

Western Australia, home of the Grass-Wren (*Amytornis textilis*)

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Abstract. The first grasswrens to be seen by Europeans, at Shark Bay, were given the English name Textile Wren, later the Grass-Wren. Though detected subsequently in many other places in southern Western Australia they then declined dramatically and soon disappeared from all but the place of their original discovery. Specimens collected many hundreds of kilometres apart and in varying environments showed differences that led to their being given many separate names. They were shortly dispersed among Australian and later among North American institutions with none having a fully representative collection. Subsequent extinctions restricted the opportunity to confirm or modify this implicit taxonomic diversity. From evidence presented here I propose that two Western Australian subspecies be recognised as separate, *Amytornis textilis textilis* of the Shark Bay region and arid northern interior and *A. t. macrourus* of southern eucalypt communities.

Keywords. Western Grasswren, morphological diversity, habitat diversity, taxonomy, subspecies *macrourus* recognised.

Introduction

The first grasswrens, genus *Amytornis* (Maluridae), to be given scientific description were obtained in 1818 at Shark Bay Western Australia by Quoy and Gaimard (1824). Recently ten (Christidis and Boles 2008), now eleven (Black *et al.* 2010) grasswren species are recognised and more are envisaged (Christidis *et al.* 2010), all similar morphologically and showing restricted variation in their cryptically patterned plumages. The group has a unique pattern of distribution and occupies a number of ecological niches in continental Australia, almost exclusively in its arid and drier tropical regions. Christidis *et al.* (2010) observed that *Amytornis* shows a higher level of diversity than any other Australian arid-restricted avian genus, it has a unique distributional pattern of fragmented and restricted populations and shows plumage differentiation between discrete populations that is taxonomically significant. These characteristics mean that the genus has much to contribute to the understanding of biogeography and evolution of the Australian arid zone fauna.

In an earlier analysis of the confounding taxonomy of the grasswrens *Amytornis textilis*, *modestus* and *puhnelli* Parker (1972) wrote: "The Western Australian records of *textilis* will be discussed by Mr. J. Ford (in prep.). As a critical review of these would add little to the present paper, I have not dealt with them beyond plotting them on the map." No draft of such a review has been discovered although Ford measured and made notes on specimens held in the American Museum of Natural History (AMNH) and the H. L. White collection (HLW), Museum Victoria (MV) (R. Johnstone personal communication). The precise distribution of *Amytornis textilis* in Western Australia (WA) in the early European Australian era has not been analysed comprehensively although extensively summarised by Schodde (1982), Rowley and Russell (1997) and Johnstone and Storr (2004). While examples of the species in WA (hereafter the Grass-Wren, as it was long known) are presently treated as a single subspecies *A. t. textilis* a number of specific or sub-specific names were applied in the past to specimens taken from different localities.

My aim in this paper is to document as precisely as possible where Grass-Wrens have been recorded in WA, their habitats and morphology and the names applied to them, and to challenge their conventional treatment as a single taxonomic entity.



A Publication of:
Birds Australia
Western Australia

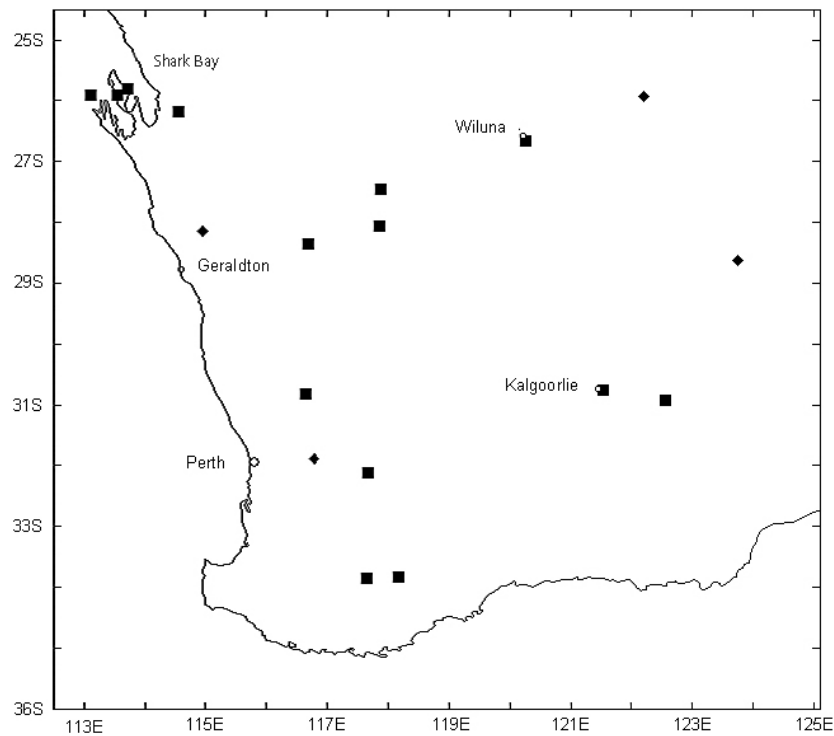


Figure 1. Localities of all skin specimens (squares) and other records (diamonds). Note that the unsettled localities of Gilbert's early observations are shown at York and his specimens at Wongan Hills; Crossman's specimen is shown east of Beverley. Gibson's unresolved record east of Laverton is indicated but his Nullarbor claims are omitted.

Methods

I have attempted to review all published reports of the Grass-Wren (*WA textilis*), including those describing specimens used as the basis for published names, and others with information concerning locality and habitat. As part of a morphological review of the *Amytornis textilis-modestus* complex (Black *et al.* 2010), I examined plumage details and measured all WA specimens of *textilis* in Australian museum collections ($n = 29$), namely the Western Australian Museum, Perth (WAM) (14), South Australian Museum, Adelaide (SAMA) (1) and HLW, MV (14). These data allowed sub-specific separation of *A. t. myall* ($n = 17$) from *A. t. textilis* (29) and specific separation of both from *A. modestus* (54). Female sample size in many sub-populations was too small for analysis and most inter-group comparisons were restricted to males. All measurements were then log-transformed to allow inter group comparisons using two group *t*-tests. The data uncovered phenotypic diversity within males of the three best represented (northern) populations of *A. t. textilis*, Dirk Hartog Island (4), Shark Bay (5) and northern inland (4). Northern inland birds had smaller bill length/depth ratios and, consistent with Campbell's (1927) and Schodde's (1982) findings, Dirk Hartog Is. birds were generally darker. Southern birds, three only in total, were not part of the statistical analysis but were also consistently darker. In this study I test mor-

phometric data of three putative northern populations of *A. t. textilis* using Discriminant Function Analysis, I review available evidence relating to southern birds and I examine plumage variation among all populations. Figure 1 shows the probable and approximate localities of specimens and other recoverable records of the Grass-Wren.

Results

Historical distributional and taxonomic review

1. Shark Bay, Quoy and Gaimard, and textilis.

As is well known, the Grass-Wren was first collected from the Peron Peninsula, Shark Bay in 1818 by Quoy and Gaimard (1824), naturalists with Freycinet's expedition, who observed nonetheless that it had been seen earlier [1803] by naturalists with Baudin. The specimens were said to have been lost in the subsequent shipwreck of l'Uranie in the Falkland Islands (Schodde 1982) but the drawing by expedition artist Jacques Arago survived and was later published as an engraving and the species was named Mériion Natté [= braided or woven] *Malurus textilis* by Dumont (1824). It is surprising that in the publication of Freycinet's voyage Quoy and Gaimard (1824) referred to museum specimens of the species, one with a pointed bill, upturned at the tip and another with darker plumage. Their reference to variation within the species was one

of a number of reasons why some later ornithologists had difficulty knowing whether specimens secured elsewhere were of the same or separate species.

Shark Bay next produced grasswren records only after Gregory Mathews had persuaded Tom Carter (Carter and Mathews 1917) to visit Dirk Hartog Is. (see below) and Peron Peninsula in 1916. It may surprise a modern reader to learn that Carter, a most able field ornithologist, spent seven days on the peninsula before obtaining a single male specimen (AMNH 598057); this despite his having obtained a very good bag on the island (Carter and Mathews 1917). Whitlock (1921) collected a single female specimen in 1918 (un-traced), and another four in September 1920 (HLW 2754, 2755, 7457, 7458) but "found the Grass-Wrens on Peron just as wary and difficult to observe as those at Lake Austin and Lake Way."

2. *The "interior of Western Australia", John Gilbert and macrourus.*

Gould (1841) saw and collected specimens of two grasswren species purportedly on the lower Namoi River in inland northern New South Wales in 1839. He named the Striated Wren *Amytis striatus* as a new species but the other he took to be Dumont's *textilis* and gave it the English name Textile Wren. John Gilbert saw grasswrens in "thickets in the interior of Western Australia" (the Northam and York districts) in 1839 and in notes prepared on his return to England concluded that they too were *textilis* and the same species that Gould had collected in New South Wales (Fisher 2008 and C. Fisher, personal communication). Gilbert revisited "the interior" during 1842 and 1843 and went further, travelling "through almost impenetrable scrub" to explore the thickets of Wongan Hills for the first time (Fisher 2008). He obtained two grasswren specimens during these subsequent visits that Gould recognised were actually very different from his eastern birds [Thick-billed Grasswrens *Amytornis modestus* (North, 1902)] but Gould failed to realise that they were geographically and phenotypically closer to the true *textilis* and described them as a new species, the Large-tailed Wren *Amytis macrourus* (Gould, 1847). Such was Gould's influence that many following writers felt compelled to accept his authority, even while recognising or criticising his errors. The date and locality at which Gilbert secured his specimens are not known (C. Fisher, personal communication) but Mathews (1922-1923) wrote that they were from the Wongan Hills without providing evidence for the claim.

3. *The east Murchison and beyond, Milligan, Whitlock, Kearland and gigantura.*

When asked by his Director to identify two Spinifex-birds in the Perth Museum, A. W. Milligan (1901) looked for grasswren skins for comparison. He could

find only a single example of what was thought to be "*Amytis macrura*", a female taken by J. T. Tunney in 1899 from Mount Magnet, south of Lake Austin (WAM 20771). Curiously he did not see a second skin, a male collected by Tunney in the same year from Cue to the north of Lake Austin (WAM 11474). He later found a Striated Grasswren skin of un-named provenance and compared the Mount Magnet specimen with it and with Gould's descriptions of *textilis* [actually *modestus* from New South Wales] and *macrourus* and declared it a new species *Amytis gigantura* Western Grass-bird [sic]. His points of differentiation are largely spurious and he was misled, as were others, by an unaccountable error in Gould's Handbook in which the tail length of *macrourus* was given as 2 $\frac{1}{8}$ inches instead of 4 $\frac{1}{4}$ inches as in its original description (Gould 1847). The tail of the Mount Magnet bird measured 3 $\frac{3}{4}$ inches and it is understandable therefore that Milligan believed his new species *gigantura* [even a female] had the longest tail of all.

Further records followed, with specimens taken at Lake Austin (WAM 11843, 11844) and Day Dawn in 1903 (WAM 11476, 11477, AMNH 598059), Yalgoo in 1908 (WAM 11475, AMNH 598058) and Lake Way in 1909 (HLW 2759, 2760, 2761). F. Lawson Whitlock was the chief collector of these specimens to which he gave versions of Gould's common name Large-tailed Grass-Wren and Milligan's scientific name *Amytornis gigantura* (Whitlock 1910). Whitlock was an exceptional field worker and was the source of much early information on grasswrens and their habitats (Whitlock 1910, 1921, 1922, 1924). Another who reported observations of this population was George Kearland, naturalist on the tragic Calvert Expedition whose collections had to be abandoned in the Great Sandy Desert so that half the party might survive. Kearland saw grasswrens that he identified as *Amytis textilis* near Lake Way and further inland "near our camel depot on Brookman [sic = Sholl] Creek" north of Lake Carnegie (Kearland in North 1898, Kearland 1904) but Whitlock (1910) doubted Kearland's observations, not from the above publications but as reported in a letter to H. L. White, because he had said they were made in samphire. Kearland was thoroughly familiar with grasswrens from his experiences with them on the earlier Horn Expedition to central Australia (North 1896; Kearland 1904) and it is likely that he saw them as reported but he was inaccurate and forgetful about some details and especially unsound on the subject of habitats. Quite likely he did not distinguish samphire from other chenopods or remember the circumstances fully. Whitlock (1910) dismissed Kearland's observations for another reason, his calling them *A. textilis* which Gould had described from the east with *macrourus* its larger and more robust western representative; Whitlock thought that the dimensions of *gigantura* exceeded both.

4. Dirk Hartog Island, Carter, Whitlock and *carteri*.

At Gregory Mathews' direction Tom Carter collected birds on Dirk Hartog Is. in April, May and October 1916 (Carter and Mathews 1917). Carter gave an extended account of his pursuits and trophies, describing the capture of six Grass-Wrens and citing all but two of the relevant dates for thirteen birds whose skins can now be found in public collections (WAM 1198, HLW 6599-6603, AMNH 294760, 294761, 598063-598067). The only other person to record grasswrens on the island was Whitlock who saw a single pair in October 1918 but, "owing to the ravages of cats", could find none during three months in 1920 (Whitlock 1921). These grasswrens were given the name *Diaphorillas textilis carteri* by Mathews (1917).

5. The south-west, Crossman, Carter and *varia* (= *macrourus*).

Alan Crossman (1909) listed the birds of Cumminin Station about 140 km east of Beverley and described shooting and his spaniel retrieving a "Western Grass-Wren *Amytis gigantura*" somewhere between those two localities in June 1906. He sent the specimen to WAM where it was identified but on visiting the museum later to examine other specimens of *gigantura*, "it struck (him) that the bird (he) had sent down differed in certain respects" but it "had been mislaid." The specimen was registered 8420 on 3 July 1906 and its data were transferred to a later register as A 32788 but it could not be located in 2002 (R. Johnstone personal communication). In fact it had somehow found its way east and into another collection and in January 1927 was registered in Adelaide as part of the "old collection" as SAMA B 7358, having been "exchanged with Perth Museum". Both its labels declare it to be male but it carries the distinguishing amber flank patches of a female.

Further south Carter shot one of a pair of grasswrens at his home property, Wensleydale, Broome Hill on 21 June 1908 (AMNH 598061) and described it as a new species *Amytis* (or *Amytornis*) *varia* Marlock Grass-Wren (Carter 1908a). Later he compared his specimen with a Day Dawn 1903 skin of *A. gigantura* and could see that it was much darker and richer in tone than the latter. He noted that Day Dawn "was 450 miles almost due north from Broome Hill, much hotter and drier" with a rainfall of "8 inches against 22" (Carter 1908b). After receiving the "opinion of experts" (e.g. North, cited in Mathews 1922-1923), who pointed out the erroneous tail length of *macrourus* in Gould's Handbook, Carter (1910) agreed that his two skins "provisionally described (as) *varia* were referable to *Amytis macrura*, Gld." He obtained a second skin 30 miles east of Broome Hill on 19 October 1908 (AMNH 598060) but a third taken from the same local-

ity on 1 September 1910 could not be traced (Carter 1924, Mathews 1922-1923).

There is an earlier record of this population. North (1910, 1913-1914) wrote that George Masters, late Curator of the Mcleay Museum, University of Sydney had seen "a small flock of *Amytis macrurus* in the scrub, bobbing up and down like tennis balls" "while collecting in South-western Australia" in 1868.

6. Kalgoorlie, the Nullarbor and Gibson.

Charles Gibson, WA Assistant Government Geologist, sent skins, the photograph of a nest and three clutches of eggs from near Kalgoorlie to A. J. North at the Australian Museum, Sydney (AM), allowing North (1910) to describe "the nests and eggs of the Large-tailed Grass-Wren *Amytis macrurus*". North had never previously seen a WA *textilis* and continued to believe that some of the grasswrens collected during the Horn Expedition to central Australia [= *purnelli*, Mathews, 1914] were the "true *Amytis textilis* of Quoy and Gaimard" (North 1901-1904). Furthermore his man-in-the-field Keartland had seen further examples of "*textilis*" at Lake Way and Sholl Creek as above. In this way North was dividing WA Grass-Wrens into northern *textilis* and southern *macrourus* while being silent on the status of *giganturus*. Later, though still ambiguous on that matter, he expressed confidence that *varius* was a synonym for *macrourus* (North 1910, 1913-1914). Gibson sent North a third skin from "Cardinia, seventy miles east of Kalgoorlie" (North 1913-1914), he described finding nine nests and sent nine clutches of eggs (in AM), all from near Kalgoorlie except one clutch and nest said (without elaboration) to be "from eighty miles east of Laverton".

During the months of September, October and November 1908 Gibson (1909) observed birds east of Kalgoorlie as far as the South Australian border and Eucla while examining the future route of the Trans Australia Railway. His comprehensive list included: "Large-tailed Grass-Wren (*Amytis macrura* = *A. gigantura*, Milligan). Odd ones noted here and there right through, chiefly amongst the blue bush"; also: "Grass-Wren (*A. textilis*). A specimen was noted near Kalgoorlie, and was unidentified; probably *A. textilis*". Gibson's report suggested the presence of grasswrens in a variety of habitats, including the treeless chenopod-covered plain but a little more than a decade later they were not detectable east of Kalgoorlie, including the Nullarbor itself (Whitlock 1922), and grasswrens have never been reliably reported from there since (Le Souëf 1928; Collins 1943; Storr 1986; Black 2004).

7. Recent times, Peron Peninsula and Shark Bay

Schodde (1982) was uncertain if any Grass-Wrens had survived in Western Australia since the early 1900s although it was known by some (Serventy and Whittell 1976) that they persisted on Peron Peninsula. While the

population there and inland near the Shark Bay coast proved to be a large and healthy population (Brooker 1988), it was generally acknowledged that it was all that had survived since about 1910 (Brooker 2000). Reports from elsewhere during that period of 100 years are few and have lacked corroborative evidence. Moriarty (1972) reported possible sightings over a thirty year period from Wanjarri Station about 100 km south-east of Wiluna but, while the locality seemed appropriate, the birds were reported in spinifex-country where Striated Grasswrens were known to be plentiful. A report from near Exmouth in August 1979 was accepted in the first Australian Atlas (Blakers *et al.* 1984) but is no longer acknowledged as valid (Storr 1985; Brooker 2000; Johnstone and Storr 2004). A more plausible report came to attention recently in the notebooks of Victorian egg-collector Len Harvey who wrote that he had seen three grasswrens ("these more or less plain, dark coloured birds") about 80 km north-west of Mullewa in September 1966 (Black and Longmore 2009).

The taxonomic arrangements of Gregory Mathews and A. G. Campbell

In Volume 10 of his major work *The Birds of Australia*, Mathews (1922-1923) treated *Diaphorillas* (= *Amytornis*) *textilis* Grass-Wren as a purely Western Australian species; he listed five subspecies and illustrated three of them. *D. t. textilis* (1) from Peron Peninsula was not shown but two specimens of *D. t. carteri* (2) from Dirk Hartog Is., described as paler and duller than the former, were on the contrary illustrated in plate 467 as distinctly dark grasswrens (see Campbell below). With *D. t. macrourus* (Gould) (3) from "Wongan Hills, Mid-west Australia", he included "*Amytis gigantura* Milligan", regarding it as synonymous, "the type locality of that form being Mount Magnet in the same kind of district" [sic! See Carter's very different and more pertinent observation above]. Mathews had examined specimens from Yalgoo and Day Dawn and illustrated them in plate 468. He found that they had similar measurements to Gould's *macrourus* and resembled its description; he therefore suppressed *giganturus* as a synonym. Mathews' fourth subspecies was "*D. t. varius* (Carter), (from) Broome Hill, South-west Australia", whose tail he found to be longer than others examined and which he regarded as "noticeably darker than *macrourus* [= *giganturus*] and easily recognised by most workers". His final subspecies was "*D. t. morgani* Mathews (from) Cardinia, South-east Coast of West Australia" which he described, after interpreting misprints and corrections, as darker below than *giganturus*, more like *varius*, but having the tail more like *giganturus* (thus shorter than *varius*).

The tangled description of the last named subspecies *morgani* with its odd sounding type locality is puz-

zling since Cardinia is located some 200 km north of Kalgoorlie. It rests upon a single specimen (AMNH 598062) and Mathews' accompanying data stating that it was taken on 31 August 1908 south-east of Coolgardie and was from WAM and bore the number 9924 (Le Croy 2008). R. Johnstone (personal communication) confirmed that WAM 9924 was a female specimen of "*Amytornis giganturus*" collected at Condinia [sic] by C.G. Gibson on 31 August 1908 and forwarded to Mathews. Moreover specimens WAM 9925, 9926 and 9927 had also been collected by Gibson. North (1913-1914) had (as above) also recorded that Gibson's third specimen was from Cardinia "about 70 miles east of Kalgoorlie." That description is apt for the locality of Cardunia and the localities of the following three specimens were all east of Cardunia. It is evident that this is the unidentified "specimen noted near Kalgoorlie" during Gibson's (1910) Nullarbor transect (above) and, rather than merely being "noted", it had been secured for posterity.

Morgan (1924) wrote that the grasswrens he and Dr. Chenery had seen and collected in the Gawler Ranges, South Australia "cannot by any stretch of the imagination be regarded as other than a subspecies of *D. textilis*" and roundly berated both Mathews and North for failing to recognise this. Morgan had been at some advantage over his targets for criticism, having "a few weeks ago had an opportunity of comparing (his) two skins with the fine series of *Diaphorillas* in the Melbourne Museum". The junior Campbell (1927) was also well placed to make comparison among "the fine series", chiefly the H.L. White Collection but with other MV, WAM and SAMA material. He recognised phenotypic diversity (see below) within *Amytornis textilis* Western Grass-Wren, accepted *textilis*, *carteri* and *macrourus* of Mathews' subspecies, but placed northern *giganturus* more aptly in *textilis* rather than in southern *macrourus*. He followed Morgan (above) by including *myall* as a non-WA subspecies of the "Western Grass-Wren".

The habitats

Beyond the recent comprehensive descriptions of habitats of Peron Peninsula and Shark Bay (Brooker 1988; Brooker 2000) details are rather fragmentary. Brooker (1988) found grasswrens in several acacia-dominated scrublands including coastal dunes and coastal sandplain and the *Acacia ramulosa* [tall shrubland] of the extensive peninsular Red Sandplain landform. Brooker (2000) supplied detailed attributes of grasswren sites in habitats that included *Triodia* spinifex and *Ptilotus obovatus* shrubland but especially several forms of acacia shrubland that contained recumbent shrubs extending to the ground and climbers, one key feature being high foliage density, particularly below 1 m. A chenopod understorey was commonly present but was far from being the dominant structural element that *Maire-*

ana pyramidata provides for habitats of the Eyre Peninsula subspecies *A. t. myall* (Black *et al.* 2009).

On Dirk Hartog Is. Carter (in Carter and Mathews 1917) referred often to thickly or densely foliated bushes, to "low scrub three or four feet high", to "dense masses of wattle-bushes", large or big wattles, "large clumps of spreading wattles" and once to another form of vegetation, "large clumps of 'Ming-ar' bushes, which have extremely dense masses of foliage mixed with interlacing twigs". Whitlock (1921) had found them in "extra large *Acacia* bushes".

Whitlock (1910) was very certain that the grasswrens (*giganturus*) in the vicinity of Lake Austin, Lake Violet and Lake Way were "strictly confined to the saltbush near the lake." The preferred saltbush he described grew "to a height of about three feet, (with) a small and sappy leaf" that "when bruised (has) a scent like common garden sage" and "a small bright red berry, which is not unpleasant to the taste." Kearland (in North 1898) recorded grasswrens "among the saltbush near Lake Way, and also on the samphire flats or scrub-covered sandhills near our camel depot on [Sholl] Creek". Later, Kearland (1904) made a poetic but less than illuminating observation that between Cue and Lake Way "many of these birds were disturbed by our camels as we passed through some stunted heath resembling boronia". While Whitlock (1910) suggested that any bird seen in samphire would have been a Fieldwren, Kearland knew (and collected) grasswrens as well as fieldwrens and this anomaly probably only illustrates; as is seen above, how unreliable was Kearland's recognition and recollection of habitats.

The only habitat information for Gilbert's type specimens of *macrourus* is that they were in thickets (Gould 1847), presumably within or between eucalypt woodlands. Crossman (1909) did not describe where or in what type of vegetation he obtained his grasswren specimen but at Cumminin Station he listed *Acacia acuminata*, York Gum, Salmon Gum, Gimlet and Yate, this "good land (being) surrounded by vast sand-plains, some covered with practically impenetrable scrub". Carter obtained his three Broomehill specimens in Marlock, very dense thickets of mallee. Gibson (North 1910, 1913-1914) described finding grasswrens and their nests near Kalgoorlie in "a clump of thick bush", "a small thicket, extending some 40 chains by 20 chains" [c. 800 x 400 m], "thick brush thickets" or "dense bush thickets. Presumably such thickets were found amongst or between the open eucalypt woodlands of the region.

Morphological review

As remarked above, it was only A.G. Campbell (1927) of earlier authors who had a sufficient series of skins to be able to make valid comparative observations among different populations of the Grass-Wren (WA *textilis*). He opened by comparing Dumont's Shark Bay *A. t.*

textilis, as supposedly illustrated in Mathews' (1922-1923) plate 468 [actually *giganturus* specimens from Yalgoo and Day Dawn] with Gould's "darker subspecies, *A. t. macrourus*" and "the darkest subspecies *A. t. carteri*" of Dirk Hartog Is., both shown in Mathews' plate 467. Campbell's "Examination of skins" supported these conclusions. He commented further that "the (darker) Dirk Hartog skins are a defined subspecies", "peculiar that the nearest to the type locality should differ most in general tone". While these plumage differences are well seen in his plates, Mathews had actually reversed the relationship in his text, describing "the island form (as) paler and duller". Rather more surprisingly Carter (Carter and Mathews 1917) had done the same, even while observing that "300 miles inland" "the Day Dawn birds are much more rufous in general colour" and "lack the dark brown stripes on each side of the central white stripes [thus paler] which are present in the plumage of the birds from Dirk Hartog Island."

My own observations of the five skins in HLW and those of Schodde (1982) are consistent with Campbell's above (and with Mathews' plates) but the only other skin from Dirk Hartog Island in Australian collections, WAM 1198, is indistinguishable from Peron Peninsula skins in WAM. Furthermore the late J. Ford (R. Johnstone personal communication) did not find the seven skins in AMNH to be unusually dark and P. Sweet (personal communication) has confirmed that they lack such a distinction.

Campbell (1927) found that inland specimens (Milligan's *gigantura*) were (all but one, 0652, from Cue, 1899) a little darker than those from Shark Bay. I drew a similar conclusion, also finding that skin, now WAM 11474, to be the palest of all in WAM, with WAM 11475 from Yalgoo, 1908 the next palest. While those two populations, Shark Bay *textilis* and inland *gigantura*, may be similar in overall plumage tone I did detect one difference, a "thicker" bill in the latter, specifically a slightly more convex profile to the lower mandible. Of some interest this feature too can be discerned in Mathews' (Grönvold's) illustrations, the bills of inland birds more closely resembling the bi-convex bill profile of Thick-billed Grasswrens (*A. modestus*), both being shown in plate 468, compared with more slender examples from Dirk Hartog Is. and the south-west in plate 467.

Campbell (1927) added that "in the greater rainfall of south-west Australia the species becomes darker in another way, mainly on the under surface." He had two southern skins from Kalgoorlie (HLW 2757, 2758) which he stated were darker than Shark Bay and northern inland birds, particularly over the whole under surface. This feature, the more extensively dark under-surface, is also well seen in Mathews' plate 467, Carter's type of *varius* (*macrourus*) being shown between two Dirk Hartog Island birds (*carteri*). Carter



Figure 2. Dorsal view of specimens; HLW 2757 male, Kalgoorlie, HLW 2761 male, Lake Way, HLW 7458 male, Peron Peninsula.



Figure 3. Ventral view of specimens; SAMA B 7358 female, [east of] Beverley, HLW 2761 male. Lake Way.

(1908b) had previously described the whole plumage as well as the abdomen and flanks of his Broome Hill birds (*varia* = *macrourus*) as much darker than *gigantura* and the white striations as more pronounced on the flanks. Moreover Gibson (1911), after comparing "*A. gigantura* obtained by Mr. F. L. Whitlock at Wiluna with *A. macrura* which (he) obtained near Kalgoorlie, had not the slightest hesitation in giving as (his) opinion that the birds are distinct." Mathews (1922-23) commented that this southern form is "noticeably darker than [northern birds] and easily recognised by most workers". Crossman (1909) too, as above had recognised differences.

The only southern skins in Australian collections are HLW 2757 male and 2758 female from Kalgoorlie and SAMA 7358 female from [east of] Beverley. I find that they are dark, long winged birds, extensively dark and extensively streaked on the somewhat rufous under surfaces and are quite distinct from northern skins, as observed by Carter (1908b), Crossman (1909), Gibson (1911), Mathews (1922-23) and Campbell (1927) (Figs. 2 and 3).

A perennially asserted attribute of the Grass-Wren is its long (or large) tail. Thus Quoy and Gaimard, (1824) described it inter alia as "*Malurus, cauda longa*" although curiously gave its length as just "de trois pouces deux lignes" [3¼ inches, c. 84 mm] which could partly explain why Gould, (1847) believed Gilbert's birds were a different and indeed truly "Large-tailed (Grass-) Wren *Amytis macrourus*". Milligan (1901), puzzled to think his specimen's tail was bigger again, had to find an even more gargantuan descriptor *gigantura* and finally Carter (1908b) declared that "the measurements of tail and wings are considerably larger in *varia*" than even in *gigantura*.

In a morphological review of the *Amytornis textilis-modestus* complex Black *et al.* (2010) compared all male Grass-Wrens (i.e. *A. t. textilis*) with male *A. t. myall* from Eyre Peninsula, South Australia, using non-

parametric statistics. Tails were longer ($P = 0.01$) and bills shorter and shallower ($P < 0.01$ for each) in the former. An analysis of variance within *A. t. textilis* (Kruskal-Wallis test) revealed non-homogeneities in tarsus length ($P < 0.05$), bill length ($P < 0.05$) and bill length/depth ratio ($P < 0.02$). In the light of the historical review (above) of diversity among Grass-Wrens from separate regions of Western Australia four potentially distinct and/or allopatric populations were identified from the Shark Bay area, Dirk Hartog Is., northern inland and southern regions. Sample sizes appeared sufficient for analysis of the first three only and the measurements (in mm) of all accessible Grass-Wren skins are summarised in Table 1. Standard deviations are not given in view of the small sample sizes of some groups.

Males of all but the southern group were compared using two group t tests after log-transformation of data; statistically significant differences are indicated. No significant differences are detected in wing or tail lengths although it can be seen that wings of one southern male and one southern female were longer than in any other skin; the Shark Bay population have longer tarsi and the northern inland population have shorter and "thicker" bills. Discriminant Function Analysis of measurements of all *A. t. textilis* and *A. t. myall* males with complete data sets is shown in Fig 4. This demonstrates diversity within the species and allows correct assignment to all 13 *myall* and all five Shark Bay specimens and to two of three Dirk Hartog Island and three of four northern inland specimens. Grass-Wrens of northern populations are arrayed positively and *A. t. myall* negatively on the more significant horizontal axis, indicating the generally longer tails and shorter bills of the former. On the vertical axis the thicker-billed northern inland birds fall below the other northern Grass-Wrens. Of interest the only southern representative (from Kalgoorlie) aligns more closely with *A. t. myall* than with northern Grass-Wrens.

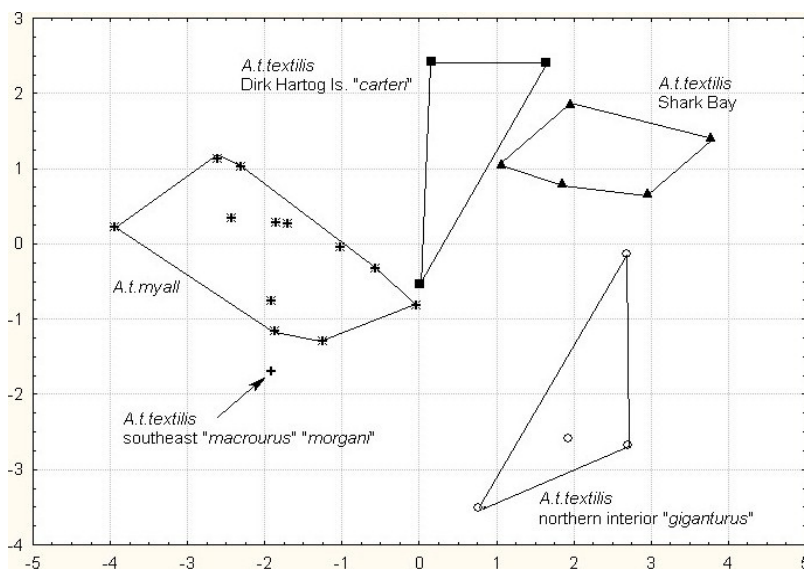


Figure 4. Discriminant Function Analysis of populations within the species *Amytornis textilis*. Root 1 (horizontal axis, $P < 0.00001$) relates positively to tail length (0.90) and negatively to bill length (1.26). Root 2 (vertical axis, $P < 0.01$) relates positively to tarsus length (0.70) and negatively to wing length (0.60) and bill depth (0.63).

Table 1. Comparative morphometry among the Shark Bay, Dirk Hartog Island, northern inland and southern populations.

(a) Wing					
Population	Sex	<i>n</i>	Min	Max	Mean
Shark Bay	M	6	60	66	64
	F	5	61	66	63.5
Dirk Hartog Island	M	4	64	66	64.8
	F	2	63	64	63.5
Northern inland	M	4	66	68	67
	F	3	62	67	65.3
Southern	M	1	69	69	69
	F	2	64	69	66.5

(b) Tail					
Population	Sex	<i>n</i>	Min	Max	Mean
Shark Bay	M	6	86.9	101	90.7
	F	5	79.3	89.9	81.7
Dirk Hartog Island	M	4	87.2	97.9	91.8
	F	2	85.8	87.0	86.4
Northern inland	M	5	85.6	101	91.5
	F	4	84.0	91.3	87.5
Southern	M	1	91.9	91.9	91.9
	F	2	89.4	96.2	92.8

(c) Tarsus					
Population	Sex	<i>n</i>	Min	Max	Mean
Shark Bay	M	5	26.9	28.4	27.8*
	F	4	25.4	27.8	26.8
Dirk Hartog Island	M	3	26.0	26.8	26.3*
	F	1	25.8	25.8	25.8
Northern inland	M	4	24.6	27.5	25.6*
	F	3	25.7	28.0	26.6
Southern	M	1	24.5	24.5	24.5
	F	2	24.1	24.1	24.1

Shark Bay > Dirk Hartog Island $P < 0.02$; Shark Bay > northern inland $P < 0.02$

(d) Bill length					
Population	Sex	<i>n</i>	Min	Max	Mean
Shark Bay	M	6	11.8	14.1	12.5
	F	5	12.0	12.4	12.2
Dirk Hartog Island	M	4	13.0	13.4	13.3*
	F	2	13.0	14.3	13.7
Northern inland	M	4	11.7	12.2	12.1*
	F	3	11.9	12.8	12.3
Southern	M	1	14.0	14.0	14.0
	F	2	12.7	13.5	13.1

Northern inland < Dirk Hartog Island $P < 0.001$

(e) Bill depth					
Population	Sex	<i>n</i>	Min	Max	Mean
Shark Bay	M	6	5.1	6.1	5.5
	F	5	5.2	5.6	5.4
Dirk Hartog Island	M	4	5.0	5.7	5.4
	F	2	5.7	5.7	5.7
Northern inland	M	4	5.5	6.2	5.8
	F	3	5.1	5.5	5.3
Southern	M	1	5.8	5.8	5.8
	F	2	5.3	5.5	5.4

(c) Bill length/depth ratio					
Population	Sex	<i>n</i>	Min	Max	Mean
Shark Bay	M	6	2.20	2.38	2.30*
	F	5	2.20	2.31	2.26
Dirk Hartog Island	M	4	2.28	2.68	2.49*
	F	2	2.28	2.51	2.40
Northern inland	M	4	2.00	2.22	2.10*
	F	3	2.26	2.33	2.31
Southern	M	1	2.41	2.41	2.41
	F	2	2.31	2.55	2.43

Northern inland < Shark Bay $P < 0.005$; Northern inland < Dirk Hartog Island $P = 0.005$; Shark Bay > Dirk Hartog Island $P < 0.05$.

Discussion

The former distribution of Grass-Wrens is described as extending over much of southern Western Australia (Brooker 2000), in a broad band from the coast between Shark Bay and Point Cloates into the south-west (Broome Hill) and east to Kalgoorlie (Storr 1985, 1986, 1991), to Lake Carnegie and possibly near Esperance (Schodde 1982) or to the Nullarbor (Rowley and Russell 1997). Such a description might imply a continuous distribution but identifiable records reveal only that the species occurred at many and sometimes widely separated localities (Fig. 1). Between Shark Bay and Yalgoo, a distance of c. 360 km is a single unconfirmed sight record from north-west of Mullewa c. 200 km south of Shark Bay and c. 220 km west of Yalgoo (Black and Longmore 2009). Between the most inland (non-specimen) record near Lake Carnegie

(Keartland, in North 1898) and Kalgoorlie is a single record of nest and eggs, apparently (Gibson in North 1910) from east of Laverton, about 300 km from each locality. The Kalgoorlie records are over 300 km east of those in the south-west and those from Yalgoo are at least 300 km north. A continuous distribution (apart from Dirk Hartog Island) is plausible but not established and at least southern and northern populations might well have been allopatric.

Ecologically there appear to have been two (or three) distinct groups, those in the south in eucalypt communities, those coastally in the north chiefly in semi arid acacia communities and those inland in the arid north in chenopod shrublands. Discrete populations of a sedentary species occupying distinct habitats on either side of the Mulga-Eucalypt line are more than likely to have undergone a degree of phenotypic differentiation, as noted above and discussed further below.

About four morphologically separate forms have been identified from earlier reports and/or from this review. Compared with nominate *textilis* from Shark Bay the extinct Dirk Hartog Island population was reported to be distinctly darker (Campbell 1927, Schodde 1982, personal observation) but this is not confirmed in specimens outside HLW for reasons that are not easily explained. The northern inland population (*giganturus*) was mistakenly submerged in darker southern *macrourus* by Mathews (1922-1923) but more aptly included in *textilis* by Campbell (1927). This study reveals that *giganturus* males have a "thicker", more *modestus*-like, bill profile than other populations including *textilis*, suggesting ecological (dietary) differentiation.

Mathews (1922-1923) did not see Gilbert's *macrourus* specimens and, assuming incorrectly that northern inland birds were the same, had no difficulty in finding Carter's Broome Hill specimens to be readily separable from them; he maintained *varius* as a subspecies even after Carter (1910) had accepted that his "provisionally described *Amytis varia*" was "*Amytis macrura* re-discovered". Mathews also found his Cardunia (east of Kalgoorlie) specimen *morgani* to be darker below than *gigantura* and the same in this respect as *varius*. Campbell had no comparative material from the south-west but concluded that the two "Kalgoorlie skins (were) *A. macrourus* (Gld)" and that these southern representatives differed by being more extensively dark underneath than all northern representatives. Mathews' assertion that eastern (Kalgoorlie) *morgani* had a shorter tail than *varius* of the south-west was bold, and as untestable then as now because specimens are too few. Both are better considered synonyms for *macrourus* as suggested by Campbell (1927) and Carter (1910) respectively. Consistent with my own observations these southern birds were consistently regarded as distinct by earlier workers as above, darker and more particularly, extensively dark below (Figs 2 and 3). Recent independent assessments have led to similar conclusions. The late Julian Ford found that Carter's Broomehill specimens AMNH 598060 and 598061 were "darker brown dorsally and more rufous brown on the abdomen than Dirk Hartog specimens"; further that Gibson's Kalgoorlie specimens HLW 2757 and 2758 were "quite dusky and closely resemble *purnelli* in coloration, especially ventrally (i.e. quite gingery brown on breast and abdomen)" (R. Johnstone personal communication). Paul Sweet (personal communication) agreed that the above Broomehill skins are darker than those in AMNH from further north ($n = 10$). Higgins *et al.* (2001) observed that the throat and upper breast of the Beverley skin was darker and colder brown and more densely streaked than Shark Bay specimens and that the Kalgoorlie skins were rufous tinged and more uniformly dark below than others.

Measurements given in the Table show that tail-lengths

of both sexes of the Grass-Wren vary greatly, with individual tails as long as 101 mm in males from Shark Bay and northern inland and 97.9 mm from Dirk Hartog Island, while Gould's type of *macrourus* and Carter's of *varius*, south-western specimens, were said to have tails of $4\frac{1}{4}$ and 4.20 inches (c 107 and 105 mm respectively). There is significant sexual dimorphism in tails of the Grass-Wren (Schodde 1982, Black *et al.* 2010) but some female tails are also very long, around 90 mm or more in skins from all four populations. While a number of populations of the Thick-billed Grasswren (*Amytornis modestus*) are separable on the basis of tail length (Black *et al.* 2010) this has not been demonstrated conclusively among different populations of the Grass-Wrens of Western Australia.

Taxonomic summary

The Grass-Wren is presently recognised as the Western Grasswren's nominate subspecies *Amytornis textilis textilis*, a second subspecies being the Eyre Peninsula population *A. t. myall* (Black *et al.* 2010) but the former is polytypic and includes the following populations with available subspecific epithets:

1. The extant Shark Bay population *A. t. textilis* (Dumont, 1824) occurring in a variety of dense acacia and other semi-arid shrublands.
2. The extinct Dirk Hartog Island population *A. t. carteri* (Mathews, 1917) that occupied presumably similar dense acacia shrublands.
3. The presumed extinct thicker-billed northern inland population *A. t. giganturus* (Milligan, 1901) of arid zone chenopod shrublands.
4. The presumed extinct dark-bellied south-western (including '*varius*') and south-eastern ('*morgani*') populations *A. t. macrourus* (Gould, 1847) that existed in dense thickets within a variety of eucalypt communities.

Although available specimens of the Grass-Wren (WA *textilis*) are few I find sufficient morphological and plumage diversity among its populations to challenge its taxonomy as a single subspecies *A. t. textilis*. Northern and southern populations occurred in entirely different environments, semi-arid or arid zone shrublands and shrub thickets within eucalypt communities respectively. Skins of the latter are consistently and extensively dark with correspondingly prominent and extensive striation above and below and wing and tail measurements of only a few skins indicate that they were larger than northern birds. Their recognition results in re-instatement of the subspecies *A. t. macrourus* (Gould, 1847). This study also finds phenotypic diversity in three northern populations, the chenopod-dependent inland population being more "thick billed", at least in males, and with conflicting evidence for or against darker plumage of the extinct Dirk Hartog Is-

land population. While morphological differences are confirmed by discriminant function analysis of the small samples available (male only) and are suggestive of their separate subspecific status, conclusive taxonomic resolution of the northern populations remains elusive.

Acknowledgements. I am most grateful to Terry Reardon, SAMA for statistical analysis of the data, Brian Blaylock, SAMA for preparation of the map, Pat Bowie for French translation and Heath Warwick and Basil Popowycz for the photographic images. I have enjoyed the support and encouragement of Clemency Fisher, National Museums, Liverpool, Walter Boles, AM, Leo Joseph, CSIRO, Canberra, Wayne Longmore, MV, Philippa Horton, SAMA, Ron Johnstone, WAM and Paul Sweet, AMNH and thank them all for their assistance and patience in answering my many requests and enquiries. Allan Burbidge and Ron Johnstone provided highly constructive suggestions for improvement to an earlier draft.

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