, especially round the stems of the Gum plants over all the low ground but those near the top of the hills had escapd the general conflagration'	Spatially extensive burning; hill tops (?with expanses of granite rock) not recently burnt	Folio 46

'We traced this brook [bay near Gull Rock] some way up the valley from which it issued a task of no little labor on account of the density and luxuriancy of its crop of brush wood & long grass which made it difficult to penetrate'	Riparian habitat not recently burnt (depending on soil and moisture, *perhaps* burnt 3–4 years previously given the presence of thick grass)	Folios 46–47
'...covered with a variety of low and shrubby vegetables [plants] but by no means so thick as made it any ways difficult to travel through. After this...some swampy ground with long grass but interspersed with scrubby trees much weather beat which obligd us to descend to the sea side & pursue our course' [east of Oyster Harbour]	Vegetation recently burnt [indicated by easy walking], except on swampy ground (thickets) [difficult walking]	Folio 47
'...for travelling now appears more difficult if not wholly impracticable for the country along there [coast east of Oyster Harbour] being so thickly covered with underwood & scattered over with trees'	Patch of vegetation not recently burnt	Folio 48
'...the difficulties we encountered in penetrating the woods [*c.* 1 mile east of entrance to Oyster Harbour] in many places on account of their density'	Ditto	Folio 49
'...though trees & bushes were scattered over it, yet they were not apparently so thick as to form any obstruction to our investigation' [north-east shore of Oyster Harbour]	Recently burnt vegetation [indicated by easy walking]	Folio 50
'...entered a very thick wood not easily penetrated' [Kalgan R]	Riparian vegetation not recently burnt	Folio 50
'...we wandered over meadows & pastures whose crop of grass reached up to our middles' [north shore of Oyster Harbour]	Vegetation not burnt previous summer	Folio 50
'...the interior part of it [Mistaken Island, occasionally accessible on foot from mainland] had been lately burnt down but the skirts of it were covered with a luxuriant crop of grass'	Grass an indication of absence of fire in the pevious summer	Folio 51
'Many of the stems of the trees bore evident marks of fire, some were even hollowed out by it' [south side of PRH]	Signs of extensive burning, some intense enough to have caused hollow butts	Folio 53
'...a thick wood chiefly composed of the Eucalyptus obliqua *[E. marginata]*...without any underwood to obstruct our progress...and many of [these trees] had the marks of fire round their bottoms' [Kalgan R]	Recently burnt forest	Folio 54
'...we seldom met these trees or the other gum plants any where about the Sound without observing their stems burnt or scorchd with fire'	Most of the landscape showing evidence of having been burnt	Folio 54
'...it was strewed over with scrubby bushes & small shrubs which however were not so thick as to impede us much in our progress' [south side of PRH]	Vegetation opened up by recent fire, as indicated by easy walking	Folio 56
'Several places about this village [a collection of aboriginal huts] seemd to have been very recently burnt down & destroyd by fire, many of the larger trees had been scorchd by it' [south side PRH]	Recent fire sufficiently intense to have scorched crowns of tall trees	Folio 57

'...the general conflagration of the country'	Widespread use of fire	Folio 61
'...why should we meet so frequently the Gum plant & Eucalyptus obliqua with the appearance of fire round their stems'	Blackened stems frequent, indicating spatially extensive use of fire	Folio 61
'The frequent marks of fire & general burnt state of the country every where around the Sound'	Spatially extensive fire	Folio 61
'...they [Aborigines] make frequent fires round the plants...& when these happen to be kindled any wise among rank grass & bushes in a dry season it is easy to conceive in a climate like this with what rapidity & devastation it spreads over a considerable tract until its progress is interrupted by some intervening cause'	Hypothesis linking Aborigines and climate to the extensive signs seen of fire	Folios 62–63
Flinders **8 December 1801 – 5 January 1802**		
'the first smoke seen upon this coast' [near Point Irwin, travelling east from Cape Leeuwin]	Burning in early summer	Flinders 1814, vol. 1, p. 52
'Marks of the country being inhabited were found everywhere' [eastern shore of PRH]	Extensive recent burning by Aborigines	p. 57
'Some smokes...perceived at the head of the harbour' [north-west shore of PRH]	Burning in summer	p. 57
Good **8 December 1801 – 5 January 1802**		
'...we found it very troublesome walking... in thick brush wood and long grass 5 or 6 feet high' [Kalgan R]	Riparian zone not recently burnt	Edwards 1981, p. 49
'...we traced this River [near Torbay] a considerable time walking among large Trees and excessive brush wood 5 or 6 feet high with frequent Morasses'	Riparian zone not recently burnt (?burnt 3–4 or more years previously)	p. 50
Baudin & Freycinet **13 February – 1 March 1803**		
'From where we were on the hills [near Oyster Harbour] we had seen some very dense smoke, but it was too far away'	Aboriginal burning in late summer	Cornell 1974, p. 486
'Everywhere we went [banks of Kalgan R] we saw traces of fire'	Aboriginal burning extensive; not even riparian vegetation escaping firing	p. 487
'At the foot of a high range of inland mountains running from North to South [Porongurup Range], we saw many separate columns of smoke'	Extensive burning in late summer, with numerous individual fires	p. 487
'During the afternoon we saw several columns of smoke' [mainland north of Eclipse Island]	Burning at hottest part of the day in late summer	p. 495
'...et les végétaux si multipliés sur ses bords [of the Kalgan R], qu'il étoit presque impossible de la remonter plus avant'	Some riparian thickets not recently burnt	Péron & Freycinet 1816, vol. 2, pp. 151–152

Cunningham
20 January – 1 February 1818

'Several new Smokes, issuing from the woods, above the Trees, indicate the presence of natives…'	Burning in summer	Cunningham 1818, folio 235 (26 January)
'The Natives who (from their fires) appear to be all around us…we observed this aftn. their fresh fires, lighted among the Trees, near the Beach…'	Burning in hottest part of the day in late summer	Folio 235 (27 January)
'…the whole Side of the Harbour [PRH] being recently fired by Natives…Ascending to the Highest Point of the Hill, through a considerable tract of Burnt…Brushwood…'	Scale of burning ?50–100 ha	Folio 273 (31 January)
'The Hills overlooking those, of the Immediate Coast [west of KGS] were one grand blaze of Fire; having been kindled by the aborigines. Its running course before the wind, illuminating all around these [?sterile] Elevations, had a brilliant Effect [observation made at night from ship]	Scale of burning ?many hundreds of hectares. Fire at night.	Folio 238 (1 February)

King
23 December 1821 – 6 January 1822

'The stem of the *casuarina*, on which the [HMS] Mermaid's name and date of our visit had been carved, was almost destroyed by fire'	Area burned since February 1818 [i.e. within the previous 3 years]	King 1827, vol. 2, p. 123

Cunningham
23 December 1821 – 6 January 1822

Nine aborigines on rocks of the south point of the entrance to PRH [Point Possession] 'having fired the thick brushwood about them on the declivities of the Hill…'	Scale of burning ?tens of hectares	Cunningham 1821, folio 199 (24 December)
'…the smokes of several families of Natives being remark'd at the foot of the Range' [west of Oyster Harbour]	Multiple ignitions	Folio 203 (26 December)

D'Urville, Quoy & Gaimard
7 – 25 October 1826

The aborigines 'carry these burning [Banksia] cones everywhere with them…mak[ing] use of their cones to set fire to the undergrowth and the dry grass as they pass through. In general, this is what makes these…forests so open and easy of access'. [d'Urville]	Source of ignition always readily available Little undergrowth present as a result of frequent burning	Rosenman 1987, p. 30
[On the left bank of the Kalgan R c. 8 km north of its confluence with Oyster Harbour] 'the ground is thickly covered with undergrowth and especially by tall ferns with interlacing branches that completely obstruct your passage'. 'On the right-hand side of the river the bush is criss-crossed by narrow well-beaten paths'. [d'Urville]	Riparian area not recently burnt	p. 36
They also use [smouldering dry Banksia cones] to quickly set alight to the area through which they are passing and mostly, it seems, for no reason at all; they do this with a nimbleness and speed	Source of ignition always available Fires started casually	pp. 43–44

that we would be hard put to emulate. So this whole stretch of country is so burned that one cannot walk anywhere without getting black all over. The tall trees are charred right up to their tips, while the undergrowth is dead and only straggly stalks are left' [Quoy & Gaimard]	Undergrowth extensively burnt Complete crown scorch (and thus moderate intensity fire) not unusual	
'The forests appear to have only eucalypts, several of which are enormous, but all appear to be suffering to some extent from the native habit of starting fires wherever they pass through. And as nearly all these trees are resinous...the fire spreads with astonishing rapidity, reaching to the highest branches and charring the tree all over, so you return from a walk in the bush completely blackened' [Quoy]	Extensive burning Complete crown scorch not unusual Undergrowth extensively burned	p. 47
[The Aborigines] 'manifested their presence in the usual way, by setting alight to the undergrowth' [Quoy]	Eyewitness evidence of burning in spring	p. 48

Lockyer
25 December 1826 – 3 April 1827

'a large fire was now burning at the head of the Harbour [PRH], and shortly after we saw a very large smoke about ten miles [16 km] on the Hills to the South west' [22 January, near Torbay]	Burning in summer On one day in midsummer, two large fires visible	Lockyer 1827, p. 465
'Yesterday was counted twelve large smokes or fires at the back of the encampment [between Mt Melville and Mt Clarence] about two miles apart, forming a complete semicircle' [22 January]	Spatially extensive burning on one day in midsummer	p. 471
'The Natives keep up a large smoke in the Country round us from Mount Gardner to West Cape Howe, and from the number of Fires, if we may be allowed to judge from that, the Country must be very numerously peopled' [28 January]	Daily burning in midsummer extensive at regional scale	p. 493
'Made a course due North through the Country [near Kalgan R]...walking is not at all difficult through the Country' [13 February]	Burning spatially extensive and recent	p. 495

Nind
25 December 1826 – October 1829

'Every individual of the tribe, when travelling or going to a distance from their encampment, carries a fire-stick, for the purpose of kindling fires'	Ready availability of source of ignition	Nind 1831, p. 26
'...the presence of the owner of the ground is considered necessary when they fire the country for game'	Evidence of tenural basis for use of fire	p. 28
[In summer] '...they procure the greatest abundance of game. It is done by setting fire to the underwood and grass, which being dry, is rapidly burnt'	Summer burning to capture large animal food	p. 28
'The violence of the fire is frequently very great, and extends over many miles of country; but this is generally guarded against by their burning it in consecutive portions'	Fire often intense, and spatially extensive, with scale of patchiness apparently tens to hundreds, possibly one to two thousands, of hectares; indication of a deliberate and planned operation, creating a mosaic of pyric vegetation succession	p. 28

'larger firings for kangaroos, or walloby'	Extensive battues to drive large mammals towards slaughtering points	p. 28
'About Christmas they commence firing the country for game'	Summer burning the norm	p. 36
[Women] 'carry a fire-stick...and, in the burning season, set fire to the ground by themselves'	Capture of small animals (lizards, snakes, small mammals) involving localized patch burns in summer	pp. 36–37

Barker
3 December 1829 – 26 March 1831

'Kangaroo...killed by the fires' (22 January 1830)	Using fire to capture mobile animals	Mulvaney & Green 1992, p. 250
'Bad walking for an hour through unburnt wood' (c. 4 hours' walking west of Albany, north of Torbay Inlet, 3 February 1830)	Existence of sizeable unburnt vegetation patch, not recently burnt, in wetter country	p. 255
'...walking through the thick brush' [east of Wilson Inlet, 4 February 1830]	Ditto	p. 255
'smoke 154°' [SSE from mouth of Sleeman R, no distance stated, 4 February 1830]	One fire, late morning in summer	p. 256
'Very thick brush (Wattle, etc)' [north of junction of Hay R with Wilson Inlet, 4 February 1830]	Karri forest not recently burnt	p. 257
'very good ground burnt' [*c.* 5 km north of Wilson Inlet near Denmark R, 6 February 1830]	Recent fire	p. 260
'Very thick underwood on both banks [of Denmark R, south of Mt Lindesay]' (February 1830)	Riparian zone in karri forest not recently burnt (?burnt 4–15 years previously	p. 260
'Blacks burn for Wallabi' [several km SE of Mt Lindesay, noon, 7 February 1830]	Burning at midday	p. 262
'Brush on the left' [near Hay R, 8 February 1830]	Patch of vegetation not recently burnt	p. 272
'thick brush' [near entrance to Oyster Harbour, 25 February 1830]	Ditto	p. 266
'Wood was so thick near the rivulet it was difficult to get to it [karri forest at Big Grove on south shore of PRH, 10 March 1830]	Riparian vegetation not recently burnt	p. 272
'Examined the wood [karri forest at Big Grove]... but it is very difficult to get through from the thickness of the underwood' (March 1830)	Isolated patch of karri forest not recently burnt	p. 276
Aborigines 'intended firing the bush on the opposite side [of PRH]' (11 April 1830). 'It is their fire we see...near the top of a hill' (14 April)	Autumn burning	p. 280
'Large fires last night & today' (14 April 1830)	Spatially extensive burning at night, in autumn	p. 281
'Steep & difficult from the precipitous rocks and thick bush between them with accumulation of dead wood...Descended by the valley very slowly in consequence of the thick brush' [Michaelmas Island, May 1830, not accessible to Aborigines]	Long unburnt vegetation virtually impenetrable	p. 290
Aborigines 'are unable to kindle [fire] at this time of year [August 1830] & if their fire goes out,	Burning in winter unlikely (or very patchy)	p. 321

must go without till they are lucky enough to meet with it from their friends'		
[Yanungup, an island in the Kalgan R] 'Not being accessable to the natives, it was unburnt... vegetation was luxuriant' (12 November 1830)	Burned country the norm in this district	p. 353
'Their fires seen by me yesterday [southern side of Porongurup Range, 2 January 1831]	Several fires on one day in summer	p. 377
Aborigines set off to the bush to burn for wallaby, 'which they begin on the grand scale tomorrow' (4 January 1831)	Extensive summer burning the norm	p. 378
'Much burning in different parts. One fire on the top of a mount under Mount Gardener' (7 January 1831)	Extensive burning in summer. No position in the landscape exempt from burning	pp. 378–379
'No Wallabi had yet been taken in their burning, only some Paddy melons' [?quokkas, near Undiup, west of Torbay Inlet, 10 January 1831]	Burning to capture game	p. 379
'...men who were burning for Wallabi' [10 January 1831]	Ditto	p. 380
Aborigines planned 'to burn for Wallabi at Bald Head' (13 January 1831)	Summer burning	p. 382
'Large fires...on M.S. hill' [Quarantine Hill on Vancouver Peninsula, 19 January 1831]	Spatially extensive burning	p. 385
'A large fire at Narinyup about noon...afterwards... there appeared a smoke near the sawyer's wood [Big Grove].' 'Fires brilliant at night on hill' (21 & 22 January 1831)	Burning late morning, afternoon, and into the night	p. 386
'Great fires at Bald Head' (23 January 1831)	Spatially extensive burning on Flinders Peninsula	p. 387
'thick bush' [along coast between Pt Nuyts and KGS]'	Extensive tract of vegetation not recently burnt	p. 393
'He pointed out their fires (smoke) at Oongarup & Copongerup, on this side of the Right hand part of the Porongerup range' (13 February 1831)	Several fires visible on one day late in summer	p. 399
'Abundance of smoke in the line of King's river & beyond...some at a very great distance towards Oorangaddak' (17 February 1831)	Several fires visible on one day in summer	p. 401
'Numerous fires near Porrongerup' (27 February 1831)	Extensive burning in late summer	p. 404
Collie **March 1831 – ?November 1832**		
'I am not aware that any race of savages is so dependent on fire for their existence... as that of this part of New Holland'	Importance of fire in Aboriginal ecology (sustenance)	Collie 1834 (p. 71 of Green 1979)
'In December, but more particularly in January and February, the natives burn large tracts of country to catch wallabee, or bush kangaroo. For this purpose they generally go in considerable numbers and select a fine and warm day, and, having fired a portion of thick	Most burning in mid and late summer Deliberate burning on dry, hot days	Collie 1834 (pp. 85–86 of Green 1979)

scrub or grass where they know these animals live, they watch their being driven out by fire... As the fire when once lighted cannot be extinguished... The fires when thus lighted generally proceed spreading and consuming everything in their progress, and before the coldness and dew of the night repress their fury or intervening barren spots stop their rage, overrun some square miles of surface, and exhibit a splendidly bright spectacle amid the gloom and darkness of the night'	No Aboriginal means of putting fires out, although Aborigines would doubtless have been aware that fires extinguish themselves at night. Therefore fires spatially extensive (?500 ha) until they run into previously burnt country or weather conditions change so as no longer conducive to further spread	
'The native season of *Mondyeunung* is succeeded by *Peerruck* which continues till about the 20th March, and in which the burning of the country is most general'	Less burning in mid and late autumn	Collie 1834, (p. 86 of Green 1979)
Collie **April – May 1831**		
'...fires, with which the natives seem to have repeatedly consumed the vegetable productions' [*c.* 9 km along Kalgan R from its junction with Oyster Harbour]	Summer or autumn burning	Collie 1831, p. 135
'...tall shrubs, now burnt' [Kalgan R near Kamballup]	Summer or autumn burning	p. 140
'...shrubs, in many parts burnt' [wandoo woodland *c.* 4 km from Kalgan R]	Summer or autumn burning	p. 141
'Fire had recently gone over its surface' [wattle scrub, south of Stirling Range]	Summer or autumn burning	p. 144
Dale **January 1832**		
'Towards the sea-coast, the country was mountainous, but the native fires in that quarter materially obstructed our view' [from summit of Toolbrunup, Stirling Range]	Extensive burning close to coast on one day in summer (panoramic overview)	Dale 1832, pp. 164–165
'The fires, which are periodically spread over vast tracts of the country for the purpose of driving objects of chase from their fastnesses'	Spatially extensive burning at landscape scales	Dale 1834, p. 13
'...the natives having at that season [summer] set fire to the country around for many miles'	Areas burnt of at least ?2000 ha	p. 14
Smoke and flames of four fires (and two aboriginal camp fires) depicted	Burning of multiple fires during an easterly wind	Etching and aquatint of panoramic view from Mt Clarence (Dale 1834). Panels 1,2,5,10 and 11 of the black and white reproduction in Hallam 1975
The fire north-east near the Kalgan R has more obvious flames than the fire close to Mt Clarence	Spatial variation in fire intensity, reflecting mosaic of fuel ages	Panel 1
Of the 36 aborigines depicted on the summit of Mt Clarence, one has a firestick	Portable source of ignition available	Panel 8

Individual plants of *Kingia australis*, *Xanthorrhoea preissii* and *Macrozamia riedlei* on summit of Mt Clarence flowering	Vegetation burned previous summer. No part of landscape exempt from burning [Note: Dale has evidently used some artistic licence, as panel 11 shows a Numbat *Myrmecobius fasciatus*, a species that did not occur near KGS. The drawing is clearly from memory as the tail is incorrect. Dale was the first European to discover this species, near present day Beverley in October 1831]	Panels 1–8, 10, 11
Portions of the vegetation are coloured brown, in contrast to adjoining and intervening parts which are tinted green (not recently burnt)	Recent burning in sections, with estimated areas of 70 ha and 200 ha	Panels 10 and 11
Collie **February 1832**		
'I looked in vain for some hill in the vicinity of the Sound [KGS]. The atmosphere not only being very hazy but thickened with the smoke of native fires' [Kalgan R, south-east of Porongurup Range]	Extensive burning in late summer	Collie 1832a, p. 171
Collie **July 1832**		
'...excellent young grass shooting up where that of the former year had been burnt, and in some places, a thick covering of old grass' [Hay R south-west of Mt Barker]	Patchy burning in previous summer	Collie 1832b, p. 205
Stokes **2 – 15 November 1840**		
'On our way [15 miles (24 km) north of Albany, i.e. south of Narrikup] we met a party of natives engaged in burning the bush, which they do in sections every year. The dexterity with which they manage so proverbially a dangerous agent as fire is indeed astonishing. Those to whom this duty is especially entrusted, and who guide or stop the running flame, are armed with large green boughs, with which, if it moves in a wrong direction, they beat it out. Their only object in these periodical conflagrations seems to be the destruction of the various snakes, lizards, and small kangaroos, called wallaby... [Aborigines] engaged in kindling, moderating, and directing the destructive element, which under their care seems almost to change its nature, acquiring, as it were, complete docility, instead of the ungovernable fury we are accustomed to ascribe to it'	Low intensity fire in late spring Deliberate management of low intensity fire [These may have been marri saplings, which were used as late as the 1920s by the Forests Department – D. Ward personal communication1999]	Stokes 1846, vol. 2, p. 228

REFERENCES – APPENDIX 1

Collie, A. (1831). Account of an excursion to the north of King George's Sound, between the 26th of April, and the 4th of May, 1831. Pp. 132–154 in Cross, J. (comp.) (1833). *Journals of several Expeditions made in Western Australia, during the years 1829, 1830, 1831, and 1832...*Cross, London.

Collie, A. (1832a). Account of a short excursion from Albany up French River. Pp. 168–177 in Cross, J. (comp.) (1833). *Journals of several Expeditions made in Western Australia, during the years 1829, 1830, 1831, and 1832...*Cross, London.

Collie, A. (1832b). Untitled. Pp. 204–205 in Cross, J. (comp.) (1833). *Journals of several Expeditions made in Western Australia, during the years 1829, 1830, 1831, and 1832...*Cross, London.

Collie, A. (1834). Anecdotes and remarks relative to the Aborigines at King George's Sound. *Perth Gazette and Western Australian Journal* [newspaper]. 5, 12, 26 July; 2, 9, 16 August.

Cornell, C. (trans.) (1974). *The Journal of Post Captain Nicolas Baudin...* Libraries Board of South Australia, Adelaide.

Cunningham, A. (1818, 1821–22). Journal [Manuscript]. State Archives of New South Wales, Sydney.

Dale, R. (1832). Mr. Dale's journal of an expedition from King George's Sound to the Koikyennuruf Range of mountains. Pp. 161–167 in Cross, J. (comp.) (1833). *Journals of several Expeditions made in Western Australia, during the years 1829, 1830, 1831, and 1832...*Cross, London.

Dale, R. (1834). *Descriptive Account of the Panoramic View, &c. of King George's Sound and the Adjacent Country.* Cross, London.

Edwards, P. I. (1981). The journal of Peter Good, gardener on Matthew Flinders voyage to Terra Australis 1801–03. *Bulletin of the British Museum (Natural History), Historical Series* **9**, 1–213.

Flinders, M. (1814). *A Voyage to Terra Australis...* Nicol, London.

Green, N. (ed.) (1979). *Nyungar – The People: Aboriginal Customs in the Southwest of Australia.* Creative Research, Perth.

Hallam, S. J. (1975). *Fire and Hearth: A Study of Aboriginal Usage and European Usurpation in South-western Australia.* Australian Institute of Aboriginal Studies, Canberra.

King, P. P. (1827). *Narrative of a Survey of the Intertropical and Western Coasts of Australia...* Murray, London.

Lamb, W. K. (ed.) (1984). *George Vancouver: A Voyage of Discovery to the north Pacific Ocean and round the World 1791–1795.* Hakluyt Society, London. Volume 1.

Lockyer, E. (1827). Despatch No. 1 to Colonial Secretary Alexander Macleay. Journal [8 Nov 1826–21 Jan 1827]. *Historical Records of Australia. Series* 3, **6**, 460–474.

Menzies, A. (1791). Journal [Manuscript]. Folios 40–74. Mitchell Library, Sydney.

Mulvaney, J. and Green, N. (1992). *Commandant of Solitude: The Journals of Captain Collet Barker 1828–1831.* Melbourne University Press, Melbourne.

Nind, S. (1831). Description of the natives of King George's Sound (Swan River Colony) and adjoining country. *Journal of the Royal Geographical Society London* **1**, 21–51.

Péron, F. and Freycinet, L. de. 1816. *Voyages de découvertes aux Terres Australes...* Imprimerie impériale, Paris.

Rosenman, H. (1987). *An Account in two volumes of Two Voyages to the South Seas by ... Dumont D'Urville ...* Volume 1. Melbourne University Press, Melbourne.

Stokes, J. L. (1846). *Discoveries in Australia; with an Account of the Coasts and Rivers Explored and Surveyed during the Voyage of H.M.S. Beagle, in the Years 1837–38–39–40–41–42–43...* Volume 2. Boone, London.

APPENDIX 2

Extracts from letters by J.T. Tunney (hitherto unpublished) held in the Western Australian Museum and relating to his search for *Atrichornis clamosus* Noisy Scrub-bird.

9 August 1900 [The Williams]: '...I have not seen...in my travels...A. clamosa, I think [it] must be found near the coast between Fremantle & Bunbury'.

29 June 1904 [written at Kojonup]: 'I went to Denmark to try & get the A. Clamosa but was not successful'.

17 August 1904 [Gracefield]: [George Masters in 1866] 'was staying with my Grandfather at that time so must have got them near the town [Albany]'.

31 August 1904 [Gracefield]: 'I will leave here about end of Sept & try for A. Clamosa in Albany for a week'.

15 December 1904 [Gracefield]: 'I spent a week in Albany looking for A Clamosa but could not find any traces of them. I will spend a couple of weeks later between Mt Barker & Hay River & Torbay looking for them as Mr Masters was out that way collecting in 67 & may have got them there'.

10 February 1906 [Gracefield]: 'I will stay a week in Albany & try for the A. Clamosa as I heard of a bird resembling it being seen about 10 miles from there the other day'.

13 April 1906 [Esperance]: 'I was not fortunate in getting a Clamosa I was told they used to be numerous 11 miles from Albany. I went there but could not find any traces of them the settler said he heard there were still some up towards Tor bay so when I return I will have a look out there'.

APPENDIX 3

Months when fires started by Aborigines or by lightning were recorded.

Month	Number of dated observations of Aboriginal fires recorded in 1791–1840 (APPENDIX 1)	Number of lightning-caused fires recorded in Albany District 1996–99
September	0	0
October	2	1
November	1	0
December	6	6
January	20	3
February	11	2
March	2	4
April	2	2
May	0	0
June	0	0
July	0	0
August	0	0