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Front cover: Juvenile male Large-tailed Nightjar, Maroochy Wetlands Sanctuary, November 2013. Photograph by Ian Gynther.

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Forty-four Years of *The Sunbird* – a Tribute to Scientists and Amateur Ornithologists Alike

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Abstract

The content of *The Sunbird*, journal of Birds Queensland (Queensland Ornithological Society), over 44 years from 1970 to the end of 2013, is reviewed and compared with that of *The Australian Bird Watcher (ABW),* published by the Bird Observers Club over 44 years, from 1959 to 2002 (Ley 2011). Given its restricted geographical scope (mainly Queensland), *Sunbird* compares well with the nation-wide ABW, having just under half the total number of contributions and authors. Refereed articles comprised an identical percentage (88%) of contributions in both journals, and the proportions allocated to each major subject area were remarkably similar. However, while the vast majority of major contributors to ABW were amateur ornithologists, almost half of those to *Sunbird* were institution-based scientists, whose contributions, in terms of volume, exceeded that of amateur ornithologists (58% vs 42%, respectively).

About 9% of articles concerned studies conducted outside Queensland, mostly in northeast New South Wales. Not surprisingly, for studies within Queensland, regional coverage was heavily biased (47% of all articles) towards the populous southeast. Passerines were the subject of about 40% of articles, commensurate with their representation among all birds, but only 22% of the pages devoted to breeding behaviour concerned passerines. Relatively few articles in the journal concerned migration, and the majority appeared before 1990. Yet data on the timing of migration are important in determining the behavioural responses of birds to climate change and other threats. Early volumes of the journal featured the results of the QOS Annual Bird Count and Garden Bird Survey, yet these pioneering projects, which provided rich sources of data for *Sunbird* articles, were short-lived. As scientists are increasingly obliged to publish in high impact journals, the collection and publication of breeding and migration data have become the responsibility of birdwatchers and citizen scientists. *The Sunbird* remains an important and highly respected vehicle for the publication of such information.

Introduction

The Queensland Ornithological Society (QOS), the official name of Birds Queensland, began with a meeting of 33 people at the Biological Sciences Building at the University of Queensland, St Lucia, on 15 October 1969 (Straw 1969; Dow 2003a). Its aims were to "promote the scientific study and conservation of birds, by all means possible, with particular reference to the birds of Queensland". As part of achieving the first aim, one of the activities envisaged by the original Council was the production of a quarterly scientific journal for the publication of papers on all aspects of Queensland ornithology (Straw 1969; Niland 2004). Only five months later, in March 1970, the inaugural issue of *The Sunbird* (hereafter, *Sunbird*) was published, ushering in a new era in Queensland ornithology.

The history of the Society's journal up to December 2011 has been detailed by Rounsevell and Kuershner (2011), who also provided a table summarising the size of each volume, and their editors. Except for two years, the journal was published on a quarterly basis until 1998 (Volume 28) when it was reduced to three issues per annum, and finally, to two issues from 2004 to present day. Over the four full decades of *Sunbird*, the size of each volume fluctuated, peaking in the 1990s, when each volume averaged 98 pages (Figure 1). Although the 2000s saw a drop to 81 pages, on average, per volume, the size of each issue increased from 27 to 34 pages. Indeed, the two largest volumes were in 1996 and 2003, both of which totalled 120 pages (Rounsevell & Kuershner 2011). Nevertheless the drop in content has continued into the current decade, with an average of 65 pages per volume.

In this paper I review the content of *Sunbird* from 1970 to the end of 2013, a total of 44 years. Contributions were categorised in terms of the locality, species or ecological group, and major topic concerned. Authors were categorised as scientists if their address was a scientific or academic institution; those with private addresses were assumed to be amateur ornithologists. The state of Queensland was divided into eight regions, as defined in the QOSI Bird Reports of the 1980s (Palliser 1985). Coincidentally, in the same year as Rounsevell and Kuershner's review, Ley (2011) reviewed 44 years (1959–2002) of publishing of *The Australian Bird Watcher* (hereafter, *ABW*), the forerunner of *Australian Field Ornithology,* published by the Bird Observers Club. Since this period is identical to that of my review of *Sunbird*, albeit a decade earlier, I make some comparisons of the content of the two journals.

Ley (2011) presented a table showing the number of articles in *ABW* on each major subject area. However, the number of articles concerning a particular topic does not necessarily reflect the volume of text devoted to it.

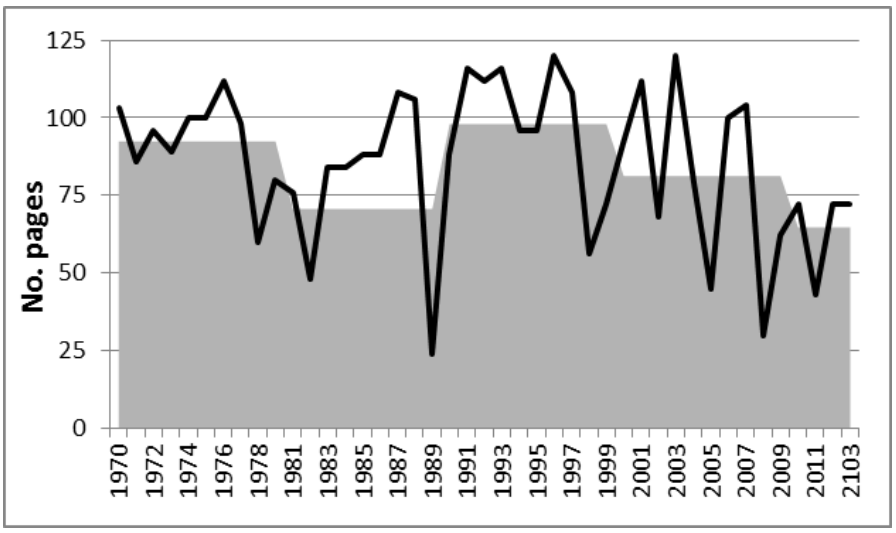

Figure 1. Fluctuations in the number of pages in each volume (line graph) and mean number of pages per decade (shaded background) of *Sunbird* from 1970 to 2013.

For example, in the first 20 years of publication of *Kukila,* the journal of Indonesian ornithology, annotated avifaunal lists of particular regions, islands and protected areas comprised 27% of the articles, yet they contributed a massive 67% of the volume by pages (Noske 2006). Accordingly, for each contributor, region, species or topic in *Sunbird* I present data on both the number of articles and the pages they occupy.

Overview

While *Sunbird* and *ABW* are comparable in size and content, and in the predominance of contributions by amateur ornithologists, as opposed to professional ornithologists or biologists, their geographical scopes differ profoundly in that *ABW* covers the whole of Australia, while that of *Sunbird* is largely restricted to the state of Queensland. Given this disparity, it is not surprising that *ABW* published slightly over twice as many contributions as *Sunbird* (Table 1). Of the contributions to *ABW,* 1,398 (88%) were refereed articles, comprising long papers and short notes (which overlapped in size), while the remainder mainly consisted of book reviews, notices, errata and obituaries. Interestingly, refereed articles comprised an identical percentage (88%) of contributions to *Sunbird* (Table 1). The number of contributions to *Sunbird* was less than half (44%) that of *ABW,* yet the total number of pages for the two journals was much closer, *Sunbird* having 62% as many pages as *ABW*. This is due to contributions (of all types) being 40% longer, on average, in *Sunbird* than in *ABW* (5.2 vs 3.7 pages, respectively; Table 1), though this does not consider the number of words per page.

One indicator of the international significance of Australian ornithological journals is the number of their articles that have been cited in the definitive 16-volume *Handbook of the Birds of the World* (del Hoyo *et al.* 1992–2011). Significantly *Sunbird* articles were almost as well represented as the nation-wide journal Corella, although the average number of *ABW* articles per year of publication was more than double that of *Sunbird* (Table 2).

Table 1. Comparison of number and type of contributions to *Australian Bird Watcher* and *Sunbird.*

Type of contribution	*Aust. Bird Watcher*		*The Sunbird*	
	n*	**%**	**n**	**%**
Articles	1,398	87.7	617	87.9
Reviews	76	4.8	54	7.7
Obituaries	19	1.2	7	1.0
Other	101	6.3	24	3.4
Total	**1,594**	**100**	**702**	**100**
No. pages	5,850		3,656	
Mean page length	3.67		5.21	

Table 2. Number of articles from Australian ornithological journals cited in *Handbook of the Birds of the World* (del Hoyo *et al.* 1992-2011)*.

Journal title	First year of publication	Last year of publication	No. years to 2011	No. papers in HBW*	No. papers per yrs. of publication
Emu	1901	-	111	1100	9.9
Aust. Bird Watcher	1959	2002	44	324	7.4
Corella	1977	-	35	127	3.6
Sunbird	1970	-	34	117	3.4
Aust. Birds	1974	2010	37	111	3.0
S. Aust. Orn.	1914	-	98	97	1.0
Aust. Field Orn.	2003	-	9	18	2.0
Aust. Bird Bander	1963	1976	14	14	1.0
Amytornis	2008	-	4	1	0.3

* Source: *Handbook of the Birds of the World Alive* (2015).

Major contributors and geographical coverage

Relative to the total number of contributions, *ABW* had 19% more authors than *Sunbird* (3.13 vs 2.62 authors per contribution). *ABW* published contributions by 510 sole or senior authors, 25 (4.9%) of whom made ten or more contributions (Ley 2011). *Sunbird* has had 268 such authors, yet a very similar proportion (4.6%) wrote ten or more papers. Twenty-seven authors (10.1% of the total) made six or more contributions (Table 2), which in combination comprised 39% of all contributions and 40% of all pages. Twelve (44%) of these 27 authors were institution-based scientists, who contributed slightly fewer articles than amateur ornithologists (46% vs 54%), though the total volume of their contributions exceeded that of amateurs (58% vs 42%). All of these authors were based in Queensland, except three who were based in New South Wales.

By far the most prolific contributor to *Sunbird* was Peter Woodall who contributed 29 papers, more than twice as many as the next most productive author (Table 3). However, as the average size of contributions varied greatly among authors, the total number of pages is a more accurate gauge of the volume of published material. Using this measure, Woodall wrote substantively more (194 pp) than the next most productive authors, Peter Britton and Stephen Debus (Table 3). Along with Jiro Kikkawa, the latter authors wrote over 100 pages of text, and averaged 11–12 pages per article. Impressively, Stephen Debus also made more contributions to *ABW* than any other author, and was Editor or Coordinating Editor of that journal from 1984 to 2002 (Ley 2011).

Table 3. Major contributors to Sunbird (senior authors only), listed in order of number of contributions, with total number of pages and average length of their contributions.

Name	No. contrib.	Total pp §	Pp per article	Name	No. contrib.	Total pp #	Pp per article
Woodall, P.F.*	29	**194**	6.7	Macdonald, J.D.*	9	28	3.1
Pratt, E. #	14	23	1.6	Robertson, J.S.	9	37	4.1
Britton, P.L.	13	**143**	11.0	Garnett, S.*	8	51	6.4
Corben, C.	12	35	2.9	Czechura, G.*	7	26	3.6
Debus, S.*#	11	**127**	11.5	Fien, I.	7	14	2.0
Ingram, G.*	11	64	5.8	Stewart, D.*	6	79	13.2
McLean, J.A.	11	72	6.5	Baldwin, M. #	6	32	5.3
Roberts, G.	11	53	4.8	Boles, W.*#	6	26	4.3
Vernon, D.P.*	11	32	2.9	Dawson, P.	6	31	5.2
Beruldsen, G.	10	52	5.2	Dow, D.D.*	6	28	4.7
Griffin, A.C.M.	10	43	4.3	Frith, C.B.*	6	29	4.8
Jaensch, R.*	10	83	8.3	Nielsen, L.	6	14	2.3
Hopkins, N.	9	21	2.3	Rounsevell, D.	6	14	2.3
Kikkawa, J.*	9	**107**	11.9				

* Institution-based scientists; # address outside Qld; § five highest values in bold print.

The geographical scope of *Sunbird* was not delineated until the first issue of Volume 7 (1976), wherein the then editor Graham Leach invited papers on "ornithology in Queensland and the adjacent lands and seas of northern Australia". Two years later (Volume 9, 1978) this description was abbreviated by editor J.C. Pearson to "Queensland and adjacent regions of Australia", and has remained thus until today. In fact the nation's borders were breached six times by articles on Papua-New Guinea and the Solomon Islands, which provided no fewer than 38 pages. Including the latter, regions outside Queensland accounted for 9.2% of articles (and 5.8% of pages) in which the region under study was identified. Most of these contributions concerned studies conducted in northeast New South Wales (32 articles/ 98 pages), followed by the Northern Territory (13/52).

Within Queensland, articles about birds in the southeast overwhelmingly dominated *Sunbird*, comprising almost half of the number of articles (47%) and pages (45%) (Figure 2). This is not unexpected given that almost half of the human population of Queensland lives in Brisbane, although this proportion has risen over the lifespan of the journal (ABS 2015). In the southeast, localities that received the most attention included Fraser Island (5 articles/67 pages), Redcliffe (1/40), Wellington Point (4/31) and Stradbroke Islands (12/27). Northeast Queensland, including Cape York, ranked second among the regions, comprising 28% of all articles and 31% of pages. Each of the other six regions featured in less than 8% of the

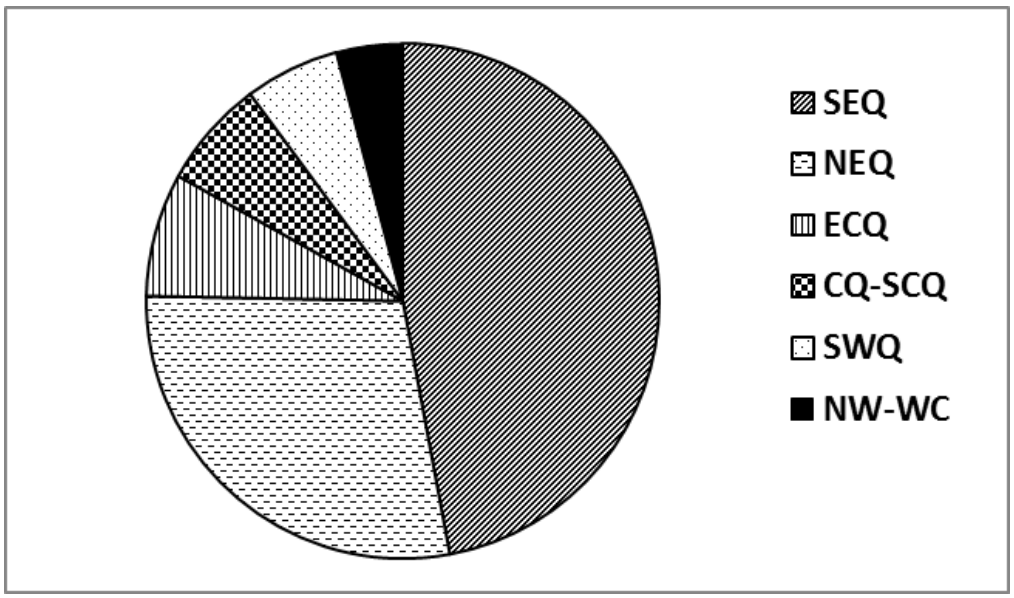

Figure 2. The number of pages of *Sunbird* devoted to different regions of Queensland (1970–2013; n=2795 pages). Excludes articles concerning whole of the state, or regions outside the state, or where locality was unspecified or irrelevant.

articles, and 7% of the pages (Figure 2). In east-central Queensland, Heron Island (5/48) and the Rockhampton area (5/47) were important localities. southwest Queensland received more attention (33/167) than the central-west and northwest (23/117).

Taxonomic spread and major topics

Of the 513 articles in which the subject could be assigned to a particular taxon or ecological group, 41% concerned passerines, a percentage that is remarkably close to their representation in the Queensland checklist. Among the non-passerines, aquatic birds (seabirds, waterbirds and shorebirds) and terrestrial birds were almost equally well represented, with 49.7% of articles and 52.8% of pages concerning the former. Seabirds were featured more than waterbirds and shorebirds in terms of number of articles (24.5% vs 13.6% and 11.6%, respectively) and total pages (21.6% vs 16.2% and 15.1%). Diurnal raptors were the fourth most represented group (Figure 3), their total pages being more than twice that of the next most represented non-passerine order (parrots and cockatoos). Rails followed the latter, which is surprising given the relatively small number of species this family contains.

Among the passerines, honeyeaters (excluding chats) received the most attention, filling 20% of the pages devoted to this order. Another 10% solely concerned the Yellow Chat *Epthianura crocea*. Malurids (fairy-wrens, emu-wrens and grasswrens), finches, Acanthizids (thornbills, gerygones and scrubwrens) and white-eyes (mainly the Silvereye *Zosterops lateralis*) each contributed more than 5% towards the total pages devoted to passerines.

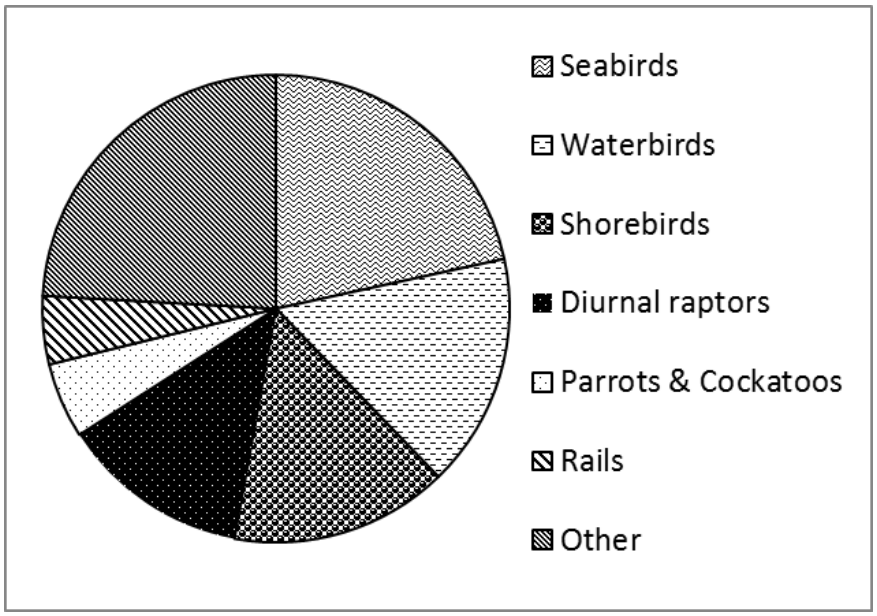

Figure 3. The number of pages of *Sunbird* devoted to various non-passerine groups (1970–2013; n=1337 pages).

The most frequent subject of articles in *Sunbird* by far was behaviour, including breeding biology, feeding behaviour (and/or diet) and vocalisations. Although the average size of articles on these topics was relatively small (4.1 pp), they contributed the most pages overall (Figure 4). The second most frequent subject was geographical distribution of species, mostly range extensions, but again, these articles were relatively short (4.0 pp). Articles about the status, including abundance or seasonality, of species

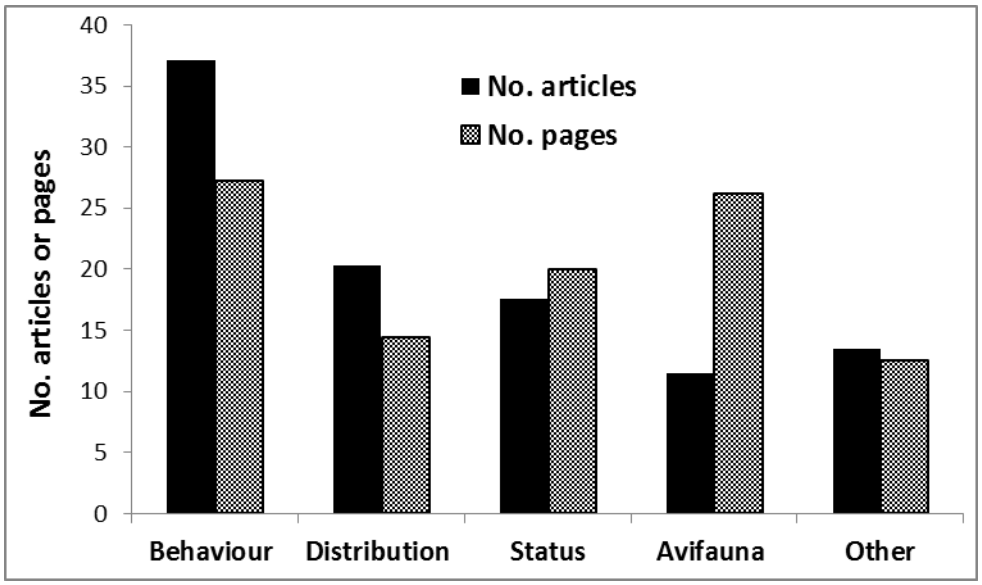

Figure 4. Number of articles (n=625) and pages (n=3516) of *Sunbird* devoted to major topics (1970–2013).

or taxonomic groups (e.g. waders), on the other hand, ranked third in both frequency and volume, as such articles averaged somewhat longer (6.4 pp). In contrast, articles about the avifauna of particular regions, including surveys, were relatively long (on average, 12.7 pp), making their contribution by volume the second largest in the journal (Figure 4). Other subjects, in order of decreasing frequency were species' ecology, human-bird interactions, ornithological history, plumage variations, identification, taxonomy and nomenclature. Using the categories of Ley (2011), the relative contribution of each subject area to *Sunbird,* based on numbers of articles, is remarkably similar to that of *ABW* (Table 4).

Behaviour and distributional studies

Breeding behaviour, including cooperative breeding, was the subject of 81 articles occupying 423 pages, or 13% and 12% of the respective totals, in the journal. Only 22% of the pages and 33% of the articles devoted to this topic concerned passerines, despite species of this order constituting more than 40% of the Queensland checklist. Of the non-passerines, the group that received the most attention in relation to breeding was the waterbirds, contributing 19% of the pages on this topic, and 21% of the articles. The two most prolific authors on this topic were Gordon Beruldsen (6 articles/ 40 pages) and Roger Jaensch (5 articles/ 41 pages). Author of the only book on nests and eggs of Australian birds written in the second half of the 20th century (Beruldsen 1980), Beruldsen contributed far more articles (23) to *ABW* than *Sunbird,* making him the fifth most published author in *ABW* (Ley 2011). Another 13% of articles dealt with foraging behaviour and diet, but occupied fewer pages (318) than articles on breeding behaviour. The most frequently represented taxonomic group were raptors, which

Table 4. Comparison between *Australian Bird Watcher* and *Sunbird* of number of articles on various topics, as defined by Ley (2011)

Topic	*Aust. Bird Watcher*		*The Sunbird*	
	n	**%**	**n**	**%**
Species ecology	352	22.1	140	19.9
Distribution & rarities	347	21.8	127	18.1
Miscellaneous bird biology	215	13.5	104	14.8
Food & feeding	189	11.9	83	11.8
Regional lists	159	10.0	72	10.3
Behaviour	100	6.3	57	8.1
Vocalisations	19	1.2	10	1.4
Taxonomy	8	0.5	7	1.0
Identification	5	0.3	13	1.9
Not classified	200	12.5	89	12.7
Total	**1,594**	**100**	**702**	**100**

contributed 30% of the articles and 37% of the pages on this topic. The diet of frugivores occupied 12% of these articles, but surprisingly few articles were written about the feeding behaviour of nectarivores and granivores (6% each).

The frequency of articles on the distribution of species found in Queensland gradually dropped each decade from 23.7% in the 1970s to 7.5% in the 2000s; the volume of these articles similarly dropped from 11.6% of pages to 5.6%. This decline may be partly due to the intervention of two national bird atlases (Blakers *et al.* 1984, Barret *et al.* 2003), each of which increased our knowledge of the distributional limits of most Australian bird species. However, between the two atlases, from 1984 to 1992, the journal featured annual QOS Bird Reports, which listed 'interesting' records that had been submitted from all parts of the state over the previous calendar year. In the first of these reports, which detailed records submitted by 70 observers, Stewart (1983) suggested a relationship between the large numbers of waterbirds in the state's southeast and a severe drought, a theme that was later explored empirically by Woodall (1985, 1988a). The 1991 Bird Report (Britton 1992) was the largest, comprising 33 pages and containing records for 289 species submitted by 201 observers, including two alleged sightings of the Endangered Coxen's Fig-Parrot *Cyclopsitta diophthalma coxeni*. Sadly, this report was the last of its kind.

Bird counting studies

Articles concerning the birds of a particular region or island, including surveys and counts, were categorised as 'avifauna' for the purposes of this review (Figure 4). From 1972 to 1974, *Sunbird* featured reports and data summaries of the QOS Annual Bird Counts of the Brisbane region, which encompassed a circle of 80 km radius centred near Darra southwest of the city. Due to increasing participation by members over that short period and greater coverage of the survey area, the number of birds counted more than tripled from 8,804 individuals, comprising 191 species, in the first of two counts in 1972 (QOS 1972) to 28,782 individuals, comprising 262 species, in 1974 (QOS 1975). Only two species (Pacific Black Duck *Anas superciliosa* and European Starling *Sturnus vulgaris*) featured among the five most numerous species in all four counts (Table 5). Unfortunately, although bird counts continued until 1983, the journal's annual reports ceased after 1975, replaced by brief summaries in the QOS Newsletter. Nevertheless, the data from these counts provided the basis for valuable detailed analyses of the influence of local and inland rainfall on Brisbane's populations of waterfowl, finches and inland waders (Woodall 1985, 1987, 1988a). The counts were also one of three sources of data used for an analysis of changes in wader numbers in Moreton Bay over three decades (Woodall 1988b).

Table 5. Numbers counted of ten species that were among the five most abundant species (bold values) in at least one of the first three years of QOS Annual Bird Counts. Data extracted from QOS (1972, 1973, 1974, 1975).

Species	Jan-72	Oct-72	Oct-73	Oct-74	No. years in top 5
Pacific Black Duck *Anas superciliosa*	**306**	**806**	**531**	**986**	4
Dusky Moorhen *Gallinula tenebrosa*	122	391	107	**1,194**	1
Purple Swamphen *Porphyrio porphyrio*	221	**1,026**	306	**1,019**	2
Red-capped Plover *Charadrius ruficapillus*	**327**	34	108	77	1
Sharp-tailed Sandpiper *Calidris acuminata*	235	**1,760**	257	395	1
Red-necked Stint *Calidris ruficollis*	**1,006**	78	**367**	546	2
Bar-tailed Godwit *Limosa lapponica*	**270**	537	355	601	1
Fairy Martin *Petrochelidon ariel*	191	**782**	**389**	**760**	3
House Sparrow *Passer domesticus*	178	397	**402**	522	1
Common Starling *Sturnus vulgaris*	**374**	**2,230**	**589**	**797**	4

Another important QOS counting project reported in *Sunbird* was the year-long Garden Bird Survey during 1979–1980. These counts were conducted at many sites on a regular basis, often weekly, to determine seasonal and spatial variation in the abundance of birds in cities and towns of Queensland (Woodall 1995). Analysis of these data revealed that the House Sparrow was, on average, the most numerous and frequently recorded species, followed by the Silvereye *Zosterops lateralis*. In addition, many species were more frequently recorded and numerous in autumn-winter than in spring-summer, including the Willie Wagtail *Rhipidura leucophrys,* Grey Fantail *R. albiscapa* and Rufous Whistler *Pachycephala rufiventris* (Woodall 1995). In 1999–2000, the Garden Bird Survey was repeated to assess changes after 20 years. Nineteen species had increased in frequency and abundance by the second survey, and ten species had declined (Woodall 2002). All species that increased were large-bodied (mostly > 100 g), while decreasing species were small-bodied, with median weights of 207 g and 17 g, respectively (Woodall 2002). This reduction of small birds in gardens was attributed to exclusion by the hyper-aggressive Noisy Miner *Manorina melanocephala,* the smallest of the increasers.

Migration was the subject of 24 articles comprising 91 pages of the journal, representing only 3.8% and 2.8% of the total articles and pages, respectively. The majority (70%) of these articles were written before 1990, and concerned arrival and departure dates of migratory land birds. An interesting exception was that of Woodall (2007), who used data from the above-mentioned Garden Bird Surveys and several other published and unpublished sources to show that Spangled Drongos *Dicrurus bracteatus* exhibited complex movements in southeast Queensland. In some Brisbane suburbs they were present year-round, with a large winter influx, but on the

coast, they were largely winter visitors, and at the higher altitudes of D'Aguilar NP and Toowoomba, summer visitors only. These findings contradict the conclusions of a broad-scale analysis of Atlas data for 407 species (Griffioen & Clarke 2002), which failed to find any strong evidence of movements in this species. Thus Woodall's (2007) study demonstrates the importance of regular counts at fine spatial scales, such as city suburbs, in determining the movements of these birds over the year.

Discussion and conclusions

This review suggests that, despite its much smaller geographic scope, *Sunbird* compares favourably with the *ABW,* having 44% of the number of contributions and 62% of the number of pages of the latter. The number of contributors to *Sunbird* was 53% of that of *ABW,* but the proportion of authors that wrote ten or more contributions was very similar. Moreover, the apportionment of major topics was remarkably consistent between the two journals. As expected, due to the high population density of Brisbane and surrounding regions, there was a significant bias in geographic coverage towards the southeast of the state. The far northeast was also well represented, probably partly owing to the appeal of its endemic tropical rainforest-dependent avifauna.

Perhaps the most surprising discovery from this review is that among the 27 most productive authors, scientists rivalled amateur ornithologists in terms of volume of contributions. Although Ley (2011) did not attempt to analyse the professional status of authors, the vast majority of the major contributors listed in his Table 1 appear to be amateur ornithologists. This disparity between the two journals in participation by scientists may be attributable, at least in part, to the origins of the two organisations, the Bird Observers Club being grounded in the Melbourne birdwatching fraternity, in contrast to that of QOS, which had a strong scientific foundation, beginning with a meeting of staff and students of the Zoology Department at the University of Queensland (Dow 2003a). The Society's Foundation President was Jim (J.D.) Macdonald, long-term curator at the Bird Section of the British Museum of Natural History, Harold Hall Australian Expeditions leader and author of many books and papers about birds of Africa, as well as Australia (Leach 2003; Dow 2003b). Its second President (1972–1975) was Jiro Kikkawa, who became Professor and Head of the School of Zoology at UQ in 1980, and was awarded the Ecological Society of Australia's Gold Medal in 1986 and Birds Australia's D.L. Serventy Medal in 1999.

Early volumes of *Sunbird* featured the results of the QOS Annual Bird Count and Garden Bird Surveys, but the former was discontinued in 1983 and the latter was conducted in only two years, 20 years apart. It seems a shame that these two pioneering initiatives were discontinued for they

almost certainly would otherwise have furnished a unique historical record of changes in the avifauna of southeast Queensland. Similarly, early volumes featured many articles that provided arrival and departure dates of migratory land birds in southeast Queensland and northeast New South Wales (e.g. Pratt 1972; Perkins 1973), but there have been few papers about this subject in the journal since 1990. Yet data on the migration schedules of birds are now more important than ever, given the evidence for changes in the arrival dates of some species in response to a warming climate (Beaumont *et al.* 2006; Chambers & Keatley 2010).

A questionnaire survey of QOS members in 1993 suggested that while most members read the journal, surprisingly few contributed articles (Rounsevell & Kuerschner 2011). Indeed Rounsevell & Kuerschner (2011) concluded that while "some outstanding and consistent contributions from a few club members have found their way onto the pages of *Sunbird,* articles from non-Birds Queensland (QOS) authors are the life blood of the journal". One reason for the lack of contributions by members could be the widespread perception that we already know all there is to know about the life history and ecology of Australian birds, a misconception reinforced by the large number of 'coffee table' bird books on the market. Another factor may be apprehension fuelled by the belief that analysing and publishing field data requires the use of sophisticated software, and an understanding of complex statistical procedures. In relation to this misconception, I can do little better than quote the words of the first QOS President, J.D. Macdonald, which remain as pertinent today as they were when they were printed 46 years ago:

> *There may be certain people who hesitate to join the Society, because they feel they do not measure up to what is implied by the terms "scientific" and "ornithology". But they need have no misgivings; anyone who can make an accurate observation on any aspect of bird life and who takes the trouble to record it is contributing as much to knowledge as those who accurately observe and record the shape of a bone or artery or submit analyses of blood samples. The society wants such people to be members of the Society and to co-operate in achieving its aims.* (Macdonald 1969).

Given the ever-increasing imperative for scientists and students to publish their findings in high impact journals, *Sunbird* has become more dependent than ever on contributions from amateur ornithologists and birdwatchers. There is huge scope for members of Birds Queensland and other ornithological organisations to fill the enormous gaps in our knowledge of the life history and ecology of Australia's birds, especially those of the tropical and arid regions.

Acknowledgments

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The Contribution of Queensland Birdwatchers to Ornithology: How Does it Compare With That of Other States?

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Abstract

Among the activities promoted by the original Council of the Queensland Ornithological Society (QOS, now known as Birds Queensland) in 1969 were participation in the Nest Record Scheme (NRS) of the Royal Australasian Ornithological Union (now BirdLife Australia) and involvement in bird banding studies. In this review I evaluate the contribution of Queensland birdwatchers to these two activities since 1969, and compare this with their participation in four national bird survey projects. Contrary to the aspirations of those QOS pioneers, participation in the NRS and bird banding has been poor. The number of nest records submitted in Queensland ranked fifth among the eight states and territories, and the number of participants in Queensland was second lowest. Similarly, the number of registered banders in Queensland from 1953 to 2013 ranked last and second last among all states and territories in terms of their total population and surface area. The number of birds banded in Queensland ranked third last.

During the two national bird Atlases, Queensland was the least well surveyed of the eastern states. However, in terms of its population, Queensland's contribution was 50–70% higher than that of either New South Wales or Victoria. Similarly, adjusting for its small population, Queensland was the largest contributor of the three eastern states to Eremaea-eBird from 2010 to 2014. Projects which involved counting birds, like the Annual Bird Counts (1972–1983) and Garden Bird Surveys (1979, 1999), were popular in the early days of QOS, but today, only the small, but highly dedicated Queensland Wader Study Group conducts regular counts. Predicting the responses of birds to climate change and other human-induced impacts rely on a detailed knowledge of the timing of breeding and movements, yet such information is still lacking for the majority of land bird species in Queensland. Birdwatchers and other 'citizen scientists' offer the only hope that such knowledge will be obtained before it is too late.

Introduction

The Queensland Ornithological Society (QOS), now known as Birds Queensland, was formed in October 1969 with the aim of promoting 'the scientific study and conservation of birds, by all means possible, with particular reference to the birds of Queensland' (Macdonald 1969: 1). To achieve these aims, the original Council envisaged members being involved in the following activities: (a) field outings, (b) the Nest Record Scheme (NRS), (c) bird banding studies, (d) bird photography (partly for use in the Society's journal), (e) recording of bird calls, (f) encouraging junior members, and (g) a scientific journal covering all aspects of Queensland ornithology (Straw 1969; Niland 2004). Regarding the second activity (b), the

Council hoped that 'members of the Society can be encouraged to participate in the already existing RAOU Nest Record Scheme' (Straw 1969: 3). In relation to the third activity (c), it was stated that 'members will already be fully aware of the operations of the Australian Bird Banding Scheme conducted under the auspices of the CSIRO Division of Wildlife Research. As so few bird banders are working in Queensland at present it is hoped that the Society can encourage members to take an active interest in banding projects' (Straw 1969: 3).

In this review I evaluate the contribution of Queensland birdwatchers to these two schemes since 1969, by comparing their participation levels with those of birdwatchers from other states and territories. I also examine the level of participation of Queenslanders in four national volunteer programs, comprising the two Atlases of Australian Birds, the Australian Bird Count and eBird. A review of the content of the Society's journal, *Sunbird,* is presented separately (Noske 2015).

Nest Record Scheme

Despite the impression that may be gained from the many coffee-table bird books, we know very little about the breeding biology of a large proportion of Australia's birds, especially those of the tropics (Clarke 1997; Noske & Franklin 1999; Noske 2003). In his review of studies of avian breeding biology in Australia from 1986 to 1995, Clarke (1997) showed that the vast majority of intensive studies were conducted near capital cities in temperate regions by professional researchers affiliated with academic or scientific institutions, rather than amateurs. There was also a strong bias towards sedentary species that breed colonially or cooperatively, probably due to the relative ease with which large datasets could be accumulated with the minimum amount of time and resources. Such datasets increase the chances of publishing papers in scientific journals with higher impact factors, and consequently, the researcher's potential for professional advancement (Clarke 1997).

Beginning in 1963, the Nest Record Scheme is BirdLife Australia's (formerly RAOU) longest-running bird project, allowing both amateur and professional ornithologists to contribute information about all aspects of breeding of Australian birds. Its important contribution to ornithology can be gauged from inclusion of NRS data in the breeding section of the vast majority of Australian species in the *Handbook of Australian, New Zealand and Antarctic Birds (HANZAB),* wherein it is often the only source of information on breeding seasons, nest location, clutch size, incubation and nestling periods, and breeding success (BirdLife Australia 2015).

Up until 2006, the NRS had amassed almost 87,000 records of nests of Australian birds. Although 271 observers (14% of the total number) submitted nesting records of Queensland birds, the number of submitted

records ranked fifth among the eight states and territories (Table 1). In terms of the state's area, the number of nest records from Queensland ranked second last, the only lower effort coming from the NT, where the population is roughly 5% of that of Qld. In terms of its population, the number of observers in Queensland was also the second lowest among all states and territories (Table 1). Thus the Queensland contribution to the Nest Record Scheme is considerably less than that of most other parts of Australia, indicating that the initial QOS aim of assisting this scheme was over-optimistic.

A breakdown of Queensland nest records by individual species shows some woeful sample sizes and alarming gaps. Of an estimated 470 breeding species in the state (Noske, unpublished data), less than half (206) were represented in the NRS by Queensland records, and of these, 41% were represented by one to four records only. Among those species with only one record from Queensland are the Mangrove Honeyeater, Barred Cuckoo-shrike and Spectacled Monarch (Table 2), species whose range falls largely or wholly within this state. Similarly, it seems almost inconceivable that there was only one Queensland record for such common, widespread species as the Rainbow Lorikeet, Varied Sittella and Fuscous Honeyeater. Likewise, the White-throated Treecreeper, Brown Thornbill and Bell Miner, highly abundant species in southeast Queensland, were each represented by only two or three records. On the other hand, the number of records submitted for common urban species, such as the Noisy Miner, Magpielark and Willie Wagtail was relatively high (Table 2).

Table 1. Numbers of participants to the Nest Record Scheme (to 2006) from each state and territory in terms of human population, and numbers of NRS records in terms of state's area.

State/territory	Observers		Records		
	No.#	Per head of mean population* x 10^4	No.#	% total	Per sq km^4
New South Wales	461	0.88	30,089	34.6	37.6
Victoria	499	1.26	21,527	24.8	94.7
Western Australia	192	1.46	11,409	13.1	4.5
South Australia	238	1.82	8,744	10.1	8.9
Queensland	**271**	**1.13**	**6,334**	**7.3**	**3.7**
Tasmania	112	2.62	4,231	4.9	61.9
ACT	68	3.12	2,677	3.1	1135.3
Northern Territory	96	7.72	1,953	2.2	1.4
Total	**1,937**	**1.29**	**86,964**	**100**	**11.3**

Data provided by BirdLife Australia.

*As 99% of records were submitted before 1999, average state populations for years 1963 to 1998 were calculated from Australian Bureau of Statistics (2015) data.

Table 2. Queensland nest records for 25 selected species to 2006 (source: BirdLife Australia Nest Record Scheme).

Species	No. records
Rainbow Lorikeet *Trichoglossus haematodus*	1
Crimson Rosella *Platycercus elegans*	1
Fan-tailed Cuckoo *Cacomantis flabelliformis*	1
Spectacled Monarch *Symposiachrus trivirgatus*	1
Barred Cuckooshrike *Coracina lineata*	1
Common Cicadabird *Coracina tenuirostris*	1
Varied Sittella *Daphaenositta chrysoptera*	1
Mangrove Honeyeater *Gavicalis fasciogularis*	1
Fuscous Honeyeater *Ptilotula fusca*	1
Spiny-cheeked Honeyeater *Acanthagenys rufogularis*	1
Satin Bowerbird *Ptilonorhynchus violaceus*	1
Buff-banded Rail *Gallirallus philippensis*	2
Pied Oystercatcher *Haematopus longirostris*	2
Pheasant Coucal *Centropus phasianinus*	2
White-throated Treecreeper *Cormobates leucophaea*	2
Eastern Cattle Egret *Bulbulcus coromandus*	2
Shining Bronze Cuckoo *Chrysococcyx lucidus*	3
Little Shrikethrush *Colluricincla megarhyncha*	3
Brown Thornbill *Acanthiza pusilla*	3
Bell Miner *Manorina melanophrys*	3
Australian Magpie *Gymnorhina tibicen*	68
Welcome Swallow *Hirundo neoxena*	87
Noisy Miner *Manorina melanocephala*	125
Magpie-lark *Grallina cyanoleuca*	129
Willie Wagtail *Rhipidura leucophrys*	149

A good example of the paucity of information available on the breeding biology of eastern tropical-subtropical birds is the White-eared Monarch *Carterornis leucotis,* which is endemic to coastal Queensland and the far northeast corner of New South Wales. Despite its occurrence on the outskirts of Brisbane, it was represented in NRS by one record concerning a nest found in Innisfail in 1966 (Higgins *et al.* 2006). Aside from descriptions of its nest and eggs from collectors during the first half of the 20th century, the only information available on the breeding biology of this species derives from Beruldsen (1978), who described the dates, sites and contents of six nests in Noosa National Park. The incubation and nestling periods, and the roles of the sexes in incubation and provisioning of young of this species are unquantified, despite estimates or statements given in secondary sources (e.g. Schodde & Tidemann 1986; Boles 1988). Clearly many opportunities remain for Queensland birdwatchers to contribute to our understanding of the breeding biology of this and many other tropical and sub-tropical species.

Bird banding

Much of what is known about the demography or life history of birds, including longevity, survival rates, mobility, migration routes and timing, social organisation, breeding biology and success, has derived from studies employing banding. The forerunner of the Australian Bird and Bat Banding Scheme (ABBBS) began in 1953 under the auspices of CSIRO Division of Wildlife Research, which passed administration of the scheme over to the Australian National Parks & Wildlife Service (now the Department of Sustainability, Environment, Water, Population and Communities) in 1984. Apart from storing banding data, ABBBS issues bands and oversees the recruitment of bird and bat banders in Australia (ABBBS 2015).

Queensland trails well behind most other states in respect of the number of people conducting bird banding studies. Though the number of active registered banders in Queensland in 2014 ranked fourth among the eight states and territories, in terms of its total human population size, this state ranks last (Table 3). In terms of banders per square kilometre, too, Queensland ranks equal second last with Western Australia. Finally, in terms of numbers of birds banded, Queensland ranks third last, with a mere 5.9% of all banded birds being banded in this state; only the two territories (ACT and NT) have lower totals. However, unlike most states, the number of birds banded per annum since 2006 has risen in Queensland, largely due to the efforts of Jon Coleman and his team of volunteers working in southeast Queensland.

Table 3. Numbers of bird banders (to March 2012) by state and territories in terms of total population*, area of state and numbers of birds banded - including mean numbers before and after 2006. All data supplied by Australian Bird and Bat Banding Scheme.

State/territory	No. banders	Per head population x 10^6	Per 10^5 km^{-2}	No. birds banded	% all birds	Mean no. banded per annum	
						1953–2005	2006–2012
Victoria	132	2.4	58.0	791,307	25.11	13,475	9,389
New South Wales	117	1.6	14.6	682,437	21.65	11,798	6,830
Western Australia	90	3.9	3.6	503,322	15.97	10,868	14,283
Queensland	**61**	**1.4**	**3.5**	187,146	**5.94**	**2,893**	**4,316**
South Australia	46	2.8	4.7	602,774	19.13	7,406	2,847
ACT	45	12.33	1908.4	68,066	2.16	1,207	464
Tasmania	27	5.3	39.5	257,346	8.17	4,490	2,286
Northern Territory	20	8.7	1.5	59,011	1.87	1,018	608
Total	**538**			**3,151,409**		**53,154**	**41,023**

*Based on 2010 values (Australian Bureau of Statistics 2015).

Part of the reason for the poor banding effort in Queensland prior to 2006 is historical. The *Fauna Conservation Act* of 1952 had no provisions for research, and even in the late 1960s, the Queensland government had reluctantly agreed to allow only 50 bird-banding permits to be issued in the state (Dow 2003). One of those first licenced banders was John ('Jack') Robertson, who banded many thousands of birds on his property at Wellington Point, c. 20 km southeast of Brisbane, between 1963 and 1978, and published several papers on morphometrics and migration of honeyeaters (Robertson 1966; Robertson & Woodall 1982a, b; Robertson & Woodall 1983). The first long-term banding project on birds of the Australian tropical rainforest was conducted by Cliff and Dawn Frith on the Paluma Range, northeast Queensland, over 20 years (1978–1997). In addition to their many publications on the biology of the bowerbirds, Frith & Frith (2005) provided the first data on the survival, longevity, moult, breeding, ageing and sexing characters, territoriality and movements of many other species endemic to the Wet Tropics.

Since 1990, banding has also been conducted at 2 or 3-yearly intervals in tropical rainforest at Iron Range National Park, Cape York, by a large number of banders from around Australia. The data have yet to be analysed, except for the White-faced Robin *Tregellesia leucops,* which was found to be highly sedentary and long-lived, with 15% of the recaptured birds (n=68) being at least 10 years old, and the oldest individual being 18 years old (Coleman *et al.* 2012). Given the uniqueness of the Cape York avifauna, where many species are endemic or shared only with New Guinea (Frith & Frith 1991), it is unfortunate that the Queensland Department of Environment and Resource Management chose to discontinue this banding project in 2013.

Banding and leg-flagging have been vital in illuminating the migration routes and duration of most of the 36 species of waders that migrate annually from the Northern Hemisphere to Australia. Mist-netting or cannon-netting began in 1970 in New South Wales, soon to be followed by Western Australia in 1972, Victoria in 1975, and Tasmania in 1979 (Minton 2005). However, wader banding did not start in Queensland until 1989, and was temporarily suspended in 1999, when the only licenced cannon-netter, Peter Driscoll, became unavailable, then moved away from the area (Minton 2005). Meanwhile wader counts undertaken around Brisbane proved that Moreton Bay was an internationally important wintering site for several wader species (Thompson 1993; Harding 1998), including the Grey-tailed Tattler *Tringa brevipes* and Bar-tailed Godwit *Limosa lapponica.*

Since 2006 all waders banded in Moreton Bay have been fitted with individually engraved leg flags. Monthly high tide roost counts by the Queensland Wader Study Group (QWSG) provided multiple re-sightings of 41 individual Grey-tailed Tattlers one season after banding, 18 of which

were re-sighted two seasons after banding, mostly at the roost site where they had been banded (Coleman & Milton 2012). An even higher proportion of the flagged Bar-tailed Godwits returned to their banding roosts two seasons after banding, demonstrating that year after year, a high proportion of these two species return to the same roosting and feeding sites in Moreton Bay (Coleman & Milton 2012).

Since 2011, tiny light sensing geo-locators have been attached to the leg flags of 41 Grey-tailed Tattlers in Moreton Bay, three of which have since been re-captured (Coleman 2012; QWSG 2015). The data downloaded from the geo-locators showed that although all three travelled northward to Kamchatka Peninsula in far eastern Russia, they each took different routes and it took them as little as 27 days to get there. Their southbound migration routes to Brisbane, on the other hand, were similar and more direct (Coleman 2012). Knowledge of the migration routes and staging sites is of paramount importance in determining the causes of the now well-established declines of several wader species visiting the region (Wilson *et al.* 2011).

Bird Atlases and eBird

The two national Atlases of Australian birds were organised by the RAOU and its successor Birds Australia (now BirdLife Australia). The first *Atlas of Australian Birds* (Blakers *et al.* 1984) began only seven years after the inauguration of QOS, spanning the five years from 1977 through 1981. During that period, the percentage of all Atlas sheets and records emanating from Queensland totalled approximately 16% and 19%, considerably less than those from New South Wales and Victoria (Table 4). Relative to the area of each state, the numbers of both surveys and records submitted for Queensland was about a third of those of New South Wales, and 11% of those of Victoria (Table 4). Twenty years later, the second Atlas (Barrett *et al.* 2003) showed little change in the relative contributions of these three states in terms of their total area. However, in terms of its total population, Queensland's contribution is superior to that of the other states. In the first Atlas, the number of surveys per head of the population of Queensland was 50% higher than those from either New South Wales or Victoria, and in the second Atlas, it was 70% higher (Figure 1).

Eremaea Birds, launched in 2003, offered the first open access, online checklist program in Australia and it soon became very popular with both birdwatchers and scientists. In February 2014, Eremaea Birds merged with eBird, originally launched in 2002 by the Cornell Lab of Ornithology and National Audubon Society in USA (Eremaea-eBird 2015). From 2010 to 2014, the proportion of all checklists submitted for Queensland almost rivalled that for Victoria, and was 38% higher than that for New South Wales (Table 4). In terms of the size of the state, Queensland again fared worst (Table 4), but in terms of its population, it remained the largest

Table 4. The contribution towards national Bird Atlases and eBird from Queensland, compared to those of other eastern states in terms of the area of each state. Highest values in each row are in bold type.

Scheme	Period	Metric	Qld	NSW	Vic
Atlas 1*	1977–1981	Percentage of all surveys	16.3	**24.1**	19.0
		No. surveys per 1000 km²	8.4	26.8	**74.6**
		Percentage of all records	18.8	**27.6**	22.7
		No. records per 1000 km²	29.5	93.6	**270.5**
		No. records per head population	**22.8**	14.6	15.8
Atlas 2#	1998–2002	Percentage of all surveys	18.3	**24.7**	18.6
		No. surveys per 1000 km²	29.4	85.7	**226.8**
eBird§	2010–2014	Percentage of all checklists	28.1	20.3	**29.4**
		No. checklists per 1000 km²	34.8	54.4	**277.1**

* Extrapolated from Blakers *et al.* (1984; Table 1).
# Extrapolated from Barrett *et al.* (2003; Appendix 2); number of records not shown.
§ Data downloaded on 7 June 2015 (Mat Gilfedder, pers. comm.).

contributor, with over three times more checklists per head of population than New South Wales (Figure 1). These results suggest that Queensland remains under-surveyed because of its large area, yet considering its small population relative to the other eastern states, its coverage has been exceptionally high.

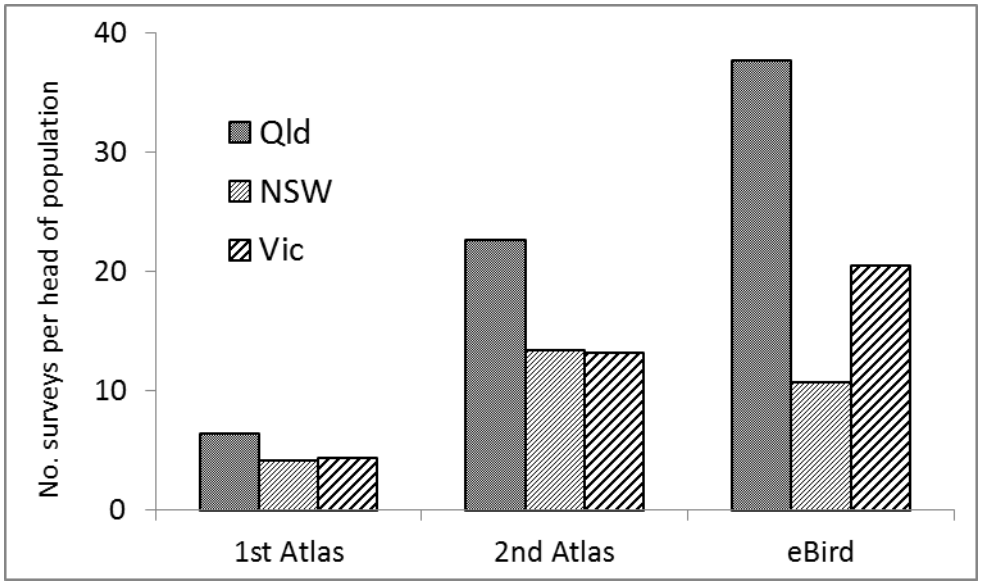

Figure 1. The relative contribution of the three eastern states to the two national Bird Atlases and eBird, based on number of surveys submitted per head of population.

Bird counting projects

While species lists can furnish information on seasonal movements if surveys are repeated several times per year in multiple locations (Griffioen & Clarke 2002; Barrett *et al.* 2003), detecting changes in the size of local populations requires repeated counting of individual birds. In 1989 Birds Australia embarked on an ambitious project called the Australian Bird Count (ABC) to gain greater insight into the extent and nature of movements of migratory bush birds. By mid-1995, almost 80,000 surveys had been completed at over 2,000 sites spread across the continent (Clarke *et al.* 1999). The state with the most 'Cabbies' (Counters of Australian Birds) was New South Wales, but Queensland boasted the second highest number of contributors (Table 5). Three Queenslanders were among the top 20 most diligent contributors, all of whom submitted over 400 surveys (data supplied by A. Silcocks). Analyses of data from both the ABC and Atlases provided the first empirical evidence of north-south migration by Australian Pipits *Anthus australis* and Scarlet Myzomelas *Myzomela sanguiolenta,* and of inland-coastal movements by Australian Golden Whistlers *Pachycephala pectoralis* (Clarke *et al.* 1999).

Members of QOS were engaged in counting birds very early in the history of the Society. Inspired by annual bird counts in the USA, and the first bird count in Australia organised by the Bird Observers' Club in Melbourne four years before, QOS members embarked on the first Annual Bird Count of the Brisbane region in January 1972 (QOS 1972). Their first count involved just 14 participants in three teams, but by 1974, the number of participants had more than quadrupled to 63 people divided among 11 teams, each of which covered different parts of the region (QOS 1975). Sadly, these bird counts were discontinued after 1983 (Noske 2015).

Table 5. Contributions to Australian Bird Count by state. Based on data supplied by BirdLife Australia (8 June 2015).

State/territory	Observer's state (%)	Mean surveys per observer	Surveys in state (%)
New South Wales	39.0	62.1	33.4
Queensland	**16.5**	**66.3**	**15.2**
Victoria	15.7	90.2	18.1
Western Australia	11.6	102.5	16.5
South Australia	7.7	78.0	7.5
Tasmania	4.0	69.6	4.0
ACT	3.2	63.7	2.3
Northern Territory	2.3	94.3	3.1
n	1,063	74.2*	78,884

*Mean no. surveys for all observers.

Wader counting is the core activity of QWSG, which was established in 1992 as a special interest group of QOS with the purpose of monitoring wader populations in Queensland and supporting research concerning their conservation. Count data collected by this group at 180 coastal sites in Moreton Bay over 16 years (Milton & Driscoll 2006) were vital in demonstrating significant declines in the populations of seven of the 22 migratory wader species visiting the region (Wilson *et al.* 2011). QWSG continues to monitor waders of the Bay on a monthly basis.

In 1998 Birds Australia launched its award-winning Birds in Backyards (BIBY) program, designed to address the loss of native bird species from urban landscapes through volunteer surveys, research, education and conservation action (Birds in Backyards 2015). Yet, the idea of counting birds in backyards had been championed by QOS almost two decades before the instigation of BIBY. During 1979–1980, QOS members conducted a year-long Garden Bird Survey to investigate seasonal and spatial variation in the abundance of birds in cities and towns of Queensland. Nearly 100 members participated in the survey, many counting birds on a weekly basis. A total of 2,826 lists were submitted, and 136,388 individual birds belonging to 257 species counted (Woodall 1995). Twenty years later, during 1999–2000, the Garden Bird Survey was repeated (Woodall 2002). Some results of these surveys are highlighted in Noske (2015).

Conclusions

This review demonstrates that, contrary to the aspirations of the pioneers of QOS, participation of Queensland birdwatchers in the NRS and in bird banding projects has been poor compared with that of birdwatchers from other states of Australia. Until 2006, participation in bird banding projects in Queensland had been limited, possibly partly due to state legislation which hampered attempts by amateur ornithologists to be involved in such research. Similarly, the contribution of Queenslanders towards the NRS has been disappointing, especially given the large gaps in our knowledge of the breeding biology of Australian tropical birds, and the considerable potential for tropical-temperate comparisons which have been so important in the development of life history theory (e.g. Martin 1996; Russell 2000).

In contrast to the above, the participation level of birdwatchers from Queensland to national Bird Atlases, Eremaea-eBird and ABC compares very favourably with that from other states. Historically, bird counting projects have been popular among QOS members as evidenced by the pioneering QOS Annual Bird Counts (1972–1983) and Garden Bird Surveys (1979, 1999). Today, however, this tradition continues only through the small, but highly dedicated QWSG, whose longstanding efforts have helped to reveal the shocking decline of many migratory waders wintering in Australia (Wilson *et al.* 2011). Ironically, due to the application of satellite

transmitters and geo-locators, we now arguably know more about the migration routes and schedules of many migratory shorebirds that fly over 22,000 km back and forth to Far East Russia each year, than we do about most of our common land birds that migrate only c. 2,000–5,000 km up and down the eastern seaboard. Of 472 land bird species breeding in Australia, almost 40% are partial migrants, with both sedentary and migratory populations (Chan 2001). We are still largely ignorant of the relative proportions of these populations in any part of Queensland, and of the sources, destinations and routes of their migratory populations, in the vast majority of these species. Monthly, or preferably weekly, counts across multiple sites, preferably simultaneously, would help to fill in these knowledge gaps (Noske 2013).

Studies of the responses of birds to climate change, and the development of actions to address them, rely on a detailed knowledge of the phenology or timing of their reproduction and movements (e.g. Chambers & Keatley 2010). Yet such information is still lacking for the majority of land bird species in Queensland (Noske 2015). While some of this information was furnished by scientists in the past, the collection of such data has increasingly become the responsibility of birdwatchers and other 'citizen scientists'. Echoing the optimism of the original QOS Council, almost three decades earlier, Clarke (1997) beseeched ornithological societies to actively encourage and facilitate the study of breeding behaviour in Australian birds. Sadly, the achievement of this objective remains as elusive today as ever, and it seems inevitable that we will never have the phenological knowledge that is required to accurately predict the responses of most of Queensland's land birds in the face of multiple threatening processes. Nevertheless, a well-designed project may yet furnish such information for selected species, assuming the involvement of a large number of birdwatchers. The future of our birds may depend on it.

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Large-tailed Nightjar *Caprimulgus macrurus* on the Maroochy River of Queensland's Sunshine Coast: a Probable Recent Expansion of Range

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Abstract

Observations of Large-tailed Nightjar *Caprimulgus macrurus* made during 2012 and 2013 in estuarine wetland habitats of the Maroochy River of southeast Queensland apparently represent the first records of the species from the Sunshine Coast and indicate that the lower Maroochy River area supports a resident, breeding population. This locality is more than 60 km south of the previously published coastal limit of distribution of the Large-tailed Nightjar. Although constituting only a minor extension to the species' known distribution, these records are nevertheless significant because they strongly suggest this population is a newly established one. Climate change offers a plausible explanation for the bird's southward range expansion into previously unoccupied areas. With ongoing climatic warming predicted, the Large-tailed Nightjar may be expected to continue expanding its Queensland distribution southwards.

Introduction

The Large-tailed Nightjar *Caprimulgus macrurus,* a species readily detected and easily recognised by its prolonged bouts of monotonous, far carrying *chop-chop-chop* calling (e.g. Barnard 1935; Schodde & Tidemann 1986; Hollands 1991; Pizzey & Knight 1997), is distributed widely in the north and east of Australia. In the Northern Territory, it occurs mostly in the northern Top End, east to the Gove Peninsula, Groote Eylandt and the islands of the Sir Edward Pellew Group in the Gulf of Carpentaria (Higgins 1999). In Queensland, its distribution stretches from the western side of Cape York Peninsula, around the Cape and down the east coast to Fraser Island and the Cooloola Section of Great Sandy National Park (NP; previously called Cooloola NP) in southeast Queensland (SEQ), although the species is thought to be patchily distributed south of Ingham (Schodde & Mason 1980; Storr 1984; Debus 1994; Pizzey & Knight 1997; Higgins 1999; Barrett *et al.* 2003). Prior to 2012, the most southerly documented records of the species were from Cooloola: an unspecified locality in the NP, 26°5'S, 153° 3'E (Britton 1992); the Teewah Bridge area, 26°4'S, 153°3'E (Beruldsen 1991); North Noosa Plain, 26°3'S, 153°3'E (Hadley 1991); and near Coops Corner, 26°2'S, 153°2'E (WildNet; D. McFarland personal communication).

Across its range, the Large-tailed Nightjar is associated with margins of rainforest, vine forest, woodland and mangroves, as well as paperbark (*Melaleuca*) swamps and gallery forests, usually occurring at ecotones between vegetation communities or at the edges of clearings (e.g. Marshall 1934;

Barnard 1935; Schodde & Mason 1980; McLean 1983; Storr 1984; Schodde & Tidemann 1986; Hollands 1991; Debus 1994; Pizzey & Knight 1997; Higgins 1999; Slater *et al.* 2009). Birds typically roost and nest in leaf litter under the cover of dense vegetation, but near the edge of open areas, where they forage at night (Opit 1975; Schodde & Mason 1980; Debus 1994). Large-tailed Nightjars are sedentary, maintaining permanent territories occupied by pairs or family groups of three to four birds (Barnard 1935; Schodde & Mason 1980; Hollands 1991; Debus 1994). The breeding season is variously stated as being August–January (Schodde & Mason 1980; Hollands 1991; Debus 1994), July–November (Storr 1984) and October–January (Barnard 1935), with egg-laying peaking between September and November (Schodde & Mason 1980). The species is expected to breed throughout its tropical and subtropical range (Higgins 1999), however, breeding has only been documented south to the 23°–24°S grid cell (McLean 1983; Blakers *et al.* 1984; Higgins 1999) and, during the second Bird Atlas, was not recorded south of 18°–19°S (Barrett *et al.* 2003).

This paper details records of the Large-tailed Nightjar from the Maroochy River of the Sunshine Coast in SEQ, a location over 60 km further south than any previously published reports of the species. This unexpected discovery prompted speculation over whether the species had only recently expanded its range southward or whether it had previously been overlooked. These issues are explored and possible additional localities at which the Large-tailed Nightjar may occur on the Sunshine Coast presented.

Study area and methods

All field visits were conducted between October 2012 and January 2014 in estuarine wetlands along the Maroochy River in Marcoola and Bli Bli on the Sunshine Coast of SEQ (Figure 1). These wetland areas are approximately 9–11 km upstream of the river's mouth at Maroochydore and Twin Waters.

Marcoola

Initial records of Large-tailed Nightjars were made opportunistically (by the author, R. Donald, J. Kaluza and D. Benfer) during a survey for Water Mouse *Xeromys myoides* on the night of 25 October 2012 near the northern end of the section of the Maroochy Wetlands Regional Park (RP) that fringes the eastern bank of the Maroochy River (centred on 26°35'51"S, 153°3'33"E). This protected area was accessed by arrangement through private property on Finland Road, to the west of the Sunshine Motorway. The reserve, which is sandwiched between the river and land cropped for sugar cane, supports floristic communities typical of such estuarine situations: saltpan vegetation, including Marine Couch *Sporobolus virginicus* grassland, herbland and sedgeland on marine clay plains (Regional Ecosystem [RE] 12.1.2; Sattler & Williams 1999); mangrove shrubland to

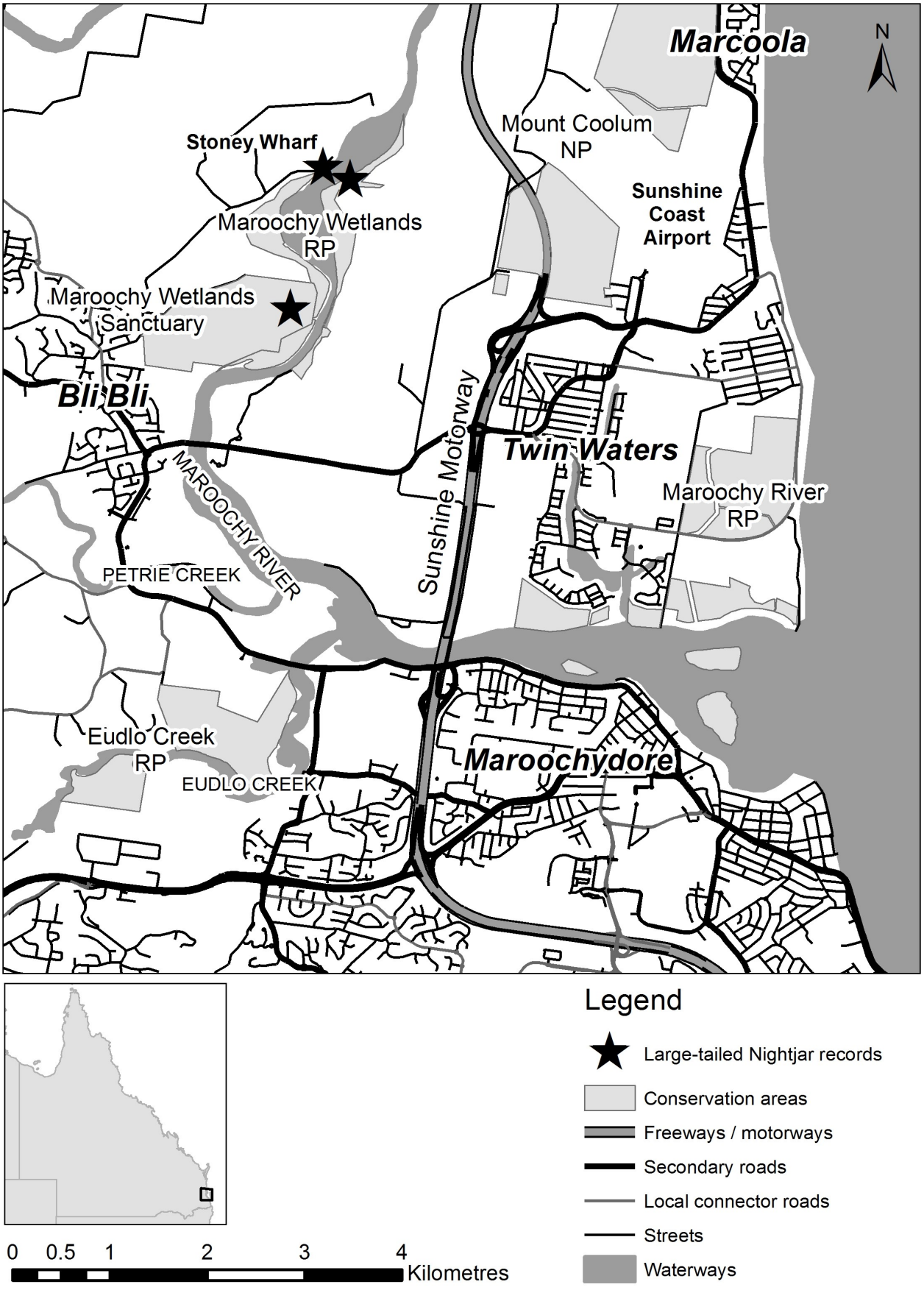

Figure 1. The lower Maroochy River system, Sunshine Coast, showing locations where Large-tailed Nightjar records were made. Conservation areas referred to in the text are also indicated.

low closed forest on marine clay plains and estuaries (RE 12.1.3); and areas of Swamp Oak *Casuarina glauca* woodland situated on the margins of the marine clay plains (RE 12.1.1; although of insufficient extent to appear in RE mapping of this area).

Calls of Large-tailed Nightjars were first heard coming from the western side of the river (see Bli Bli), but after a few minutes calling commenced close to our campsite on the eastern bank. However, due to a commitment to the Water Mouse survey, only a brief attempt to locate the vocalising individual was made.

This section of Maroochy Wetlands RP was revisited during the daytime on 5 January 2014, primarily for the purposes of compiling a vegetation description of the site and photographing the area, but the exercise also provided an opportunity to conduct a non-exhaustive search for roosting Large-tailed Nightjars.

Bli Bli

Following the initial detection of the Large-tailed Nightjar described above, various locations at Bli Bli (Cook Road, Stoney Wharf and the Maroochy Wetlands Sanctuary) were visited for follow up searches for this species between January 2013 and January 2014. Cook Road (26°37'8"S, 153° 2'59"E), on the eastern side of the Maroochy River, downstream of Maroochy Wetlands RP, was visited at around 2145 hrs on 12 January 2013 to listen for calls of the Large-tailed Nightjar over a period of 15 mins. This road, which is accessed from David Low Way, passes through areas of mangroves and Marine Couch grassland before it terminates in a residential area that backs onto a mangrove wetland.

Stoney Wharf, at the northern end of Stoney Wharf Road (26°35'47"S, 153°3'24"E), lies on the western bank of the river at a point almost directly opposite our 2012 Water Mouse survey campsite (in the eastern section of Maroochy Wetlands RP – see Marcoola) and was approximately where the first Large-tailed Nightjar calls emanated on the evening of 25 October 2012. Upstream and downstream of Stoney Wharf are extensive stands of mangroves (RE 12.1.3). Those on the downstream side, i.e. within the western section of Maroochy Wetlands RP, are flanked on their landward side by cleared residential land. In the upstream direction, the vegetation communities are more intact, with a broad stand of Swamp Paperbark *Melaleuca quinquenervia* open forest (RE 12.3.5a) forming a palustrine wetland behind the mangroves. Small stands of Swamp Oak (RE 12.1.1) are also present.

Stoney Wharf was visited at 1930 hrs on 12 January 2013 when 10–15 mins were spent passively listening for calls of Large-tailed Nightjars. The site was again visited (with C. Neligan) at 1500 hrs on 17 November 2013, when a period of 45 mins was spent searching for roosting or nesting Large-

tailed Nightjars in areas supporting Swamp Oak and Swamp Paperbark forest and closed mangrove communities dominated by Large-fruited Orange Mangrove *Bruguiera gymnorhiza* and Grey Mangrove *Avicennia marina*. At 1845 hrs, just after dusk, we returned to listen for 5 mins before conducting 5 mins of call playback, using Large-tailed Nightjar calls from a Nature Sound compact disc (CD; Stewart 2002), a portable CD player (a Sony Walkman) and a megaphone to maximise the broadcast range. This was followed by a further 5 mins of listening. Subsequently, additional periods of passive listening were conducted: a) around 1900 hrs, southwest along Stoney Wharf Road near intersections with Twin Peaks Road (26° 35'56"S, 153°3'5"E) and Espin Road (26°36'1"S, 153°2'54"E), both being sites at which the mangroves of the regional park are relatively close, and b) from 1915–1930 hrs, along Sports Road (centred on 26°36'29"S, 153° 2'43"E), which forms the northern boundary of the Maroochy Wetlands Sanctuary (see below) and runs through Swamp Paperbark open forest (RE 12.3.5a).

The Sunshine Coast Council's Maroochy Wetlands Sanctuary (centred on 26°36'40"S, 153°2'58"E) protects a large remnant of natural vegetation on the western side of the Maroochy River and is contiguous with the western section of the Maroochy River RP. Regional ecosystems found here are those already described above (REs 12.1.1, 12.1.2, 12.1.3 and 12.3.5a), but an additional small area of 'wet eucalypt forest' (RE 12.9-10.1; tall open forest with *Eucalyptus resinifera*, *E. grandis*, *E. robusta* and *Corymbia intermedia* on sedimentary rocks) with rainforest elements in the mid- and understorey exists near the entrance. Because the Sanctuary has a walking track and boardwalk that offer a convenient transect through the major vegetation communities to the bank of the Maroochy River, several visits were made to this area.

Spotlight searches, using a 50 W globe and 12 V battery (Faunatech, Mount Taylor, Victoria), were also undertaken from 1945–2120 hrs on 12 January 2013 along the entire track system of the Maroochy Wetlands Sanctuary. This transect was repeated by day on 17 November 2013 (1600–1645 hrs), with a short period devoted to a search for roosting nightjars in an area of Swamp Oak forest with a layer of leaf litter on a low, levee-like rise close to the river's bank. Spotlight searches and call playback were undertaken between 1930 and 2100 hrs within those sections of the boardwalk that traversed Swamp Oak forest, but only spotlight searches were conducted through the mangrove community.

Large-tailed Nightjars encountered along the boardwalk were viewed with Leica Trinovid 10x42A binoculars, photographed with Nikon Coolpix S550 and Panasonic Lumix digital cameras, and filmed with a Sony Handycam digital video camera. This location was visited again from 1615–1720 hrs on 5 January 2014, when a description of the area's vegetation was made and a brief search of potential daytime roosting sites undertaken.

Results

Large-tailed Nightjars were recorded at three separate locations in Marcoola and Bli Bli between October 2012 and November 2013. These observations are described below.

Marcoola

At approximately 1830 hrs on 25 October 2012, while at our campsite in the eastern section of the Maroochy Wetlands RP, I heard the distant but unmistakeable *chop-chop-chop* call of a Large-tailed Nightjar coming from a point to the west. I immediately moved to an open section of the Maroochy River's bank to listen further. The calls, which continued for a few minutes, originated from the western side of the river, in the direction of Stoney Wharf, Bli Bli (26°35'47"S, 153°3'24"E; Figure 1). The Maroochy River at this location is some 200 m wide. As I was unaware of any records of this species south of the Cooloola region (Great Sandy NP), I returned to the campsite, only 30 m from the water's edge, and discussed the significance of the event with my colleagues. Soon afterwards at 1850 hrs, loud calling by a (possibly different) Large-tailed Nightjar individual commenced very close to the campsite (26°35'51"S, 153°3'33"E) on the river's eastern bank (Figure 1). With the aid of a spotlight, I attempted unsuccessfully to sight the individual responsible. The calls sounded as if they were coming from a perch 2–3 m above ground, but the density of the vegetation prevented any views. On closer approach, the bird flushed to perch further away, as judged by the sudden change in direction of its vocalisations. Calling continued for approximately 10 mins. However, because the primary aim of the field work was mammal trapping, I did not pursue this nightjar individual further.

Additional bouts of calling were heard throughout the small hours of the following morning (i.e. early on 26 October 2012) and, during the pre-dawn period, the calls of several Large-tailed Nightjar individuals were heard simultaneously, coming from separate locations within the vicinity of our campsite. Conditions on this night were fine and clear, with little or no breeze. Night light was relatively bright because the moon phase was between third quarter and full.

The next morning, I ascertained that the Large-tailed Nightjar whose calls were first heard close to the campsite had been perched in a Swamp Oak growing in an open forest community that was situated on a 10 m-wide, low rise (a natural 'levee') oriented parallel to the river bank (Figure 2a). This forest was dominated by Swamp Oak (to about 11 m in height), but also comprised Tuckeroo *Cupaniopsis anacardioides* (to about 7 m) and Beach Hibiscus *Hibiscus tiliaceus* (to about 4 m), with some White Bottlebrush *Melaleuca saligna*, Freshwater Mangrove *Excoecaria agallocha* and the introduced Broad-leaved Pepper *Schinus terebinthifolius* also present. Immediately adjacent on the western side was a narrow (8 m-wide) strip of mangroves fringing the

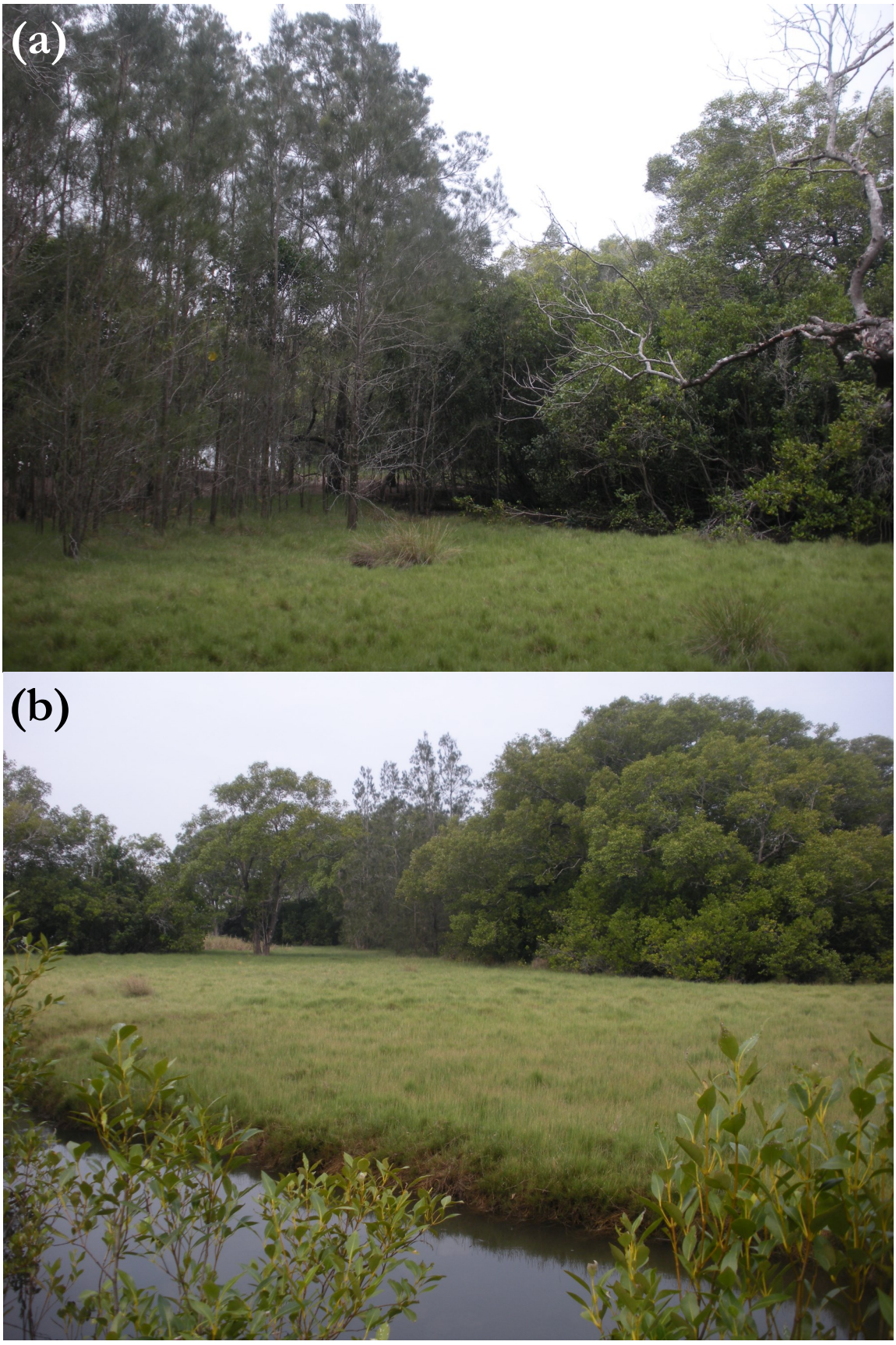

Figure 2. Habitat where Large-tailed Nightjars were heard calling on the eastern side of the Maroochy River within Maroochy Wetlands RP on 25–26 October 2012: (a) Swamp Oak stand on a levee parallel to the river (visible through the trees at centre left); (b) mangrove and Swamp Oak forest adjacent to Marine Couch flats to the northeast of a narrow drainage channel. Photos: Ian Gynther.

river's eastern bank. This vegetation consisted of Grey Mangrove, Large-fruited Orange Mangrove, River Mangrove *Aegiceras corniculatum* and a small component of Stilted Mangrove *Rhizophora stylosa*, with occasional Mangrove Fern *Acrostichum speciosum* growing along the landward edge. To the east, the stand of Swamp Oak open forest was bordered in some sections by 15–50 m-wide flats of Marine Couch grassland with occasional sedges (*Juncus kraussii* and *Fimbristylis* sp.) and, in other sections, by clumps or extensive stands of Grey Mangrove forest (to 10 m), with a midstorey of River Mangrove and young Grey Mangrove (Figure 2a).

The other nightjar calls heard during the night and early morning came from the east and northeast of the campsite, across a narrow drainage channel. There the Marine Couch saltmarsh formed a broad (up to 80 m-wide) grassland, bounded on the landward side by clumps of Grey Mangrove (to 10 m) that merged to form an open forest with a dense midstorey of River Mangrove and Large-fruited Orange Mangrove (both to a height of 4 m). Some isolated small stands of Swamp Oak stood around the margins of these mangroves (Figure 2b). The calls heard during the second half of the night probably came from this area of mangrove and Swamp Oak forest, or from its outer edge, at the boundary with the saltmarsh. Confirming this would have required actually sighting the birds because the various vegetation types within this eastern section of the Maroochy Wetlands RP form a complex mosaic of closed and open communities.

On a subsequent 90 min visit to this site on the afternoon of 5 January 2014, no Large-tailed Nightjars were observed roosting, despite walking transects within all vegetation types near the former campsite, including through Swamp Oak open forest in which the understorey was open and the ground carpeted with Swamp Oak needles and leaf litter.

Bli Bli

All subsequent attempts to locate Large-tailed Nightjars at Bli Bli by using passive listening and call playback at night, as well as daytime searches for roosting or nesting birds, were unsuccessful. This was even so at Stoney Wharf (26°35'47"S, 153°3'24"E), the approximate point of origin of the first calls of this species detected.

Despite not being able to pinpoint the location of Large-tailed Nightjars at Stoney Wharf, habitat in the area nevertheless appeared suitable for the species. To the north (upstream along the river) was an extensive closed community of Grey Mangrove and Large-fruited Orange Mangrove with open mid- and understorey structure and large amounts of accumulated leaf litter that provided potential roosting sites. Immediately adjacent to the mangroves was a broad Swamp Paperbark wetland with stands of Swamp Oak at its southern edge, both habitats with abundant leaf

litter on the ground. Downstream of Stoney Wharf, within the western section of Maroochy Wetlands RP, were more mangroves, fringed on the landward side by a narrow strip of Swamp Oak woodland and then cleared land. I was unable to investigate this area because adjoining residential land hampered access.

Large-tailed Nightjars were not seen or heard at the Maroochy Wetlands Sanctuary (Figure 1), during a visit on 12 January 2013 despite a spotlight search of 95 mins along the walking track and boardwalk to and from the river bank. However, on a second visit, on 17 November 2013, I located two birds, via their red eyeshine, perched in Swamp Oaks growing close to the edge of the mangrove forest where an area of open mud formed a small inlet. The closer of the two individuals, estimated to be about 30 m away, was perched crosswise at a height of 3.5 m on a horizontal section of a thin, sloping trunk (Figure 3a). Despite the viewing distance, it was readily identified as a Large-tailed Nightjar because of the presence of pale sections at the tips of the outer feathers of the slightly fanned tail. The second bird was estimated to be another 3–4 m away and at a lower height, although details of its shape and plumage were not noted.

The nearer of the two birds was approached more closely to enable digital images and video to be recorded, the latter using the light of the spotlight beam. Because rain fell throughout the period of observation, water drops on the camera lens made photography difficult. Nevertheless, from beneath the perched bird, pale panels at the tips of the outer two pairs of tail feathers were readily apparent (Figure 4a & b). These panels were relatively small and dirty-buff in colour. Furthermore, the tail was short, not projecting much (if at all) beyond the tips of the primaries, and the individual possessed an overall tawny plumage tone. Together, these features suggest it was a juvenile female – males have larger tail panels; adult birds are not as dull-coloured, and the tips of their folded primaries reach only a little over half the length of the tail, falling 3–4 cm short of the tail's tip (Schodde & Mason 1980; Debus 1994; Higgins 1999). The second individual was not observed at close range and so its age and sex were not determined. Shortly afterwards another bird was observed perching 1.5 m above ground on a thin, dead branch of a Freshwater Mangrove shrub growing at the boundary between the bare mud of the intertidal zone and Swamp Oak woodland on the eastern side of a low island (Figure 3b). This was not the same bird previously photographed because its tail, while also relatively short, showed glimpses of larger, white panels on the outer rectrices (Figure 5). After a few moments the nightjar flew across the open area towards the Birdhide Loop, alighting on a 2.5 m-high perch approximately 3 m inside the mangrove forest near the boardwalk (Figure 3a). In the air, the bird was reminiscent of a large moth, flying with a light, dancing style and revealing for the first time the white patches in both the wingtips and the flared tips of the uppertail's outer feathers.

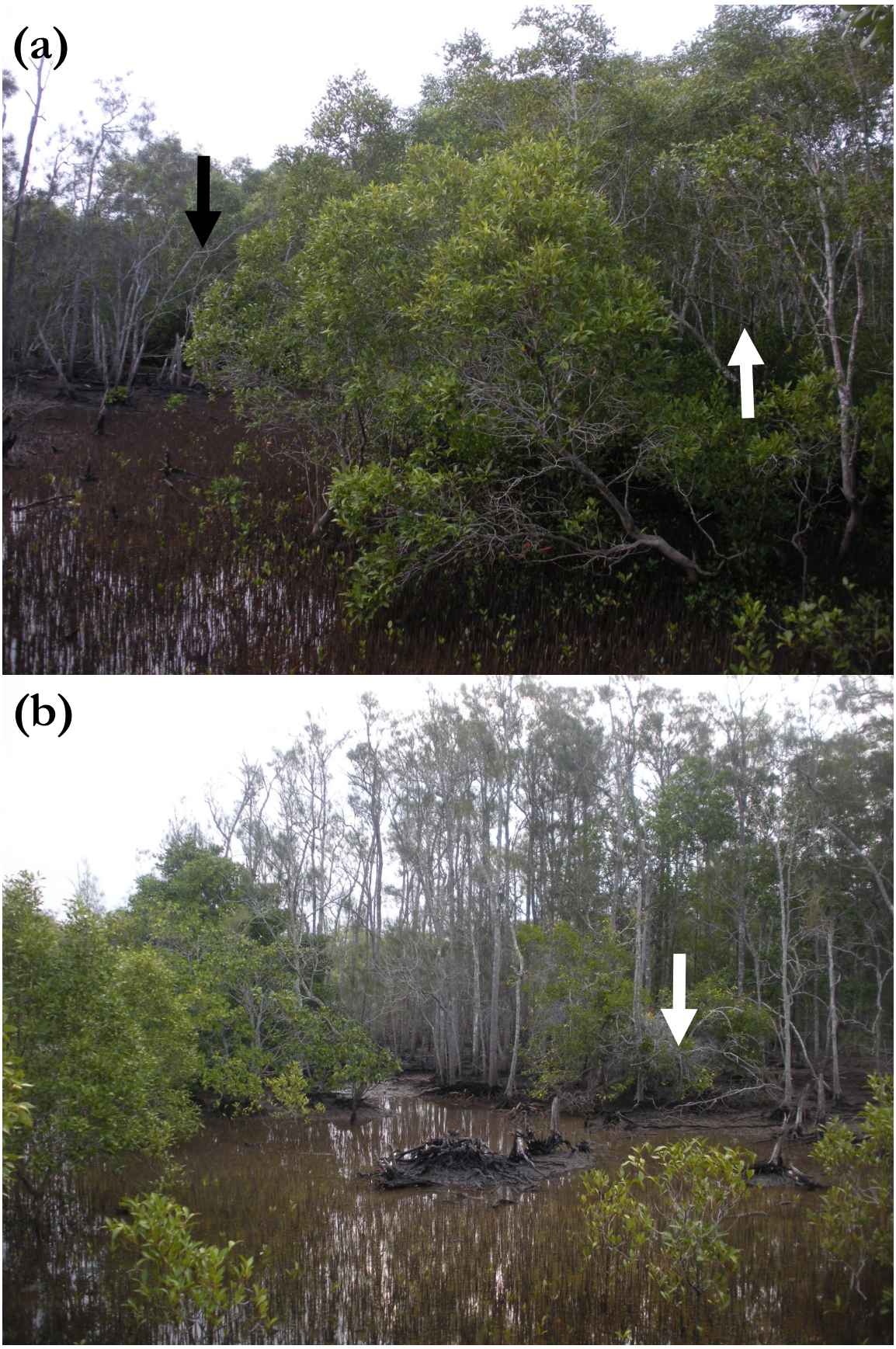

Figure 3. Habitat where Large-tailed Nightjars were observed in the Maroochy Wetlands Sanctuary on 17 November 2013, viewed from the Birdhide Loop: (a) the black arrow indicates where the individual in Figure 4 perched; the white arrow shows the perch used by the male in Figure 6; (b) the white arrow points to the perching position of the male in Figure 5. Photos: Ian Gynther.

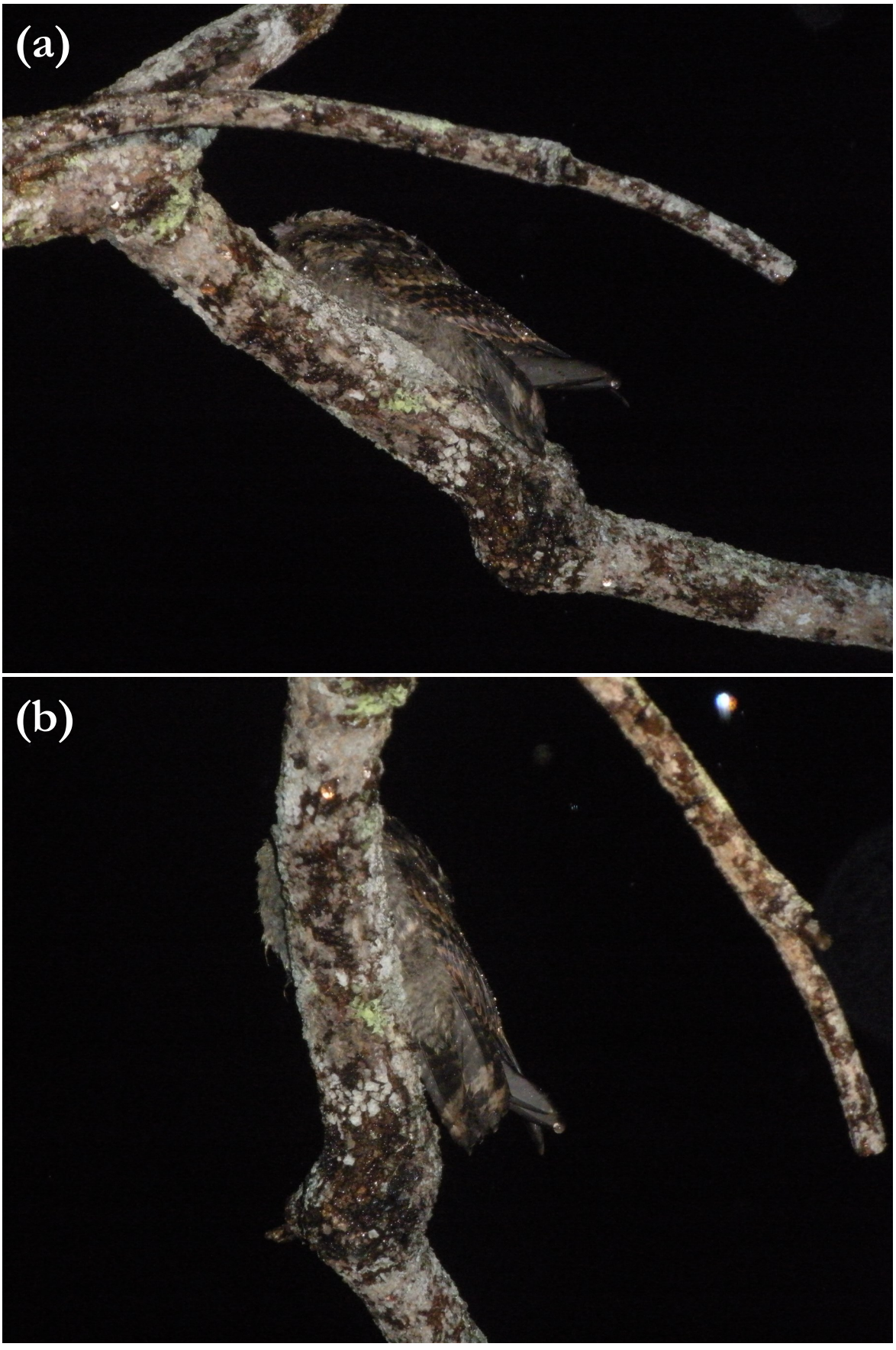

Figure 4. Two views from beneath a juvenile (probably female) Large-tailed Nightjar at the Maroochy Wetlands Sanctuary on 17 November 2013. Pale panels at the tips of the outer pairs of tail feathers are discernible in both (a) and (b); the short tail is more evident in (b). Numerous raindrops are present on the bird's plumage. Photos: Ian Gynther.

Photographs taken of this second individual as it perched in a Grey Mangrove clearly show the white panels in the undertail (Figure 6a & b) and the rictal bristles along the gape (Figure 6b), both features diagnostic of Large-tailed Nightjar (Schodde & Mason 1980; Debus 1994; Higgins 1999). Also evident in Figure 6a is that the white panels in the outer pair of rectrices are longer than those in the second pair, and the fact that the brownish-grey edging to the outer vanes of each of these pairs of rectrices extends well past the point where the white commences on the inner vanes. These plumage features match those of some north Queensland individuals of Large-tailed Nightjar in the Queensland Museum's specimen collection (personal observation). The large size and clean white colour of the tail panels demonstrates this bird was a male but, again, the short tail compared to the wing length, and the fact that the white panels extend over most of the length of the outer rectrices (*cf.* only around one-third of the length, and located at the feather tips; Higgins 1999) indicated the tail feathers were not yet fully grown. Additional plumage features supporting this assessment of the bird's young age included the narrow (*cf.* extensive) black median crown stripe and black folded primaries with distinct rufous tips (both features evident in Figure 5), the absence of a white throat patch or white band

Figure 5. Juvenile male Large-tailed Nightjar at the Maroochy Wetlands Sanctuary on 17 November 2013. Pale panels in the outer uppertail feathers are visible. Note that the overall plumage tones are unnatural due to the yellowish spotlight beam. Photo: Ian Gynther.

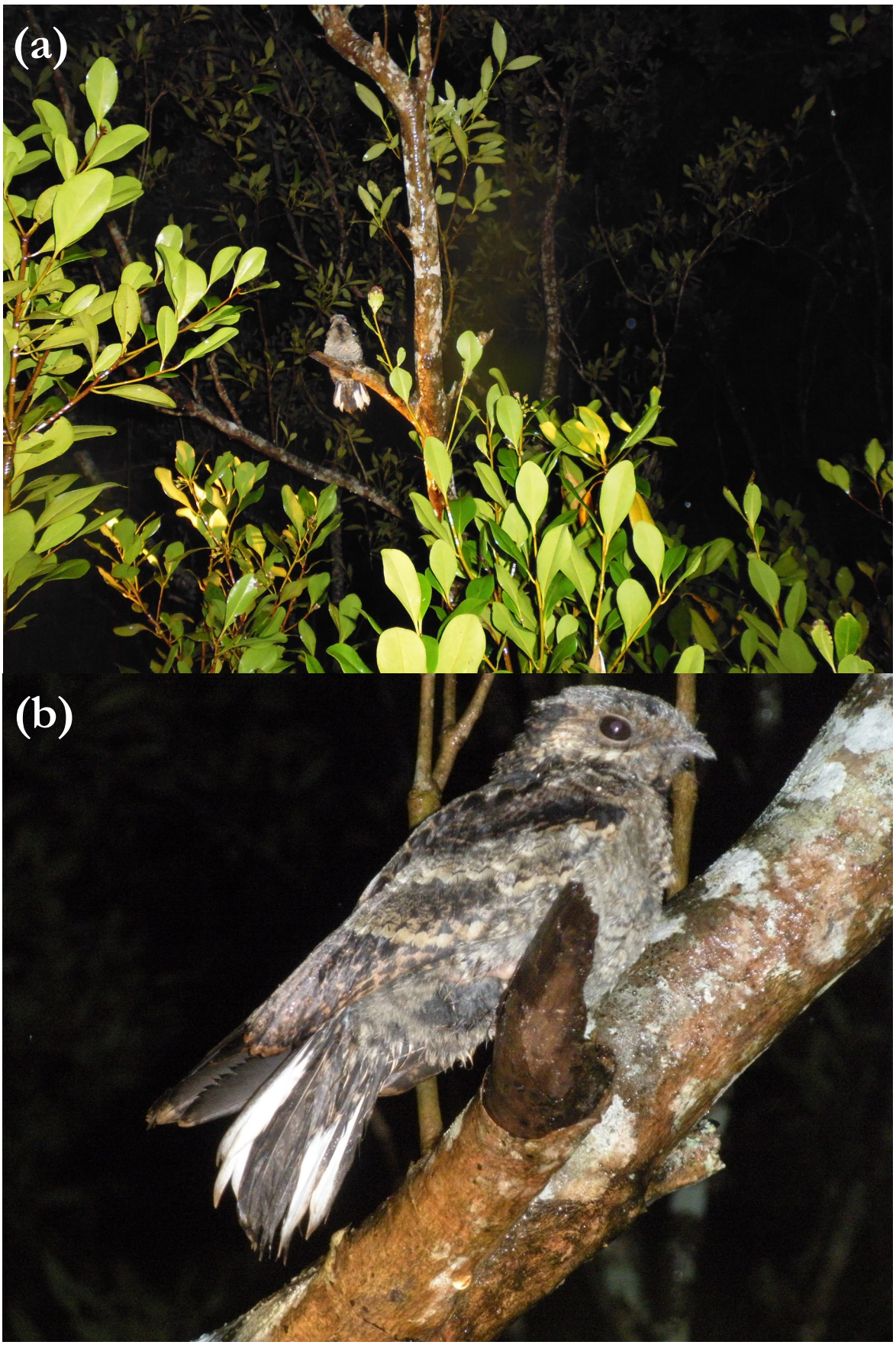

Figure 6. A juvenile male Large-tailed Nightjar (the same individual illustrated in Figure 5) at the Maroochy Wetlands Sanctuary on 17 November 2013: (a) front view; (b) side view on the same perch. Elongate, white panels in the outer two pairs of tail feathers are obvious in both photos. The short tail is apparent in (b). Photos: (a) Christobel Neligan; (b) Ian Gynther.

across the foreneck (Figure 6a), a character acquired late (after several months, at the first annual moult), and, as seen in Figure 6b, the indistinct (*cf.* prominent) submoustachial stripe from the gape to the ear, and the buffy (*cf.* cream or white) spots on the wing coverts, forming bars (Schodde & Mason 1980; Debus 1994; Higgins 1999).

Before leaving the site at 2025 hrs, a quick sweep of the spotlight again detected the red eyeshine of a different individual, on this occasion perched at the top of a Swamp Oak at 10–12 m height and some 2 m inside the woodland's edge. No calls of Large-tailed Nightjar were heard during the entire period of 25 mins spent observing these birds.

A daylight inspection of the Maroochy Wetlands Sanctuary on 5 January 2014 confirmed that the nightjars had been observed on and around a low island that was some 35–40 m in diameter. In addition to Swamp Oaks (Figure 3), other trees present on this island were Tuckeroo (to 13 m) and Freshwater Mangrove (to 8 m). Whip Vine *Flagellaria indica* occurred either as clumps at ground level or as individual climbers in Swamp Oaks and Freshwater Mangroves. A small clump of a sawsedge (*Gahnia* sp.) was also present. Above the high tide mark, the ground was carpeted with Swamp Oak needles and leaf litter, the latter in sufficient abundance to support an active Australian Brush-turkey *Alectura lathami* nest mound. On the western margin of the island, i.e. the side opposite to where the Large-tailed Nightjars were observed, was an 8 m-wide area of Marine Couch. The island's Swamp Oak woodland almost contacts the surrounding mangroves on the northern side (Figure 3a), but was surrounded by an open zone elsewhere (Figure 3b). This zone ranged from 3–15 m wide in the sections where the nightjars were seen perching, but broadened to at least 50 m around the southern side. The areas fringing the island contained the stumps and trunks of many dead or dying Swamp Oaks or Freshwater Mangroves, with only a few low (<2 m) Grey Mangrove or Large-fruited Orange Mangrove individuals present. Beyond this was open mud with abundant mangrove pneumatophores, although hundreds of River Mangrove saplings appeared to be recolonising the mudflat on the southern side. Encircling the whole area was a low open forest or shrubland dominated by Grey Mangrove (to 6 m), with a midstorey of River Mangrove (ranging in height from 2–5 m) and Large-fruited Orange Mangrove (to 3 m), through which the boardwalk passed.

Discussion

This report describes records of Large-tailed Nightjar from estuarine wetlands at three separate localities separated by up to 1.6 km along the Maroochy River of SEQ between October 2012 and November 2013. These records include several individuals heard calling within the Maroochy Wetlands RP at Marcoola and sightings of at least two individuals in the

Maroochy Wetlands Sanctuary at Bli Bli. At the latter site, the presence of two juvenile birds, most likely siblings, strongly suggests the parents would also have been close by because the species is known to be sedentary and permanently territorial, living in pairs or family groups of three to four within small territories (Schodde & Mason 1980; Hollands 1991; Debus 1994). Furthermore, the young remain with their parents until two to three months old before dispersing (Schodde & Mason 1980). Taken together, these observations indicate a resident breeding population of Large-tailed Nightjars exists along the lower Maroochy River of the Sunshine Coast. This represents a minor southerly extension of the known Queensland (and Australian) range of more than 60 km from the previously published limit of distribution in the Cooloola region of the Great Sandy Strait NP (Beruldsen 1991; Hadley 1991; Britton 1992). These observations also extend the known breeding range for the species considerably further south, by 3° of latitude as compared to the first Bird Atlas (Blakers *et al.* 1984) and 8° as compared to the second Bird Atlas (Barrett *et al.* 2003).

The vegetation types and structures utilised by Large-tailed Nightjars on the Maroochy River (Swamp Oak and mangrove communities fringing open areas) were consistent with habitat preferences previously described for the species (Marshall 1934; Schodde & Mason 1980; Storr 1984; Schodde & Tidemann 1986; Hollands 1991; Debus 1994; Higgins 1999).

Other, unpublished records of Large-tailed Nightjar south of Cooloola exist in various databases (e.g. Atlas of Living Australia, Birdlife Australia's Historical Bird Atlas, Eremaea/eBird, WildNet), but some of these records appear to be erroneous, while others were deemed unreliable or to have an unacceptable degree of error. The WildNet database (the Queensland Government's wildlife application, managed by the Department of Science, Information Technology and Innovation) does, however, contain valid records of Large-tailed Nightjar from two subcoastal localities south of Cooloola, namely Widgee (26°14'S, 152°28'E) in 1967 and the adjoining Mt Glastonbury State Forest (SF124; 26°14'S, 152°27'E) in 1995, both locations where the species is still seen and heard on a semi-regular basis (P. Hughes personal communication). Although this general area is south of documented Cooloola records of Large-tailed Nightjar, it is actually more distant from the Maroochy River localities described here, lying some 72 km to the northwest.

While this manuscript was in preparation, additional records of Large-tailed Nightjar were reported from two sites within the Maroochy River catchment (Lamb & de Groot 2014; Roberts 2014a). First are reports on Eremaea/eBird from the Maroochy Wetlands Sanctuary (26°36'24"S, 153° 2'58"E) at Bli Bli on 20 October 2014 (Lamb & de Groot 2014), the same general locality as some of the observations reported here, but 500 m to the northwest in wet eucalypt forest (RE 12.9-10.1) abutting the wetland. Second are one or two birds seen and heard on 9 November 2014 in the

Yandina Creek area (26°34'13"S, 153°2'34"E), 4.5 km north of the Maroochy Wetlands Sanctuary or 6.5 km upstream by river (Roberts 2014b). These records add further weight to the conclusion that a resident population of Large-tailed Nightjars exists along the extent of the Maroochy River's estuarine wetland system.

It seems reasonable to speculate that the Large-tailed Nightjar also occurs along the Noosa River, the next major catchment system to the north of the Maroochy River. The Noosa River, which flows south from the Cooloola region to its mouth (at 26°23'S, 153°5'E) near Noosa Heads, provides an obvious north–south riparian link between the two southernmost known coastal populations of the Large-tailed Nightjar (i.e. Cooloola and the lower Maroochy River) and supports large areas of suitable habitat for the species along both its freshwater and estuarine segments. Targeted surveys for the species along the Noosa River are warranted to confirm this prediction, although even casual observers should remain alert to the possible occurrence of the Large-tailed Nightjar there.

Of the three nights on which records of Large-tailed Nightjar were made or sought during the current, albeit limited survey of wetlands bordering the Maroochy River, calling was heard only once (on 25–26 October 2012), despite all visits being made within the August–January breeding period when calling behaviour in this species is known to peak (Barnard 1935; Schodde & Mason 1980; Hollands 1991). On this particular night, the almost full moon provided bright illumination. No spontaneous calling or responses to call playback were heard during night time visits on 12 January or 17 November 2013. Both nights, when calling was not heard, were dark because, on the first occasion, the lunar phase was just one day beyond a new moon and, on the second, the full moon was obscured by 100% cloud cover. These observations concur entirely with the previously established correlation between the territorial calling behaviour of the Large-tailed Nightjar and bright or clear moonlit nights (Barnard 1935, Schodde & Mason 1980, Higgins 1999).

The question raised by the discovery of this resident population of Large-tailed Nightjars along the lower Maroochy River system is whether the species has always been present and simply overlooked until now or, rather, whether it is the result of a recent change in distribution, with birds from more northerly areas moving southward into previously unoccupied habitats. Although definitive evidence is lacking, a number of considerations provide support for the latter hypothesis. Firstly, the lower Maroochy River catchment of the Sunshine Coast supports a relatively large human population (including a concentration of bird enthusiasts) and the river and its tributaries are well visited by boaters, fishers and other recreational users. Many birdwatchers, natural historians and conservationists also visit the estuarine and adjacent habitats of the river, including those of the Maroochy Wetlands Sanctuary, where some of the observations described in the

current work were made. Secondly, the Large-tailed Nightjar has a distinctive, loud, far-carrying and incessant (often to the point of monotony) territorial call (Marshall 1934; Barnard 1935; Schodde & Mason 1980; Schodde & Tidemann 1986; Pizzey & Knight 1997; Higgins 1999; Slater *et al.* 2009) that is unlikely to go unnoticed. Spontaneous calling is expected during the spring and summer breeding season when use of the river and surrounds by humans is likely to be high. Furthermore, although it is a nocturnal species, at this time birds may commence calling shortly after daylight begins to fade at dusk and often begin calling again in the hours prior to dawn, continuing well into the dawn chorus (Marshall 1934; Schodde & Mason 1980; Hollands 1991). These peaks in vocalisation also coincide with periods during which humans are often present in or near areas likely to be occupied by Large-tailed Nightjars, which should have facilitated detection of the bird. Despite these foregoing factors providing opportunities for humans to encounter the species, no reports of Large-tailed Nightjars from the Maroochy River prior to 2012 appear to have been documented.

Lending extra weight to the notion that that the Large-tailed Nightjar is only a relatively recent addition to the area's avifauna is the fact that, within two years of the first of the records of the species described in the present work being made, other ornithologists separately reported the occurrence of the bird from the Maroochy River system (Lamb & de Groot 2014; Roberts 2014a), with these observers recognising the novelty and significance of the records.

If, as seems most likely, the Large-tailed Nightjar has only recently expanded its range southward, one possible explanation is a change in climatic conditions that has made the Sunshine Coast region of SEQ favourable for the species. The Earth is warming dramatically compared with natural historical rates of change (IPCC 2007). Today global surface temperatures are more than 0.75°C warmer than at the beginning of the 20th century, and rates of temperature rise are greatest over the last five decades (nearly double that of the 100-year trend; Hurrell & Trenberth 2010). Observed changes across Australia since 1910 include increases in average daily mean temperatures of 0.9°C and average annual overnight minimum temperatures of more than 1.1°C, with the frequency of hot days and nights increasing and the frequency of cold days and nights declining (CSIRO 2012; Australian Government 2014). Since 1910, the warming trend has been fastest during spring (Bureau of Meteorology 2014a). The spring of 2013 was Australia's and Queensland's warmest on record: nationally, mean temperatures for the season were 1.57°C higher than the average for the period 1961–1990 (Bureau of Meteorology 2014a). In coastal SEQ, the trend in mean temperature based on annual records from 1970–2013 has been a warming of 0.1–0.15°C per decade (Bureau of Meteorology 2014b).

Across the planet, the temporal and spatial patterns of population and species abundances are being significantly altered by climate change (Rosenweig *et al.* 2008; Hurrell & Trenberth 2010). Growing evidence exists that bird populations and distributions are changing in response to global warming trends (e.g. Wormworth & Mallon 2006; Audubon 2009; Brommer & Møller 2010; Chambers *et al.* 2011; Garnett & Franklin 2014). In Queensland, for example, Williams *et al.* (2014) found a significant number of Wet Tropics bird species are in decline and moving to refuges in higher mountainous regions where temperatures are cooler, with regionally endemic species appearing to be most at risk. Bird species that have increased are predominantly widespread, lowland generalists (Williams *et al.* 2014). It therefore seems entirely plausible that the range of the Large-tailed Nightjar, a widespread, primarily tropical species (Schodde & Mason 1980; Debus 1994) may have recently shifted in response to the warming climate, expanding southwards in Australia as a result. However, predicting which birds are likely to change their distributions in response to a warming climate is a complex task, dependent upon numerous species characteristics (e.g. a bird's functional ecological group, migration ecology, brain mass, body mass, adult survival rate, habitat type, etc.), as well as a species' exposure and sensitivity to climate change (Brommer & Møller 2010; Franklin & Wellbergen, 2014). Nevertheless, insectivores as a whole (the feeding ecological group to which the Large-tailed Nightjar belongs) are prone to changing their range margins, presumably because insects are ectotherms and follow the poleward (i.e. in Queensland, southward) shift in warming temperature regimes (Brommer & Møller 2010).

As average temperatures in Australia are projected to increase by as much as 5.0°C by 2070 compared to the climate of recent decades (CSIRO 2012), a further southward expansion of the range margin of the Large-tailed Nightjar is to be expected. Consequently, birdwatchers should remain alert to the possibility of the species occurring in areas of suitable habitat south of the Maroochy River. One such region is the Pumicestone Passage, particularly between Bells Creek (26°49'51"S, 153°4'40"E) and Ningi Creek (27°3'30"S, 153°6'00"E), where extensive estuarine and *Melaleuca* wetlands flank the Passage and its tributaries. Although habitat linkages via riparian and/or coastal corridors over the intervening 27 km or so from the Maroochy River are more tenuous compared to those in the Cooloola–Noosa–Maroochy corridor, an additional extension of the range of the Large-tailed Nightjar over this relatively short distance would not seem out of the question.

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Habitat of the Black-chinned Honeyeater *Melithreptis gularis gularis* in the Greater Brisbane Region, Queensland

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Abstract

The south-eastern subspecies of the Black-chinned Honeyeater *Melithreptis gularis gularis* is one of several bird species occurring in woodland and open forest habitats in south eastern Australia that have experienced serious population declines in recent decades. Managing for the conservation of the Black-chinned Honeyeater, or decision-making with respect to the species in relation to development assessment, may be hindered by large gaps in our understanding of its basic biology and its low detectability. This study examined the floristic assemblages at locations at which the species has been recorded in the greater Brisbane region. Within the study area, the Black-chinned Honeyeater appears to be a habitat specialist, particularly favouring open forests in which *Eucalyptus moluccana* is a dominant species. It was also recorded in open forests dominated by *Corymbia henryi* and *Eucalyptus fibrosa* subsp. *fibrosa*.

Introduction

The south eastern subspecies of the Black-chinned Honeyeater *Melithreptis gularis gularis* is one of a suite of bird species that has experienced major population declines centred on the temperate woodland zone of south-eastern Australia (Reid 1999). The Black-chinned Honeyeater is a medium sized honeyeater (Family Meliphagidae) that is believed to be predominantly sedentary and forms small social groups (Higgins *et al.* 2001; Lollback *et al.* 2008). It is primarily insectivorous but nectar forms a significant component of the diet at certain times of the year (Higgins *et al.* 2001).

The main threats to the south eastern subspecies of the Black-chinned Honeyeater include habitat destruction, nest predation, competition with aggressive species (eg Noisy Miner *Manorina melanocephala*) and a diminishing food base (Garnett *et al.* 2011). In light of these threats, the subspecies was classified as Near Threatened in the *Action Plan for Australian Birds 2010* (Garnett *et al.* 2011) and is listed as a Threatened species under the NSW *Threatened Species Conservation Act 1995*, Near Threatened under the QLD *Nature Conservation Act 1992* and Vulnerable under the SA *National Parks and Wildlife Act 1972*. It has been informally classified as Near Threatened in Victoria (Victorian Department of Sustainability and Environment 2013).

Examination of database records (in particular, The Atlas of Living Australia) of the subspecies from the last two decades indicates that it is confined to discrete, often widely separated locations across a broad distribution extending from south eastern South Australia to the Wide Bay region in south-east Queensland, mostly on the inland slopes of the Great Dividing Range but also in some near coastal areas. These records suggest a

similarly patchy distribution in southern Queensland. This is in marked contrast to the congeneric White-throated Honeyeater *M. albogularis* and White-naped Honeyeater *M. lunatus* which occupy a wide range of habitats, including disturbed remnants in fragmented landscapes (S. Priday; unpublished data). Furthermore, there is strong evidence that the Black-chinned Honeyeater occurs at lower densities than most other honeyeater species occupying the same habitats (Lollback 2008). It has been postulated that this may be attributed to the use of a specialised foraging technique, effectively narrowing its ecological niche (Lollback *et al.* 2008).

There is little published information on the habitat of the subspecies throughout much of its range. It is generally considered to have a close association with 'box–ironbark' communities (Blakers *et al.* 1984; Lollback *et al.* 2008; Oliver; Traill and Duncan 2000) but has also been recorded in River Red Gum *Eucalyptus camaldulensis* communities. This study sought to identify characteristics of the habitat of the Black-chinned Honeyeater in the greater Brisbane region of the Southeast Queensland bioregion. This region is close to the northern limits of the range of the south-eastern subspecies of the Black-chinned Honeyeater. It is also one of the few regions in which the subspecies consistently occupies near-coastal habitats, one known location north of Brisbane being within 10 kilometres of Moreton Bay. The main objective of this study was to examine whether the apparent rarity of this subspecies is due to habitat specialisation, and to explore the extent of loss of habitat within the study area. Floristic associations where the species has been relatively consistently recorded in the last fourteen years were compared to those at locations at which the species has not been recorded during the same period.

Methods

Study area

The study area comprised the Brisbane–Ipswich conurbation in southeast Queensland, including parts of the Brisbane, Ipswich, Logan, Moreton Bay, Redlands and Scenic Rim local government areas, and nearby bushland areas (henceforth referred to as the greater Brisbane region) (Figure 1). The area experiences a subtropical climate with warm to hot summers and mild winters. Rainfall in areas of lower altitude generally declines from east to west, with a greater proportion of annual rainfall occurring in the warmer months of the year (http://www.bom.gov.au/climate/data).

Database searches

Records of sightings of the species were taken from Eremaea Birds (http://www.eremaea.com/), Atlas of Living Australia (http://www.ala.org.au/), Birds Queensland sightings register (http://birdsqueensland.org.au/sightings.php), and NSW BioNet databases (www.bionet.nsw.gov.au/).

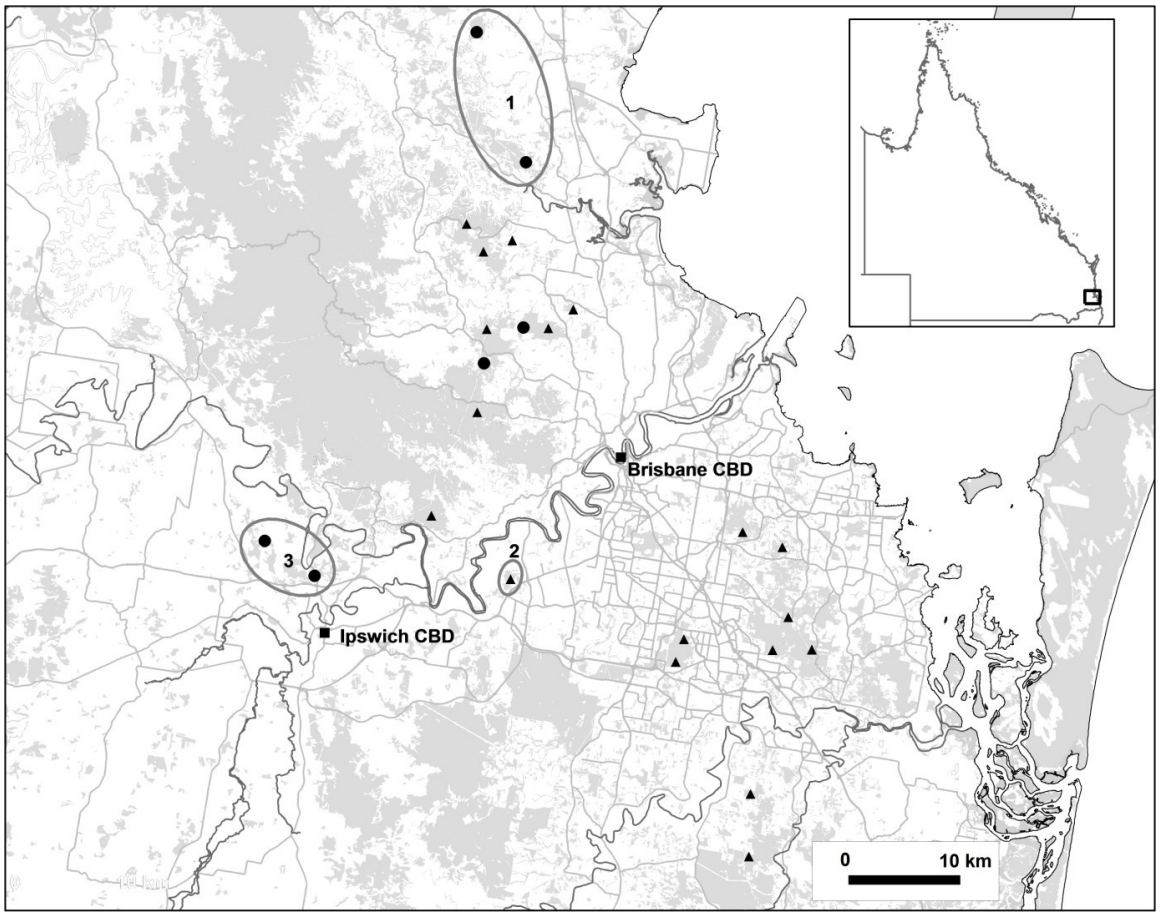

Figure 1. Map of the study area, showing locations of survey sites at which the Black-chinned Honeyeater was recorded (circles) or not recorded (triangles) during the study and the three previously known main areas of occurrence of the species: (1) Sheep Station Creek/ Kurwongbah; (2) Wacol (Pooh Corner Reserve) and; (3) Muirlea/Pine Mountain. Grey shading represents remnant vegetation. Inset shows location of study area within Queensland.

Black-chinned Honeyeater surveys

Targeted searches for Black-chinned Honeyeater were undertaken at five locations within the study area where the species has been sighted multiple times since 2000, as recorded on the abovementioned databases (Figure 1). While the reliability of many of the records contained on the databases is not quantified, it is assumed that the majority are submitted by moderately to highly experienced observers and records of the species were assumed to be substantiated. Another 19 sites for which there were no records of Black-chinned Honeyeater on the databases examined, but at which at least one bird survey had been undertaken with the results contained in the databases, were also surveyed. Based on the characteristics of the five locations within the study area with reliable records of Black-chinned Honeyeater, the 19 additional sites were located in areas below 150 m above sea level (Australian Height Datum), 10 or more kilometres inland from the coast and unoccupied by Noisy Miner colonies. Survey sites were located within the four major Land Zones within the study area considered most likely to

contain habitat of the Black-chinned Honeyeater: 3, 5, 9–10 and 11, although only single sites were located on Land Zones 3 and 5 which have been extensively cleared (Queensland Herbarium 2014). Most sites were located on areas of metasedimentary rocks with interbedded volcanic rocks or on fine to coarse-grained sedimentary rocks. The complete list of sites is contained in Table 1.

Several survey sites were located within the same contiguous remnant of native vegetation. The minimum distance between sites was 2.2 km. No remnants of native vegetation within which survey sites were located were entirely isolated. That is, all remnants were connected to other remnants by at least a narrow strip of native vegetation, most commonly by riparian

Table 1. List of survey sites and the vegetation (Regional Ecosystem) and geology (Land Zone) at each site. Descriptions of regional ecosystems and land zones are available at https://environment.ehp.qld.gov.au/regional-ecosystems.

Site name	Regional Ecosystem	Land Zone	Previous sightings of BCH (since 2000)	Sightings of BCH during present surveys
Albany Ck	12.5.2	5	No	No
Buccan	12.9-10.4	9-10	No	No
Bunyaville east	12.11.5k	11	No	No
Bunyaville west	**12.11.5k**	**11**	**No**	**Yes**
Clear Mountain north	12.11.5e	11	No	No
Clear Mountain south	12.11.5e	11	No	No
D'Aguilar	12.11.5e	11	No	No
Daisy Hill	12.9-10.17d	9-10	No	No
Ford Rd	12.11.5a	11	No	No
Jan Sked	12.9-10.17d	9-10	No	No
JC Trotter	12.9-10.4	9-10	No	No
Karawatha north	12.9-10.17	9-10	No	No
Karawatha south	12.9-10.4	9-10	No	No
Kurwongbah	**12.11.18**	**11**	**Yes**	**Yes**
Moggill	12.11.5e	11	No	No
Muirlea	**12.9-10.2**	**9-10**	**Yes**	**Yes**
Pine Mountain	**12.9-10.2**	**9-10**	**Yes**	**Yes**
Plunkett	12.9-10.17	9-10	No	No
Pooh Corner	12.3.3b	3	Yes	No
Prout Rd	12.9-10.4	9-10	No	No
Samford north	12.11.5e	11	No	No
Samford south	**12.11.5k**	**11**	**No**	**Yes**
Sheep Station Ck	**12.11.18**	**11**	**Yes**	**Yes**
Venman	12.11.5a/5j	11	No	No

vegetation along creeks. Two sites, Sheep Station Creek Conservation Park and Albany Creek Road Reserve, had the least connectivity of all the surveyed sites, being connected to other major remnants (>200 ha) primarily by narrow strips of riparian vegetation.

Based on the recommendations of Lollback (2008), an area search whereby bird surveys were conducted within an area of approximately 8 hectares and for a period of one hour were conducted at each site. Survey sites were located within what was considered to be a representative sample of the dominant vegetation type at each location. Two surveys were undertaken at each site, the first between December 2012 and March 2013 and the second between June 2013 and November 2013. All surveys were undertaken by a single observer (S. Priday). Wherever possible, the number of Black-chinned Honeyeater present at a site was recorded. However, at some sites the species was heard and not seen, in which case it was much more difficult to determine the number of individuals present. For the purposes of the present study, a record of presence or absence of the species was all that was required. All but one site were located on public lands.

Floristic surveys

A plot measuring 100 m x 20 m was marked out in the area within which bird surveys were conducted. Plots were located so as to provide what was considered by the surveyor to be a representative sample of the vegetation contained in the larger bird survey area. All vascular plant species contained within a 20 m x 20 m plot located in the centre of the larger plot were identified and their density recorded using a cover abundance index of 1 to 6 (1: uncommon and less than 5% cover; 2: common and up to 5% cover; 3: 6 to 20% cover; 4: 21 to 50% cover; 5: 51 to 75% cover; and 6: greater than 75% cover). Densities of tree species within the larger plot were estimated using the same cover abundance index. Separate 'tree' and 'full floristics' data sets were compared to determine if the composition of the lower vegetation strata at surveyed sites offered additional insights into habitat associations of Black-chinned Honeyeater than that provided by examination of the canopy layer alone.

Grey Gum species (*Eucalyptus major* and *E. propinqua*) could not be identified to species level in several plots because of a lack of diagnostic material (e.g. fallen fruits). All observations of Grey Gum species, which are morphologically very similar and generally sub-dominant to other tree species in vegetation assemblages in the study area, were therefore treated as a single entity in the analyses.

Data analysis

Multivariate analyses of both sets of floristic data (full floristics from 20 m x 20 m plots and tree species from 100 m x 20 m plots) were undertaken using the R software (R Version 2.7.0; www.**r**-project.org). Exotic (non-native)

species were removed from the data sets prior to analysis. A dissimilarity matrix using the Bray-Curtis dissimilarity measure was generated for both data sets. Classification of the data sets was undertaken by running a hierarchical agglomerative clustering analysis using the default settings of the 'agnes' function in the 'Cluster' package in R. A non-metric multidimensional scaling ordination of the two data sets was also undertaken using the 'metaMDS' function in the 'Vegan' package. This function uses the Bray-Curtis dissimilarity measure as the default setting and ordinates the data in two dimensions unless otherwise specified.

Results

Black-chinned Honeyeater records and observations

Previous records of Black-chinned Honeyeater were found in three largely discrete areas: (1) Kurwongbah/Sheep Station Creek, (2) Pooh Corner Reserve (Wacol), and (3) Muirlea/Pine Mountain (Figure 1). Despite being located more than 10 kilometres apart and separated by extensive areas of cleared land, the Kurwongbah and Sheep Station Creek areas are considered to represent a single broad unit because they are located on the same geological formation and native vegetation assemblages are relatively consistent throughout (Queensland Herbarium 2014). In this study, Black-chinned Honeyeater were recorded at two of these three areas and four of the five localities at which it had been previously observed. They were also recorded at two of the 19 additional sites sampled during this study: Bunyaville Conservation Park and Samford Conservation Park. A group of four was recorded at Muirlea and pairs were observed at Pine Mountain and Kurwongbah.

Floristic associations

Both cluster analyses separated the sites into two broad groups, with two additional groups each comprising a single site in the classification of the full floristic data (Figure 2). The agglomerative coefficient, a measure of the structure in the groups returned by the 'agnes' clustering algorithm, was nearly twice as high for the 'trees' dataset than for the 'full floristic' set. This is an indication that the distinction between the clusters in the classification using the 'trees' data set is generally greater than that using the 'full floristics' set and that the 'trees' dataset is likely to be a more useful indicator of floristic differences between sites. The main division in both classifications was between sites on quartz-rich sediments or metasediments with extensive quartz veins and those on fine-grained sediments or metasediments and Cainozoic alluvium. Several tree species were shared between the two main groups in both cluster analyses. However, the former group was separated largely on the basis of the presence of tree species that were rare or absent from the second group (*Eucalyptus racemosa*, *E. resinifera*, *E. tindaliae* and *Corymbia trachyphloia*).

Both ordinations indicated that assemblages on metasediments and predominantly fine-grained sediments were floristically relatively similar (Figure 3). The 'trees' ordination highlighted the distinctiveness of sites dominated by *E. tindaliae* and *E. racemosa* (Karawatha sites, JC Trotter, Prout Rd, Buccan and Venman) and those by *C. henryi* and *E. fibrosa* supbsp. *fibrosa*

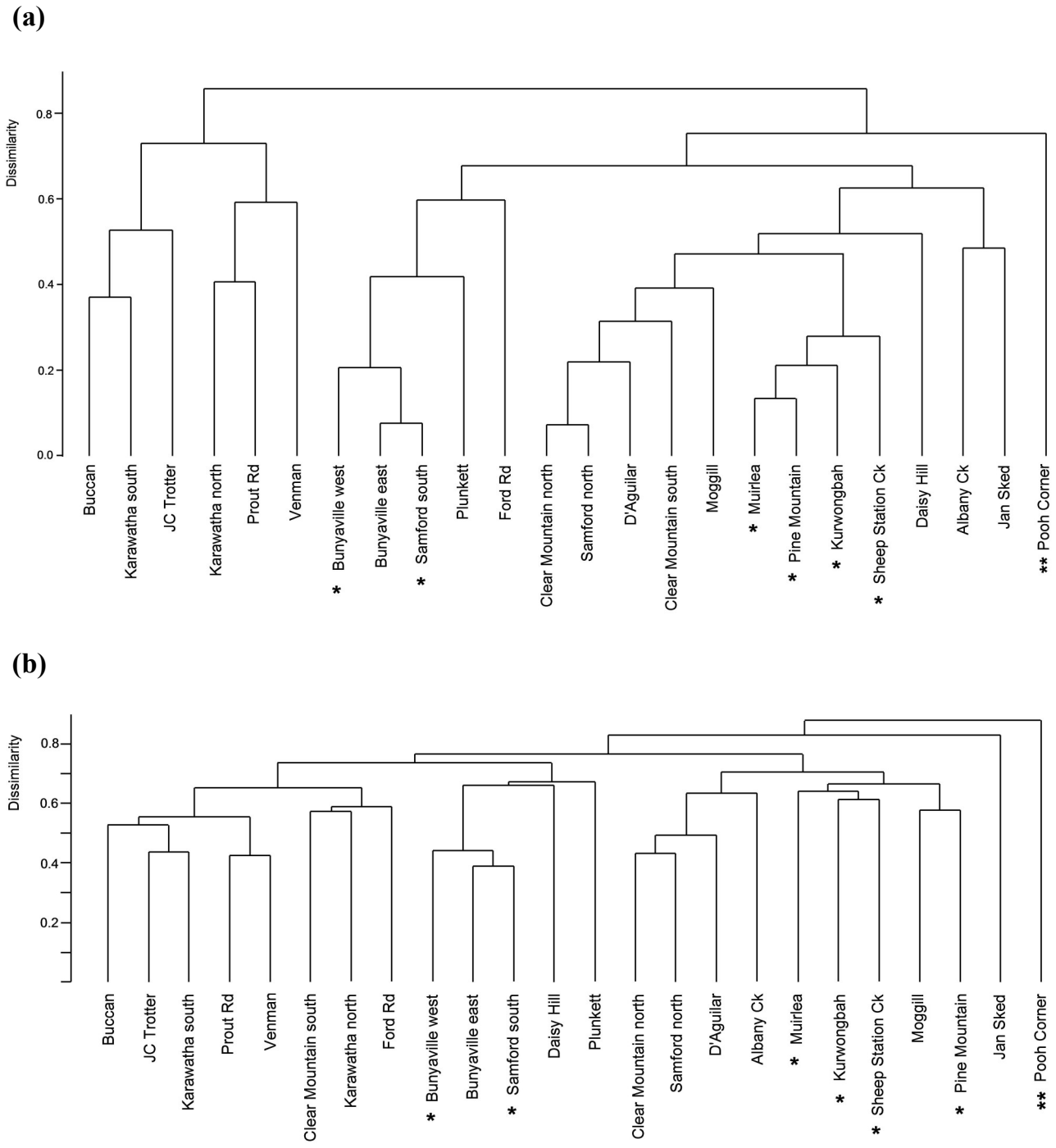

Figure 2. Similarity in vegetation characteristics of study sites using (a) 'trees' data set and (b) 'full floristics' (Bray-Curtis dissimilarity) A single asterisk indicates sites at which the Black-chinned Honeyeater was recorded during the study. Two asterisks indicate sites with previous records but for which no records were made during the current study.

(Samford south and Bunyaville sites) whereas this distinction was less pronounced in the 'full floristics' ordination.

The six sites at which Black-chinned Honeyeater were recorded were clustered in separate groups in each of the two broader groups of the classification analysis. Four of the sites, Sheep Station Creek, Kurwongbah,

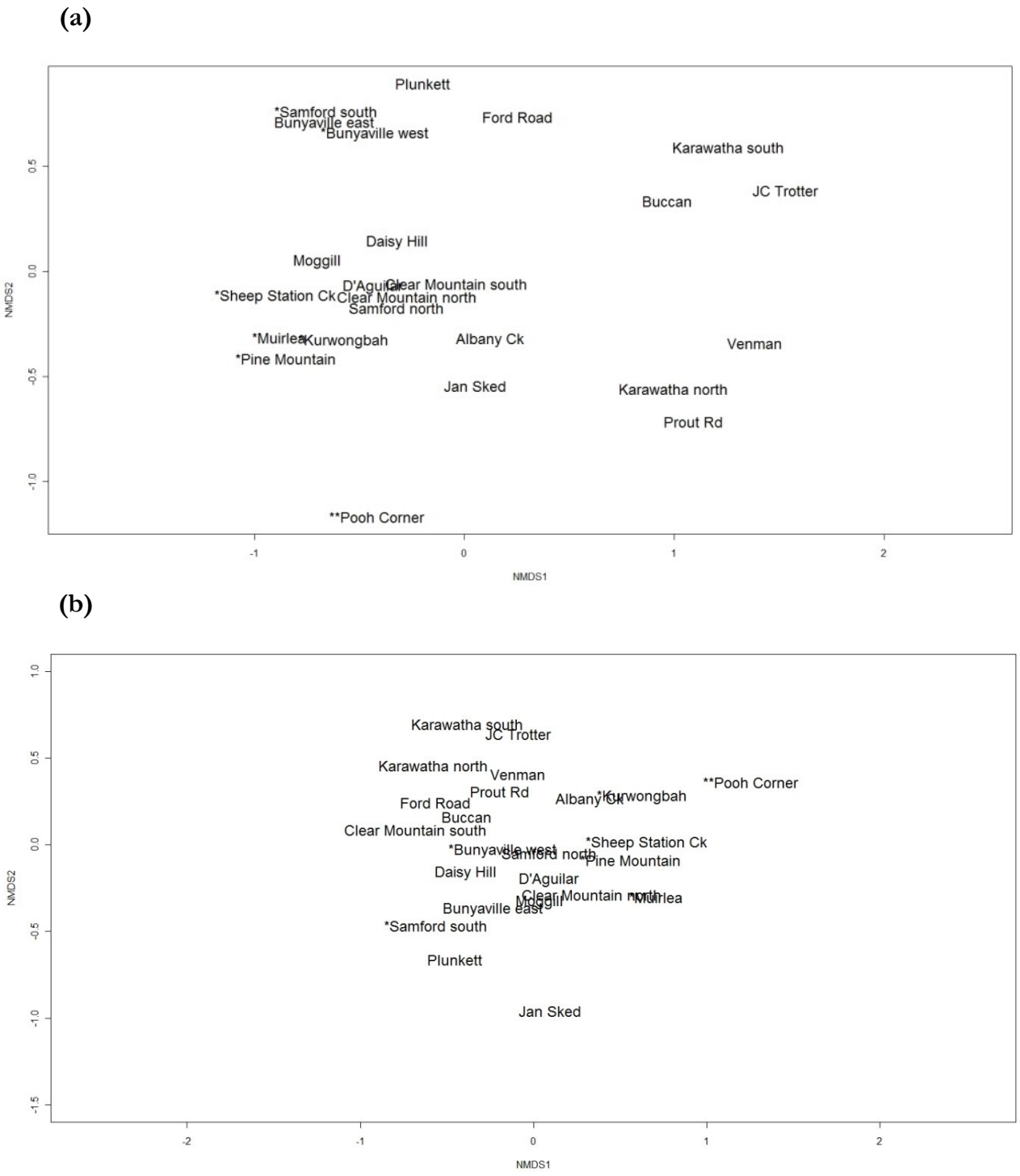

Figure 3. Ordination of sites using (a) 'trees' data set and (b) 'full floristics'. A single asterisk indicates sites at which the Black-chinned Honeyeater was recorded during the study. Two asterisks indicate sites with previous records but for which no records were made during the current study.

Muirlea and Pine Mountain, comprised a separate cluster in the 'tree' classification. These four sites, along with Pooh Corner Reserve, were the only sites containing *Eucalyptus moluccana*, which was a dominant species at these locations. Occurrences of *E. moluccana* in the Kurwongbah/Sheep Station Creek and Pooh Corner areas are associated primarily with Regional Ecosystems (RE) 12.11.18 (*Eucalyptus moluccana* woodland on metamorphics and interbedded volcanics) and 12.3.3b (*Eucalyptus moluccana* woodland) respectively (http://www.ehp.qld.gov.au/ecosystems/biodiversity /regional-ecosystems/). In the Muirlea/Pine Mountain area, the species occurs in a mosaic of vegetation assemblages, within which RE 12.9-10.3 (*Eucalyptus moluccana* on sedimentary rocks) forms a component. Although regional ecosystem mapping for this area maps RE 12.9-10.2 (*Corymbia citriodora*, *Eucalyptus crebra* open forest on sedimentary rocks) as the dominant assemblage, *E. moluccana* is common throughout the area, particularly in remnants formed on sediments of the Mount Crosby and Tivoli Formations.

The two additional locations at which Black-chinned Honeyeater were recorded during the study both contained assemblages dominated by *Corymbia henryi* and *Eucalyptus fibrosa* subsp. *fibrosa* on the Bunya Phyllite formation. This assemblage corresponds to RE 12.11.5k (woodland to open forest dominated by *C. henryi* with a range of other tree species). It is a distinct assemblage and is relatively floristically consistent between remnants.

Discussion

Habitat of the Black-chinned Honeyeater

The vegetation sampling and multivariate analyses provide clear evidence of a preference of the Black-chinned Honeyeater for a narrow range of floristic assemblages in the study area. Habitat in the region in which the species has been consistently recorded as occurring can generally be described as open forests and woodlands in which Coastal Grey Box *Eucalyptus moluccana* comprises a dominant component of the canopy layer and in which Spotted Gum *Corymbia citriodora* subsp. *variegata,* Grey Gums (predominantly *E. major*) and ironbark species may be locally dominant. These assemblages tend to be found on areas of relatively low relief, typically associated with fine-grained sediments or meta-sediments.

The apparent significance of Coastal Grey Box in habitat of the Black-chinned Honeyeater in the study area is consistent with observations of the species from other parts of its range. In a study of the foraging behaviour of the Black-chinned Honeyeater in the western New England region of New South Wales, Lollback *et al.* (2008) found that the species spent far more time foraging in 'box' species (*Eucalyptus albens*, *E. melliodora* and *E. moluccana*) than in any other tree species. The floristic assemblages on the Cumberland Plain in western Sydney with which the species is associated (Traill and Duncan 2000) have strong affinities to those found in Pooh

Corner Reserve, one of the locations within the study area from which the species has been recorded. Pooh Corner Reserve contains extensive stands of open forests dominated by *E. moluccana* with *E. sideroph*loia and *E. tereticornis* occurring as sub-dominant species. These species, with the exception of *E. sideroph*loia, are characteristic of the Cumberland Plain woodlands, although *E. crebra*, which is closely related to *E. sideroph*loia, is common on the Cumberland Plain (James *et al.* 1999). The Black-chinned Honeyeater is commonly associated with 'box–ironbark' assemblages on the inland slopes of the Great Dividing Range in Queensland, New South Wales and Victoria. Tree species typically dominating these assemblages include Inland Grey Box *E. microcarpa,* a species closely related to *E. moluccana*, and a range of ironbark species, particularly *E. sideroxylon* and *E. fibrosa* (Czaros 2005; S. Priday, unpublished data).

Extent of suitable habitat in the study area

Regional ecosystem mapping (Queensland Herbarium 2014) indicates that the floristic assemblages identified in this study as habitat of the Black-chinned Honeyeater in which *E. moluccana* is a dominant component were formerly more extensive, although restricted in occurrence compared to similar open forest communities. They occur predominantly on areas of relatively deep soil and low topographic relief and, as a consequence, have been extensively cleared since European settlement within the study area. Assemblages dominated by *C. henryi* and *E. fibrosa* subsp. *fibrosa* on metasediments were even more restricted in extent within the study area, being confined largely to the area now occupied by the western and north-western suburbs of Brisbane on the Bunya Phyllite formation. They have also been extensively cleared and exploited for timber extraction but regional ecosystem mapping (Queensland Herbarium 2014) indicates that some relatively large remnants are protected within conservation reserves on the western and north western margins of Brisbane. However, examination of many of these reserves during the study indicated that the Noisy Miner is a dominant species in a large proportion of remnants (S. Priday, unpublished data).

All locations at which the species has been recorded since 2000 have been subjected to varying levels of habitat fragmentation. Regional ecosystem mapping (Queensland Herbarium 2014) indicates that the open forests on metasediments of the Kurwongbah formation between Petrie and the Sheep Station Creek area west of Caboolture, which collectively may represent one of the main strongholds of the species in southern Queensland, have been extensively cleared. This is especially the case in the lower altitude eastern half of the formation where all sightings of the Black-chinned Honeyeater have been recorded. The forests in the southern half of the formation have been much less fragmented than those in the north, where the main occurrence of this open-forest community is protected in Sheep Station Creek Conservation Reserve. Pooh Corner Reserve at Wacol contains an isolated remnant of open forest on Quaternary alluvium in a

highly fragmented part of the study area. The habitats in which the species was recorded in the Muirlea/Pine Mountain area have also experienced high levels of clearing and timber extraction historically. However, regrowth since these historical disturbances have resulted in limited but contiguous native vegetation cover in the area.

Implications for conservation of the species

The limited extent of preferred floristic assemblages of the Black-chinned Honeyeater indicated by this study suggests that the population of the species within the study area, assuming it is largely sedentary, is likely to be small. Studies on other declining woodland bird species in Australia have indicated that occupancy of vegetation remnants may be influenced by a range of additional parameters such as structural attributes of the vegetation, the size and configuration of remnants, historical disturbances to vegetation and the characteristics of bird species assemblages within remnants (Ford *et al.* 2001; Major *et al.* 2001; Briggs *et al.* 2007). When these additional factors are taken into account, the potential area of suitable habitat available to the Black-chinned Honeyeater may be considerably smaller than is predicted by a simple spatial model based on vegetation mapping alone.

Although the species is generally described as sedentary (eg. Blakers *et al.* 1984; Lollback 2008; Traill and Duncan 2000), some observers have suggested that it may be primarily a rare visitor to the study area (eg Roberts 1979). However, summaries of sightings of the species provided in the Eremaea Birds database, combined with data collected in the present study, show that the species has been recorded in all months of the year in the study area. Records of the species from Sheep Station Creek Conservation Park, one of the best known localities for this species in the study area, have come from all months of the year with the exception of January. The erratic nature of sightings within the study area may be attributed to the low detectability of the species. Black-chinned Honeyeaters spend large amounts of time foraging in the canopy of trees and call infrequently compared to their conspecifics and other honeyeater species (Lollback 2008). However, it seems questionable that low detectability could explain the lack of previous records of the species from the areas on the north western periphery of Brisbane within which the species was recorded during the present study, as the inclusion of several surveys from these areas on the bird sightings databases examined, particularly Eremaea Birds, suggests they may be regularly frequented by birdwatchers. Further surveys will be required to determine if the birds recorded in this area were representative of a sedentary population or were dispersing or migrating individuals.

The main areas of occurrence of the Black-chinned Honeyeater in the study area are located on the peri-urban fringe of the Brisbane–Ipswich conurbation. These areas are under pressure from urban expansion, infrastructure development and extractive industries. Although five of the

six locations at which the species was recorded during the study are conservation reserves, all five are relatively small in area (<250 ha). Consequently, threatening processes affecting biodiversity within these reserves pose a potential threat to this species. Conservation of the species in the study area is likely to be dependent on the management of these threats both within dedicated conservation reserves and in suitable habitat on freehold land.

Acknowledgments

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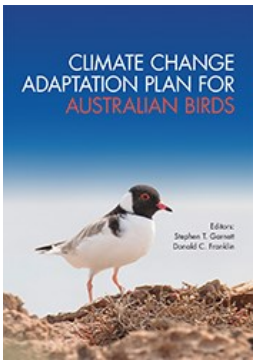
Book Review

Climate Change Adaptation Plan for Australian Birds

By Stephen Garnett and Donald Franklin (Eds.)



Published by CSIRO Publishing, 2014
Paperback, 272 pages
AU$69.95
http://www.publish.csiro.au

Review by David Milton.

Adapting to climate change is one of the major environmental challenges facing the world's biodiversity today. Over the next 50 years Australian wildlife, including our terrestrial birds will face a hotter, drier and more variable climate. Seabirds and shorebirds will face reduced nesting and feeding habitat as coastal inundation increases with rising sea levels. Stephen Garnett, Donald Franklin and their colleagues have undertaken the massive task of examining the risk of extinction or severe population decline of each bird species due to climate change. They did this by objectively assessing the exposure and sensitivity of all Australian bird species (and their sub-species). The official final report has subsequently been republished as this book.

The book is divided into six sections: 'Introduction', 'Exposure to Climate Change', 'Sensitivity to Climate Change', 'Vulnerability to Climate Change', 'Conserving Australian Birds in the Face of Climate Change' and finally, 'Adaptation Profiles of the 59 Species Identified to be Highly Sensitive and Highly Exposed to Climate Change'. The 'Exposure to Climate Change' and 'Sensitivity to Climate Change' chapters provide a general overview of the methods applied to assess the two main components of any threatening process, such as climate change. They also discuss the mechanisms by which the warming climate will affect birds and the process by which they applied their methods to assess Exposure. The sensitivity of each species to climate change was assessed according to a series of metrics that reflect each species' specialisation, genetic diversity and life history attributes.

The next two chapters of the book are devoted to the results of the assessments, with chapter 3 including a broad summary of the overall distribution of highly vulnerable species in Australia. Chapter 4 discusses the management options for conserving Australia's birds in the face of a changing climate. In this chapter the authors present a hierarchical system of practical responses as the

threat and the effect of warming climate reduces a species' population. These responses focus on outlining practical strategies for maintaining the persistence and connectivity of appropriate habitats to allow each species to persist as the climate changes. The final part of this chapter discusses the costs and timing of management actions required as the threat and population impacts increase.

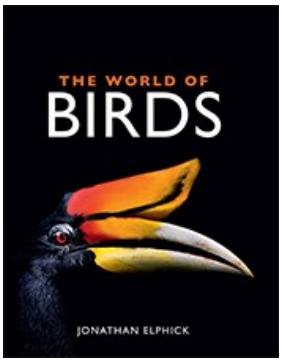
The final 163 pages of the book are devoted to a species-by-species profiling of the adaptation strategies required for each of the 79 species predicted to have at least one sub-species that are both highly exposed and highly sensitive to a changing climate. These profiles are made at both the sub-species level and at the species level and include maps showing how the core area of suitable climate for each species is predicted to change between now and 2085. In many cases, only some sub-species within a species are highly exposed and highly sensitive to changes in climate. Many of the most highly exposed and sensitive sub-species occur on Cape York or in the Wet Tropics of North Queensland. The climate models predict these areas will dry and become hotter more rapidly than elsewhere in Australia. Not surprisingly, the species and sub-species endemic to the higher altitude forests in the Wet Tropics are all among the most vulnerable. This includes iconic species such as Golden Bowerbird, Atherton Scrubwren, Mountain Thornbill, the *melasmenus* sub-species of Chowchilla, and Fernwren. Closer to home, the analysis predicts that there will be little or no suitable climate in south-east Queensland for species like Brown Cuckoo-Dove, Wompoo Fruit-Dove and Noisy Pitta. Among seabirds, a range of species including several currently breeding at Lord Howe or Norfolk Island may face reduced food availability due to reduced ocean productivity within the usual foraging distance of their colonies. For the resident shorebirds, only Beach Stone-curlew, Australian Pied Oystercatcher and Hooded Plover are predicted to be highly vulnerable, mostly due to increased inundation of their nests as sea levels rise. Several ground-nesting terns are also highly vulnerable for similar reasons. Perhaps most distressing is that the list of species predicted to be highly vulnerable includes species we traditionally might have considered relatively robust to changes in climate, i.e. those that occupy many different habitats, with large, nationwide distributions

This is quite a technical book and its main audience is not the general public. A major audience, in my opinion, is those public servants who are tasked with managing our biodiversity and their habitats, in both state and federal agencies. Tertiary students will find it a useful resource, as will Birds Queensland members with a keen interest in climate change. This book, like any analysis that tries to predict the future is really only as good as the data upon which it is based. Data are currently lacking on most of the basic aspects of the ecology and climate sensitivity of almost all Australian bird species. This is where Birds Queensland members can contribute by documenting habitat and ecological information on all species so that future climate change assessments can be based on the best available data.

Book Review

The World of Birds

By Jonathan Elphick.



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Review by Andrew Rogers.

The World of Birds by Jonathan Elphick aims to be a 'comprehensive guide to every aspect of bird life and a concise survey of the world's orders and families'. This large summary of bird biology covers everything from physiology through behaviour, followed by broad descriptions of the 32 orders and 195 families. What could easily be two separate books, Elphick's work falls closer to the 'text book' end of the 'coffee table – scientific text book' spectrum.

The first nine chapters provide an excellent reference text on everything bird related, including evolution, anatomy, ecology, and conservation. The text is detailed without being dense, with relevant examples of birds from around the world helping to tie the underlying broad biology back to the level of individual species. Indeed, as an introduction to bird biology, this book does a fantastic job of keeping the material relevant to bird ecology.

The tenth chapter makes up more than half of the book and provides brief introductions to all bird orders and families. These descriptions reveal a depth of knowledge and highlight the challenge of succinctly summarising the world's major bird groups. Perhaps unsurprisingly, the larger, well-known groups such as Sparrows get more space than the lesser known groups such as Penduline Tits *Remizidae,* Stitchbirds *Notiomystidae,* Bristleheads *Pityriasidae* or Vangas *Vangidae.* However, the detail across all groups is sufficient to provide a window into the remarkable diversity within each bird family. The only thing lacking is a well thought out quick reference guide which would make navigating this chapter far easier.

Due to the concise nature of the book, the chapter on families is unlikely to provide a detailed account of, for example, a favourite flycatcher, or describe where to find all the species of Motmots *Motmotidae.* However, for the novice birder this book is a great reference for distinguishing between groups such as old -world warblers *Sylviidae* and new world warblers *Parulidae.* For more experienced

avian enthusiasts *The World of Birds* provides a good refresher on groups such as Contingas *Cotingidae,* Jacamars *Galbulidae,* Tapaculos *Rhinocryptidae* and Bananaquits *Coerebidae.* Furthermore, Australia's birds are well represented throughout the text, from the Golden Bowerbird on page 1 through to the discussions on biogeography and Australia's 18 endemic bird families.

Despite the ever changing nature of bird biology, ecology, and genetics, this text provides a thorough and accessible review of the current understanding of 'bird life'. While it is by no means light reading, and those with a preference for more scientific literature will have to hunt for citations, this text achieves its aim admirably and is an impressive one-stop shop for information on the world's birds.

INSTRUCTIONS TO AUTHORS

The Sunbird is a peer-reviewed journal of the Queensland Ornithological Society Incorporated, which publishes original papers about birds in Queensland and adjacent northern regions.

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Appropriate referees will assess each submission. If needed, help may be given to authors to find relevant literature.

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References should be listed in alphabetical order at the end of papers in the following styles:

Fleay, D.H. 1973. Nesting habits of the brush turkey. *Emu* 36: 153–163.

Frith, H.J. (Ed.) 1976. Mallee fowl. Pp. 136–137 in *Complete Book of Australian Birds*. Reader's Digest: Sydney.

Loyn, R.H. 1985. Ecology, Distribution and Density of Birds in Victorian Forests. Pp 33–46 in *Birds of Eucalypt Forests and Woodlands: Ecology, Conservation, Management,* ed. by A. Keast, H.F. Recher, H. Ford & D. Saunders. Surrey Beatty and Sons: Chipping Norton, NSW.

IUCN 2006. *2006 IUCN Red List of Threatened Species*. www.iucnredlist.org. Accessed 14 October 2006.

Serventy, D., Serventy, V.N., & Warham, J. 1971. *The Handbook of Australian Sea-birds*. Reed: Sydney.

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