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Front cover: White-bellied Sea-Eagle taking mullet bait, south-east Queensland.
Photograph by Victoria Thomson and Tim Stevens

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Evaluation of Two Survey Methods: Transect vs Standardized Search in an Urban Park, Nanango, South-eastern Queensland

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Abstract

We present the outcomes of a survey of the avifauna of Pioneer Park, a small urban parkland in Nanango, south-eastern Queensland. Two counting methods were employed during February and March 2010 – a Finnish strip-transect as advanced by Järvinen & Väisänen (1975) and the "standardized search" as advocated by Watson (2003). The latter's "lenient stopping rule" was applied in both.

The primary aims of this study were to add to the paucity of literature on birds using Pioneer Park and to compare the effectiveness and efficiency of the two counting methods, especially under the stopping rule as advocated by Watson (2003).

The total number of species recorded in Pioneer Park over the years by the authors amounts to 65. The more common reflect the residential/ ornamental lagoon/parkland environment of Pioneer Park: Noisy Miner *Manorina melanocephala*, Crested Pigeon *Ocyphaps lophotes*, Rainbow Lorikeet *Trichoglossus haematodus* along with Maned Duck *Chenonetta jubata*, Australian White Ibis *Threskiornis molucca* and Dusky Moorhen *Gallinula tenebrosa* (personal observation). Species of particular note found in the park include Red-backed Kingfisher *Todiramphus pyrrhopygius*, Azure Kingfisher *Ceyx azureus*, Australian Reed-Warbler *Acrocephalus australis* and Red-tailed Black-Cockatoo *Calyptorhynchus banksia* (Bielewicz & Bielewicz, unpublished data).

Although it has been illustrated that significantly different results can arise when using different counting methods, our study shows little difference between results obtained from transect and standardised searches. Nevertheless, Watson's (2003) assertion that standardised searches are the more time-efficient method was upheld.

Introduction

Apart from one reference to an Azure Kingfisher *Ceyx azureus* by Bielewicz & Bielewicz (August 2009) on the Birds Queensland online sightings page (http://birdsqueensland.org.au/sightings_bydate_short.php), the only known avian research on Pioneer Park is by Templeton (1992) in which: Little Egret *Egretta garzetta*; Buff-banded Rail *Gallirallus philipensis*; Australian Reed-Warbler *Acrocephalus australis*; Little Grassbird *Megalurus gramineus* and Common Starling *Sturnus vulgaris* are mentioned. There is no reference to methodologies used.

This current survey offered the opportunity to further advance avian research at Pioneer Park. The survey also provided an opportunity to compare strip transect and area search counting methods and examine the results.

There is a large amount of literature available covering the variety of techniques used to count birds (e.g. Bibby *et al.* 1992; Ralph *et al.* 1993; Sutherland *et al.* 2004), including different count methods for different situations. For example, Ralph *et al.* (1993) prescribe mist net capture and nest counts in the study of declining bird populations; Spurr & Ralph (2006) recommend point counts in forest habitats; Sanderson *et al.* (2008) promote line transects as the most efficient way to conduct beach surveys and Verner (1984) asserts that total mapping is the only suitable method if an absolute scale of density estimation is required. However, each of these methods has its advantages and inherent defects; with no one single method providing a panacea to correct all irregularities and potential biases (Verner 1984; Wakeley 1987; Recher 1989).

To overcome this there have been a number of attempts to combine two or more counting methods in the one study, and the benefits of using more than one method have been clearly established (e.g. Vorišek *et al.* 2008). Loyn (1980) compared standard mapping techniques with density estimates derived from transects. Conant *et al.* (1981) used a mixture of two line transect methods, a variable-distance circular plot and spot-mapping. Shields & Recher (1984) used four methods to census birds in forest and woodland near Bombala on the Southern Tablelands, NSW. Arnold (1984) used interval point counts and strip transects in Wandoo woodland. Watson (2004) compared single strip-transects (sampled repeatedly), multiple strip-transects (time-balanced area proportionate sampling), a fixed number of 20-minute searches and a variable number of 20-minute searches (his "standardized search").

In his comprehensive review of counting methods, with particular reference to Australia, Recher (1989) cites several further examples of counting combinations used in the field.

Methods

Study Area

Nanango (26°40'S, 152°00'E) lies at the junction of the D'Aguilar and Burnett Highways and is part of the South Burnett region, which has traditionally been known as a centre of timber-getting, agriculture and pastoralism (Matthews 1997). In more recent times the area has diversified into vineyards, olives (Caffery & Groves 2007) and even more exotic crops such as dragon fruit Hylocercus undatus (personal observation).

The township of Nanango itself was established in the late 1840s (Matthews, 1997; Grimes, 1998), is Queensland's 4th oldest settlement and the first to be established in the South Burnett (Grimes, 1998).

Nanango experiences warm, wet summers and cool, dry winters (Caffery & Groves, 2007). The mean maximum temperature for January, the hottest month, is 30.4°C while the coolest (mean minimum) is 2.7°C in July, although lows of -6°C have been recorded (Bielewicz & Bielewicz, unplublished data) and frosts are not uncommon (personal observation). Local mean rainfall reaches a high of 107.6 mm in January and is at its lowest in August, 32.2 mm, with an average annual rainfall of 783.5 mm.

Pioneer Park, an 8 ha parkland, lies on the town edge, on the western side of Sandy Creek and to the east of the former railway station. Drayton Street forms its narrow northern boundary while Mill Flat Road/Appin Street West mark its broader southern boundary.

Pioneer Park presents a "patchy landscape": Sandy Creek with its reed-lined banks; suburban gardens, some planted with introduced flora; native eucalypts and gums; a Casuarina grove; a wide expanse of grass; and the ornamental lake (the "Duck Pond") with its well-treed and reed-bordered central island.

Procedures

A total of 20 sampling sessions (ten per counting method) were conducted from the end of February and throughout March 2010. Each counting method was used once on each sampling day. The order of usage was alternated, such that if one method was conducted first on a particular day, the other method took precedence on the following sampling day. An equal effort of 20 minutes was used on both counting methods. Counts were conducted from 0700 to 0720 hours each morning and again from 1600 to 1620 hours each afternoon.

Watson's (2003) lenient stopping rule was applied to both counts. "Completion" was reached when the number of singletons (species observed only once) equalled or fell below the number of doubletons (species noted only twice). Species tallies were tabulated at the end of each sampling period to ascertain when the completion point had been reached.

During standardized searches the area was actively covered to ensure that each of the "mini habitats" was sampled on each visit. Birds seen and/or heard within the designated area were recorded; those birds that were clearly outside the stipulated boundaries or flying past were recorded but not included in the final analysis.

The relatively small size of the park meant that the 200 m long / 50 m wide strip-transect could not be placed randomly, so it was located along a central route through the park, suspended on either side of the ornamental lake.

The transect was marked out on the eve of the initial sampling period. Stakes were spaced 20 m apart along the eastern and western "boundaries," with coloured tape tied to each and remained in place until the conclusion of the study.
As with the "standardized search" birds beyond the line of markers or clearly flying through were recorded as incidentals but not included in the analysis.

Results

Total number of bird species recorded during this study was 44 (Appendix 1), compared to 61 species recorded during the 2009 year-round survey (Bielewicz & Bielewicz, unplublished data).

Forty species (91%) were observed in the ten standardised searches, with 36 (81.81%) recorded at "completion" (which was reached at the end of the seventh sampling session). Thirty-nine species (88.6%) were recorded during the ten transect counts, with 35 (79.5%) recorded at "completion" of the standardized searches (i.e. at the end of the seventh sampling session).

Five species (11.36%) observed during the standardized searches were not noted during transects. Conversely, four species (9%) recorded during transects were not noted in standardized searches (Table 1).

In terms of the types of species recorded, very similar results were recorded in both transect and standardized searches (Figure 1). Passerines were the dominant species recorded (25 and 21 respectively) using both techniques.

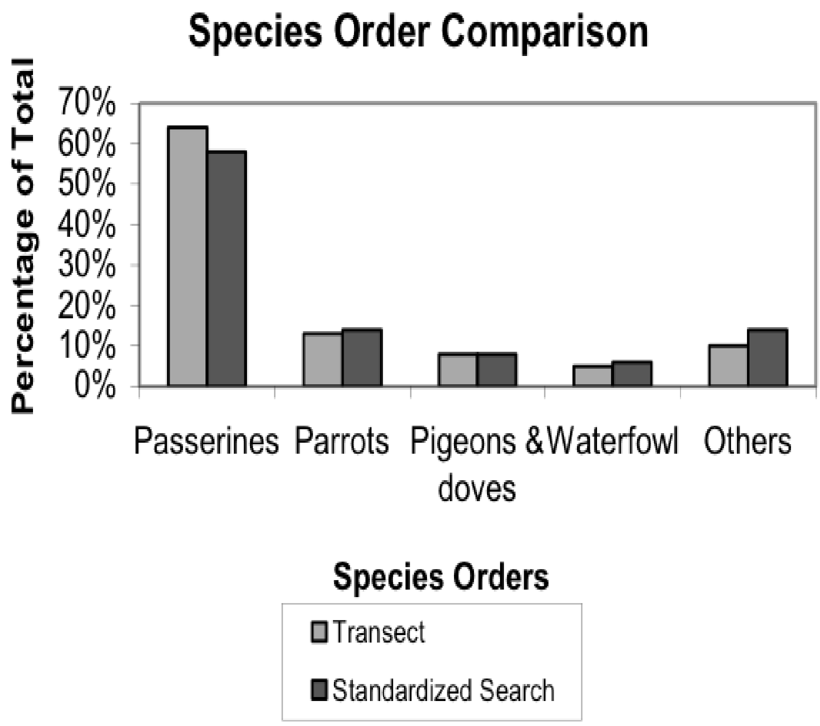

Figure 1: Species Order Distribution (Top 5).

Again, at the family level, both count methods produced similar results with honeyeaters dominant in both transect and standardized searches (eight and six species respectively). In the categories of Bellmagpies & allies and Thornbill & allies tallies were comparable at three and two species each respectively. Even the broader "Others" category was equal (13) in both counts. In a further three families, the count between transects and standardized searches amounts to one species difference (Figure 2).

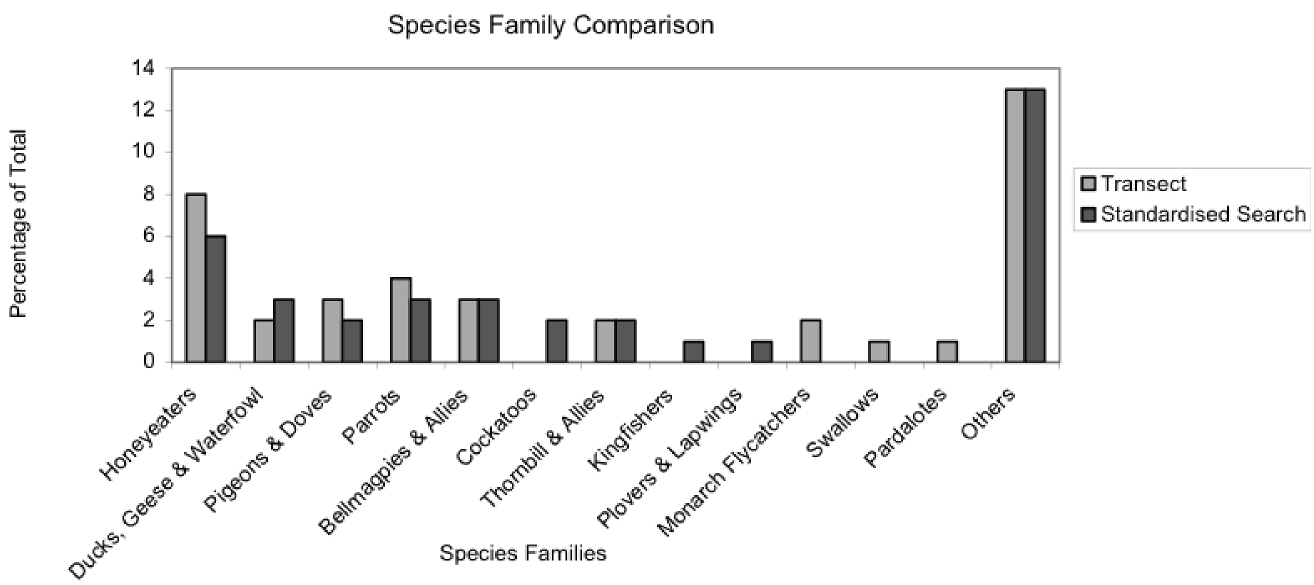

Figure 2: Species family distribution.

Complete inventories for both methods appear in Appendix 1 (standardized search) and Appendix 2 (transect). A summary of species incidence data for both counts is given in Table 1.

The standardized search method achieved "completion" after seven sampling sessions were completed. However, the transect approach failed to achieve "completion" by the end of the allotted ten sampling intervals.

Table 1. Summary of species occurrence data for both the transect count and the standardized search (with pre- and post- competion data for the latter) used to evaluate efficacy of the two sampling methods.

All species recorded were allocated an incidence value (proportion of samples in which the species was recorded).

Linnean Name	Common Name	Standardized Survey @ completion		Standardized Survey @ 10 samples		Strip Transect	
		Incidence	Max No.	Incidence	Max No.	Incidence	Max No.
Struthidea cinerea	Apostlebird	missed		0.3	1.5	0.4	5
Sphecotheres vieilloti	Australasian Fig-bird++	missed		0.1	1	n/a	
Alisterus scapularis	Australian King-Parrot+	n/a		n/a		0.1	1
Cracticua tibicen	Australian Magpie	0.85	2	0.7	2	0.7	3
Acrocephalus australis	Australian Reed-Warbler	0.71	1	0.7	1	0.1	1
Chenonetta jubata	Maned Duck	1.00	8	1.00	13	1.00	15
Geopelia humeralis	Bar-shouldered Dove	missed		0.1	2	0.3	1
Coracina novaehollandiae	Black-faced Cuckoo-shrike	0.28	1	0.3	1	0.1	1
Entomyzon cyanotis	Blue-faced Honeyeater	missed		0.1	1	0.1	1
Lichmera indistincta	Brown Honeyeater	0.57	1	0.5	2	0.4	1
Ocyphaps lophotes	Crested Pigeon	0.14	2	0.2	3	0.1	2
Gallinula tenebrosa	Dusky Moorhen	0.85	5	0.9	5	1.00	4
Acanthorhynchus tenuirostris	Eastern Spinebill+	n/a		n/a		0.2	2
Eolophus rosseicapillus	Galah	0.14	3	0.3	3	0.3	4
Anas gracilis	Grey Teal++	0.14	1	0.1	1	n/a	
Dacelo novaeguinea	Laughing Kookaburra++	0.14	2	0.1	2	n/a	

Linnean Name	Common Name	Standardized Survey @ completion		Standardized Survey @ 10 samples		Strip Transect	
		Incidence	Max No.	Incidence	Max No.	Incidence	Max No.
Myiagra rubecula	Leaden Flycatcher+	n/a		n/a		0.1	1
Philemon citreogularis	Little Friarbird	0.28	5	0.3	5	0.7	3
Microcarbo melanoleucos	Little Pied Cormorant	0.28	1	0.2	1	n/a	
Grallina cyanoleuca	Magpie-lark	1.00	4	1.00	5	1.00	4
Vanellus miles	Masked Lapwing	0.71	2	0.6	2	0.7	3
Dicaeum hirundinaceum	Mistletoebird	0.28	1	0.3	1	0.2	1
Philemon corniculatus	Noisy Friarbird	0.57	4	0.4	4	0.7	2
Manorina melanocephala	Noisy Miner	0.14	2	0.1	2	0.1	1
Oriolus sagittatus	Olive-backed Oriole+	n/a		n/a		0.1	1
Anas superciliosa	Pacific Black Duck	0.71	3	0.6	3	1.00	3
Platycersus adscitus	Pale-headed Rosella	0.42	4	0.3	4	0.4	4
Cracticus nigrogularis	Pied Butcherbird	0.28	1	0.3	1	0.3	1
Strepera graculina	Pied Currawong	0.42	6	0.4	6	0.4	2
Trichoglossus haematodus	Rainbow Lorikeet	1.00	>30	1.00	>30	1.00	>30
Myiagra inquieta	Restless Flycatcher	0.28	1	0.3	1	0.4	1
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	0.14	4	0.2	4	0.1	2
Myzomela sanguinolenta	Scarlet Honeyeater++	0.42	1	0.3	1	n/a	
Streptopelia chinensis	Spotted Dove	0.42	1	0.3	1	0.2	2
Pardalotus striatus	Striated Pardalote	0.57	1	0.5	1	0.4	1
Plectorhyncha lanceolata	Striped Honeyeater	0.57	1	0.4	1	0.2	1
Cacatua galerita	Sulphur-crested Cockatoo++	0.14	1	0.1	1	n/a	
Corvus orru	Torresian Crow	0.71	4	0.8	4	0.50	3

Linnean Name	Common Name	Standardized Survey @ completion		Standardized Survey @ 10 samples		Strip Transect	
		Incidence	Max No.	Incidence	Max No.	Incidence	Max No.
Hirundo neoxena	Welcome Swallow	0.42	2	0.3	2	0.1	2
Ardea pacifica	White-faced Heron	0.42	1	0.5	2	0.2	2
Rhipidura leucophrys	Willie Wagtail	1.00	2	1.00	2	0.9	4
Ancanthiza nana	Yellow Thornbill	0.42	2	0.4	4	0.1	1
Lichenostomus chrysops	Yellow-faced Honeyeater	0.28	1	0.3	1	0.1	1
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	0.14	6	0.1	6	0.1	6

++ species appearing in standardised searchs only
+ species appearing in transects only.

Discussion

The discrepancy in species richness between this present study (44) and that maintained by Bielewicz & Bielewicz (unplublished data) (61) is a question of timing. This current survey is a mere snapshot of the park's avifauna in the late summer/early autumn when species diversity is ebbing, whereas the latter figure represents observations during all seasons and over a number of years. By mid-March many summer migrants have departed (Bielewicz & Bielewicz, unplublished data), although, as indicated by the incidental observation of Pacific Koel, *Eudynamys orientalis*, a few individuals may linger in the area.

Comparisons of counting methods provided similar results for all orders with only a few differences existing between methods. For example, there were no cockatoos, kingfishers or lapwings recorded during transect observations; and there were no flycatchers, swallows or pardalotes recorded during standardized searches. However, whether one adopts "completion" (standardized search) figures or those at the conclusion of all sampling, the margins between results remain narrow between the two techniques and no significant difference is apparent. As such the results clearly paint a parallel scenario between the two counting methods and it is difficult to pronounce one counting method as more robust than the other.

Both prospective and retrospective consideration was given to possible biases (e.g. Verner, 1989). As described in the Methods, the park's size precluded random placement of the transect line. However, the centralized transect markers did not interfere with park users, nor did users interfere with the markers, thus it is difficult to see how this might be a factor affecting the results. Further, as described in the methods, every effort was taken to avoid bias from observers, time of day and weather. In conclusion, all that can be claimed with any degree of confidence is that while both methods produced comparable species richness figures, the standardized search achieved "completion" after 140 minutes effort, the transect did not; indicating the former to be the more time efficient method. The more time efficient method allows more counts per effort and is thus more practical for citizen scientists.

Appendix 1

A complete inventory of species observed using the standardized search method. The progress of singletons to doubletons is depicted at the bottom. Counting ceased on completion at end of the 7th session.

PIONEER PARK STANDARDIZED SEARCH INVENTORY

Linnean Name	Common Name	1	2	3	4	5	6	7
Struthidea cinerea	Apostlebird	0	0	0	0	0	0	0
Sphecotheres vieilloti	Australasian Figbird	0	0	0	0	0	0	0
Alisterus scapularis	Australian King-Parrot	0	0	0	0	0	0	0
Cracticua tibicen	Australian Magpie	1	1	1	1	1	0	1
Acrocephalus australis	Australian Reed-Warbler	1	0	1	1	1	0	1
Chenonetta jubata	Maned Duck	1	1	1	1	1	1	1
Geopelia humeralis	Bar-shouldered Dove	0	0	0	0	0	0	0
Coracina novaehollandiae	Black-faced Cuckoo-shrike	0	0	1	0	0	0	1
Entomyzon cyanotis	Blue-faced Honeyeater	0	0	0	0	0	0	0
Lichmera indistincta	Brown Honeyeater	1	0	1	0	1	0	1
Ocyphaps lophotes	Crested Pigeon	1	0	0	0	0	0	0
Gallinula tenebrosa	Dusky Moorhen	0	1	1	1	1	1	1
Acanthorhynchus tenuirostris	Eastern Spinebill	0	0	0	0	0	0	0
Eolophus rosseicapillus	Galah	0	0	0	0	0	1	1
Anas gracilis	Grey Teal	0	1	0	0	0	0	0
Dacelo novaeguinea	Laughing Kookaburra	0	0	1	0	0	0	0
Myiagra rubecula	Leaden Flycatcher	0	0	0	0	0	0	0
Philemon citreogularis	Little Friarbird	0	0	1	0	0	0	1
Microcarbo melanoleucos	Little Pied Cormorant	0	0	1	0	0	0	1
Grallina cyanoleuca	Magpie-lark	1	1	1	1	1	1	1
Vanellus miles	Masked Lapwing	0	1	0	1	1	1	1

Linnean Name	Common Name	1	2	3	4	5	6	7
Dicaeum hirundinaceum	Mistletoebird	1	0	0	0	1	0	0
Philemon corniculatus	Noisy Friarbird	1	0	1	0	1	0	1
Manorina melanocephala	Noisy Miner	1	0	0	0	0	0	0
Oriolus sagittatus	Olive-backed Oriole	0	0	0	0	0	0	0
Anas superciliosa	Pacific Black Duck	1	1	1	1	0	1	0
Platycersus adscitus	Pale-headed Rosella	1	0	0	0	1	1	0
Cracticus nigrogularis	Pied Butcherbird	1	1	0	0	0	0	0
Strepera graculina	Pied Currawong	1	0	1	0	1	0	1
Trichoglossus haematodus	Rainbow Lorikeet	1	1	1	1	1	1	1
Myiagra inquieta	Restless Flycatcher	0	0	0	0	1	1	0
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	1	0	0	0	0	0	0
Myzomela sanguinolenta	Scarlet Honeyeater	0	0	1	0	1	0	1
Streptopelia chinensis	Spotted Dove	1	1	1	0	1	1	0
Pardalotus striatus	Striated Pardalote	1	0	1	1	0	1	0
Plectorhyncha lanceolata	Striped Honeyeater	1	0	1	0	1	0	1
Cacatua galerita	Sulphur-crested Cockatoo	0	0	0	1	0	0	0
Corvus orru	Torresian Crow	1	0	1	1	0	1	1
Hirundo neoxena	Welcome Swallow	1	0	1	0	0	0	1
Ardea pacifica	White-faced Heron	1	0	1	0	0	1	0
Rhipidura leucophrys	Willie Wagtail	1	1	1	1	1	1	1
Ancanthiza nana	Yellow Thornbill	0	0	1	0	1	1	0
Lichenostomus chrysops	Yellow-faced Honeyeater	0	0	0	0	0	1	1
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	1	0	0	0	0	0	0
		23	11	23	12	18	16	20
	Singletons			15	16	12	13	7
	Doubletons			11	7	7	5	9

Appendix 2

A complete inventory of species observed using strip transect method.

PIONEER PARK STANDARDIZED SEARCH INVENTORY

Linnean Name	Common Name	1	2	3	4	5	6	7	8	9	10
Struthidea cinerea	Apostlebird	0	0	1	0	1	0	0	1	0	1
Sphecotheres vieilloti	Australasian Figbird	0	0	0	0	0	0	0	0	0	0
Alisterus scapularis	Australian King-Parrot	0	0	0	0	1	0	0	0	0	0
Cracticua tibicen	Australian Magpie	0	1	1	0	1	1	1	0	1	1
Acrocephalus australis	Australian Reed-Warbler	0	0	1	0	0	0	0	0	0	0
Chenonetta jubata	Australian Wood Duck	1	1	1	1	1	1	1	1	1	1
Geopelia humeralis	Bar-shouldered Dove	1	1	0	0	0	0	0	0	1	0
Coracina novaehollandiae	Black-faced Cuckoo-shrike	0	0	1	0	0	0	0	0	0	0
Entomyzon cyanotis	Blue-faced Honeyeater	0	0	0	0	0	0	0	0	1	0
Lichmera indistincta	Brown Honeyeater	0	1	1	0	0	0	1	0	1	0
Ocyphaps lophotes	Crested Pigeon	1	0	0	0	0	0	0	0	0	0
Gallinula tenebrosa	Dusky Moorhen	1	1	1	1	1	1	1	1	1	1
Acanthorhynchus tenuirostris	Eastern Spinebill	0	1	0	0	1	0	0	0	0	0
Eolophus rosseicapillus	Galah	0	0	0	0	0	0	0	1	1	1
Anas gracilis	Grey Teal	0	0	0	0	0	0	0	0	0	0
Dacelo novaeguinea	Laughing Kookaburra	0	0	0	0	0	0	0	0	0	0
Myiagra rubecula	Leaden Flycatcher	0	1	0	0	0	0	0	0	0	0
Philemon citreogularis	Little Friarbird	0	0	1	0	1	1	1	1	1	1
Microcarbo melanoleucos	Little Pied Cormorant	0	0	1	0	0	0	0	0	0	0
Grallina cyanoleuca	Magpie-lark	1	1	1	1	1	1	1	1	1	1
Vanellus miles	Masked Lapwing	1	0	1	1	1	1	1	1	0	0

Linnean Name	Common Name	1	2	3	4	5	6	7	8	9	10
Dicaeum hirundinaceum	Mistletoebird	0	1	0	0	0	0	0	0	1	0
Philemon corniculatus	Noisy Friarbird	1	1	0	0	1	1	1	1	0	1
Manorina melanocephala	Noisy Miner	0	0	0	0	0	1	0	0	0	0
Oriolus sagittatus	Olive-backed Oriole	0	0	0	0	0	0	1	0	0	0
Anas superciliosa	Pacific Black Duck	1	1	1	1	1	1	1	0	1	1
Platycersus adscitus	Pale-headed Rosella	0	0	1	1	1	0	0	0	1	0
Cracticus nigrogularis	Pied Butcherbird	0	0	1	0	1	0	0	1	0	0
Strepera graculina	Pied Currawong	1	0	1	0	0	0	1	0	1	0
Trichoglossus haematodus	Rainbow Lorikeet	1	1	1	1	1	1	1	1	1	1
Myiagra inquieta	Restless Flycatcher	0	0	1	0	1	0	1	0	1	0
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	0	0	0	0	0	0	0	0	1	0
Myzomela sanguinolenta	Scarlet Honeyeater	0	0	0	0	0	0	0	0	0	0
Streptopelia chinensis	Spotted Dove	0	0	0	1	0	0	0	0	1	0
Pardalotus striatus	Striated Pardalote	1	1	0	0	1	1	0	0	0	0
Plectorhyncha lanceolata	Striped Honeyeater	0	0	1	0	0	0	0	0	1	0
Cacatua galerita	Sulphur-crested Cockatoo	0	0	0	0	0	0	0	0	0	0
Corvus orru	Torresian Crow	1	1	1	0	1	1	0	0	0	0
Hirundo neoxena	Welcome Swallow	0	0	0	0	0	0	1	0	0	0
Ardea pacifica	White-faced Heron	1	0	0	0	0	0	0	0	1	0
Rhipidura leucophrys	Willie Wagtail	1	1	1	1	1	1	1	0	1	1
Ancanthiza nana	Yellow Thornbill	0	0	0	0	0	1	0	0	0	0
Lichenostomus chrysops	Yellow-faced Honeyeater	0	0	0	0	0	0	0	1	0	0
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	1	0	1	0	0	1	0	0	0	0
	Singletons		14	14	10	12	14	16	12	12	
	Doubletons		8	8	9	7	4	2	6	5	

References

Arnold, G.W. 1984. Comparison of numbers and species of birds in wandoo woodland obtained by two census methods. *In Methods of Censusing Birds in Australia*. (S.J.J.F. Davies, Ed.)Royal Australasian Ornithologists Union/Department of Sustainability and Environment, Melbourne.

Bibby, C.T., N.D. Burgess, & D.A. Hill. 1992. *Bird Census Techniques*. Academic Press, London.

Caffery, E. & G. Groves. 2007. *The Gathering of the Waters: A Short History of the Nanango Shire*. Nanango Shire Council, Nanango.

Conant, S., M.S. Collins & C.J. Ralph. 1981. Effects of observers using different methods upon total population estimates of two resident island birds. *Studies of Avian Biology* 6: 337–381.

Grimes, J.A. 1998. *Pioneering into the Future: A Short History of Nanango Shire*. Wise Owl Research Publishers, Maryborough, Queensland.

Järvinen, O. & R.A. Väisänen. 1975. Estimating relative densities of breeding birds by the line transect method. *Oikos* 26: 316–322.

Loyn, R.H. 1980. Bird populations in a mixed eucalypt forest used for production of wood in Gippsland, Victoria. *Emu* 80: 145–156.

Matthews, T.D. 1997. *Landscape of Change: A History of the South Burnett*. (2 vols). Participating Members of the South Burnett Local Government Association, Kingaroy, Queensland.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin & D.F. DeSante. 1993. *Handbook of Field Methods for Monitoring Birds*. Pacific Southwest Research Station, Albany, California.

Recher, H.F. 1989. Counting terrestrial birds: Use and application of census procedures in Australia. *Australian Zoological Review* 1: 25.45.

Sanderson, C. J.M. Peter & M. Cullen. 2008. *Long-term Bird Monitoring: A Real-life Study of Using Volunteers*. Birds Australia Report No. 21, Carlton, Victoria.

Shields, J.M. & H.F. Recher. 1984. Breeding bird censuses: an evaluation of four methods for use in sclerophyll forest. *Corella* 8: 29–41.

Spurr, E.B. & C.J. Ralph. 2006. *Development of Bird Population Monitoring in New Zealand: Proceedings of a Workshop*. Landcare Research Science Series No.32. Manaaki Whenua Press, Canterbury, NZ.

Sutherland, W.J., I. Newton & R.E. Green. 2008. *Bird Ecology and Conservation*. Oxford, UK.

Templeton, M.T., 1991. Birds of Scientific Area S.A.16, Marbletop, Nanango, Queensland. *Sunbird* 21: 19–25.

Templeton, M.T. 1992. Birds of Nanango, south-east Queensland. *Sunbird* 4: 87–110.

Verner, J. 1984. Assessment of counting techiques. *Current Ornithology* 2: 247–302.

Voriiiek, P., A. Klvanova, S. Wotton & R.D. Gregory (Eds.). *A Best Practice Guide for wild bird monitoring schemes*. EBCC/CSO/BirdLife International/RSPB/CBS. Czech Republic.

Watson, D.M. 2003. The 'standardized search': an improved way to conduct bird surveys. *Austral Ecology* 28: 515-528.

Watson, D.M. 2004. Comparative evaluation of new approaches to survey birds. *Wildlife Research* 31: 3–11.

Wakeley, J.S. 1987. *Avian Line-Transect Methods*. Technical Report EL-87-5. Department of the Army Waterways Experiement Station, Corp of Engineers, Vickburg, USA.

Pale-headed Rosella – one of the species indentied at Pioneer Park, Nanango. Photograph: Julian Bielewicz.

The Sunbird (2016) 46(1): 16–28

Carrion Preference in Australian Coastal Raptors: Effects of Urbanisation on Scavenging

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Abstract

Ongoing urbanisation and increasing human populations threaten many natural systems including coastal ecosystems. Scavenging coastal raptors are important biological vectors between marine and terrestrial ecosystems and are significantly affected by urbanisation in south-east Queensland, Australia. Little is known on the effects of human activity on Australia's coastal raptor community, including possible influences on foraging ecology. We surveyed four locations on the Gold Coast, Queensland to compare the assemblages and to test whether urbanised locations altered the preference of four Australian coastal raptor species for types of carrion prey of either marine or terrestrial origin (mullet and quail) using baited camera sampling techniques. PERMANOVA analyses showed a significant difference in raptor abundance between urban and non-urban settings. With limited sampling, no significant difference was found for carrion preference. However, a clear trend was seen with White-bellied Sea-Eagles *Haliaeetus leucogaster* preferring mullet, and Whistling Kites *Haliastur sphenurus* preferring quail in non-urban settings. No bait was taken in urban locations. This study suggests that increasing urbanisation on the Gold Coast significantly influences where coastal raptors forage. This urbanisation also raises questions concerning the foraging territories and home ranges of these raptors, and whether these effects occur more broadly. The mechanised rubbish collecting practices in place on the Gold Coast also point to concerns about other, more subtle impacts of coastal expansion on the local scavenging community.

Introduction

Coastal development is an ongoing process with many natural systems, including mangrove and estuarine ecosystems, and sandy beaches, threatened by increasing human populations and urban expansion (Lotze *et al.* 2006; Huijbers *et al.* 2013; Sanger *et al.* 2015). Coastal areas have seen mangrove deforestation rates reportedly higher than those of global forests (Ahmed & Glaser 2016), and with human populations concentrated around coastal zones, many coastal ecosystems are under extreme pressures (Vitousek *et al.* 1997; Sanger *et al.* 2015). These anthropogenic stresses typically lead to flow-on effects, including reduced sediment and water quality (Vitousek *et al.* 1997, Birch *et al.* 2012) and loss of biodiversity (Lotze *et al.* 2006).

Urbanisation significantly affects scavenging guild compositions, including raptors (diurnal birds of prey) (Mooney 1998; Huijbers *et al.* 2013, 2015) through habitat loss and alteration, fragmentation and direct disturbance (Berry *et al.* 1998), with some species being particularly vulnerable (Eduardo *et al.* 2007). Scavenging raptors, for example, often avoid populated areas in south-east Queensland, Australia (Huijbers *et al.* 2013, 2015). Scavenging patterns have been found to be significantly altered in urban locations with feral and non-native species dominating raptor communities, whereas this pattern is reversed in rural locations (Huijbers *et al.* 2013, 2015). South-east Queensland's raptors are experiencing ongoing pressure through habitat loss related to ever-increasing urbanisation (Mooney 1998), including the loss of nesting sites for White-bellied Sea-Eagles *Haliaeetus leucogaster* on the Gold Coast (O'Donnell and Debus 2012). These animals are important carrion consumers and biological vectors acting in nutrient transport from marine to terrestrial systems (Schlacher *et al.* 2013) and any declines in abundance could have significant ecological implications.

Four raptor species commonly found along the south-east Queensland coastline that rely on fish for prey were included in the coastal raptor community considered for this study. These species are: Eastern Osprey *Pandion cristatus*, White-bellied Sea-Eagle, Whistling Kite *Haliastur sphenurus* and Brahminy Kite *Haliastur indus*. None of these species is listed as threatened globally (IUCN 2016), although their conservation status differs among species and states (Debus 2012).

It has been estimated by the Queensland State Government that between the years of 2006 and 2031, 754 000 new dwellings will be required to house the current population growth of south-east Queensland (Stirling 2009). With ongoing coastal expansion in this region, it is important to understand the anthropogenic impacts on the diet of Australia's coastal raptors to recognise the potential impacts this is having on nutrient transport between systems, and to further consider the adaptive abilities of these birds to their ever-changing environment. Human activities can change the nature of predator-prey relationships (Rodewald *et al.* 2011), and by introducing resource subsidies such as human refuse into trophic systems (Marczak *et al.* 2007; Rodewald *et al.* 2011), food web dynamics may be severely altered (Polis *et al.* 1997).

As little is known about the feeding ecology and the impacts of human activity on Australia's coastal raptor community (Lutter *et al.* 2006; Olsen *et al.* 2006; Debus 2008; Debus *et al.* 2014; Rourke & Debus 2016), the purpose of this study was to compare the assemblages of coastal raptors and their preference for carrion types in south-east Queensland in areas of differing levels of urbanisation.

Methods

Four locations were selected for this study, two urban and two non-urban with two differing levels of exposure (exposed, i.e. sandy beach, and sheltered, i.e. estuary side). All locations were within the city of Gold Coast, south-east Queensland, Australia (Figure 1). Each location was surveyed on three occasions between April and June 2014. However, the timing of surveys was not evenly or consistently spaced, precluding any analysis of seasonality in raptor abundance or carrion preference.

To assess the assemblage of raptors within each location, a structured survey of the relative abundance of raptors was conducted. This consisted of three sets of 10-minute observations across a period of four hours (at 0 min, 120 min, and 240 min). The survey area was continuously scanned using binoculars and the species and number of raptors recorded. Numbers of raptors were generally low (maximum was 5), so that double counting was unlikely. Any raptor behaviour observed during these surveys was recorded, as were miscellaneous observations of raptors outside the observational time periods, including possible disturbances (i.e. human activity such as operation of vehicles). Other bird species seen in the area were also recorded both during and outside survey periods.

In order to test preferences for carrion types, during each survey at a particular location, four camera traps were deployed, resulting in a total of 12 camera deployments per location. Thus, across the four different locations (exposed urban, exposed non-urban, sheltered urban, sheltered non-urban), a total of 48 camera deployments was

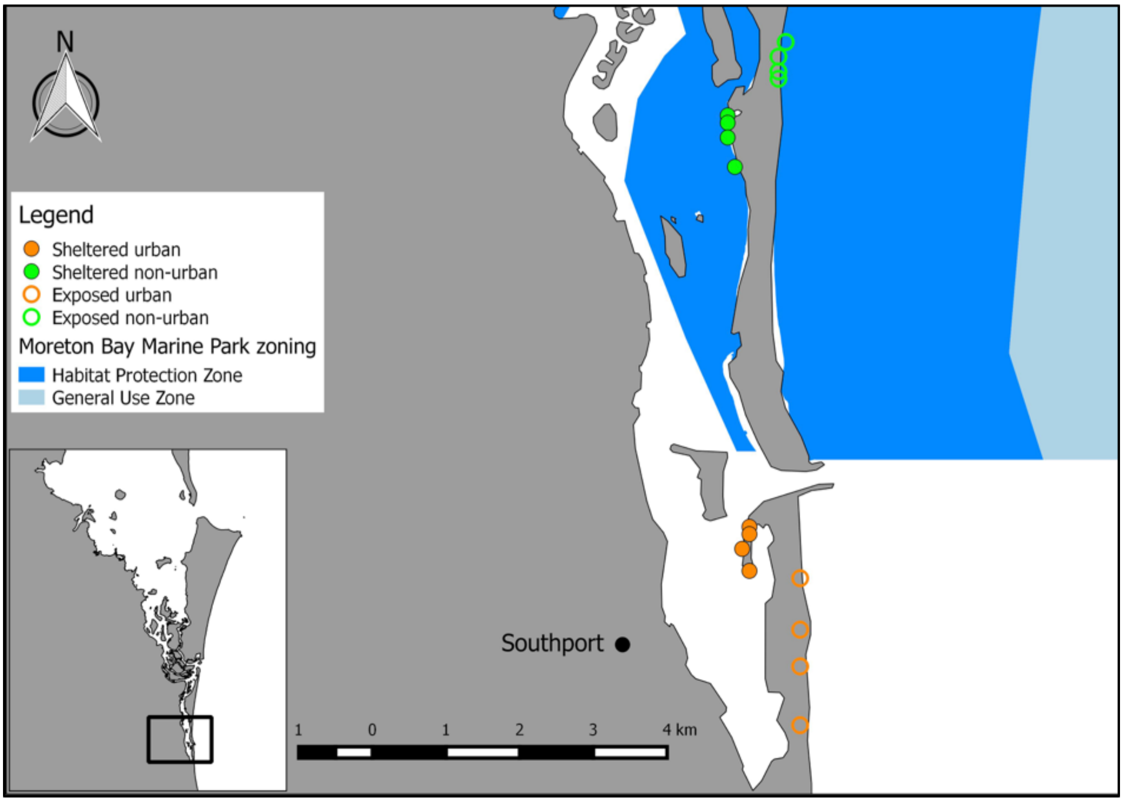

Figure 1: Camera locations for all four sampling sites, including Moreton Bay Marine Park zoning, which includes the waters surrounding the non-urbanised locations.

used for the entire study. Both non-urban locations were located on South Stradbroke Island and both urban locations were located near Southport (Figure 1). For the purpose of this study, an urbanised location is classified as being a maximum distance of 500 m from the nearest paved road.

Camera traps were placed approximately 200 m apart at each location, and deployed for an approximate four-hour period, starting at dawn. One GoPro® and one digital passive infrared (PIR) motion-triggered camera (ScoutGuard SG560Z-8M) were used per camera trap to test the relative effectiveness of the camera types. One mullet (average weight 304.7 g ± 21.25) and one adult quail bait (average 207.9 g ± 2.57) were placed at each camera trap for the four-hour period. These represented marine and terrestrial sources of prey, respectively. After the deployment, camera footage was examined to determine whether or not carrion had been consumed, and if so, by which species. Footage was also checked for any disturbances that were not seen during observations.

Statistical Design

Three sets of analyses were conducted to answer the following:

i) Was the abundance of individual raptor species different between urban and non-urban locations, and between exposed and sheltered locations?
ii) Was the raptor assemblage different between urban and non-urban locations, and between exposed and sheltered locations?
iii) Were raptor carrion preferences different between these locations, and between species?

To determine if there was a difference in raptor assemblages between locations of differing exposure and urbanisation levels, both univariate and multivariate classification analyses were used. Differences in relative abundances of individual raptor species between locations were tested using a two-way design, with factors Exposure (exposed vs. sheltered) and Urbanisation (urbanised vs. non-urbanised). Preliminary analyses indicated that there was no difference between months, so this was excluded from the final analyses. As overall abundances within the dataset were low, and assumptions of normality could not be met, even with transformation, analyses were carried out using the non-parametric Permutational Multivariate Analysis of Variance [PERMANOVA, (Anderson & Gorley 2007)] add-on within the PRIMER (version 6, Primer-E) software package. Differences in the overall raptor assemblage composition between the four locations were also tested using the same design. Data were 4th-root transformed to minimise stress in the analysis, but preliminary analyses indicated that different transformations had no effect on the results.

Differences in carrion choice between species were analysed using preference scores to express the summed preference between the two carrion types taken first (when both were available). Each instance where mullet were taken first was scored as -1, while the score for quail taken first was +1. The mean preference scores for each raptor species (Figure 2) were compared to determine whether the species had different carrion preferences. Two species (Brahminy Kite and Eastern Osprey) were not included in the analysis, as neither took any of the carrion items. The number of baits taken during the study was low compared to the total number of trials, so non-parametric Mann-Whitney test were conducted in SPSS (Version 21, IBM) in separate one-way tests for differences in carrion preference between the four locations, and between raptor species.

Results

Raptor species abundance and assemblage

The abundance of two of the four raptor species considered in this study was significantly lower in urban locations compared to non-urban locations ($P=0.041$ for White-bellied Sea-Eagles, and $P<0.001$ for Whistling Kites) regardless of exposure level (Figure 2; Table 1). Recorded numbers of the other two species (Eastern Osprey and Brahminy Kite) during the survey were very low, and therefore did not differ significantly between either urbanisation or exposure levels.

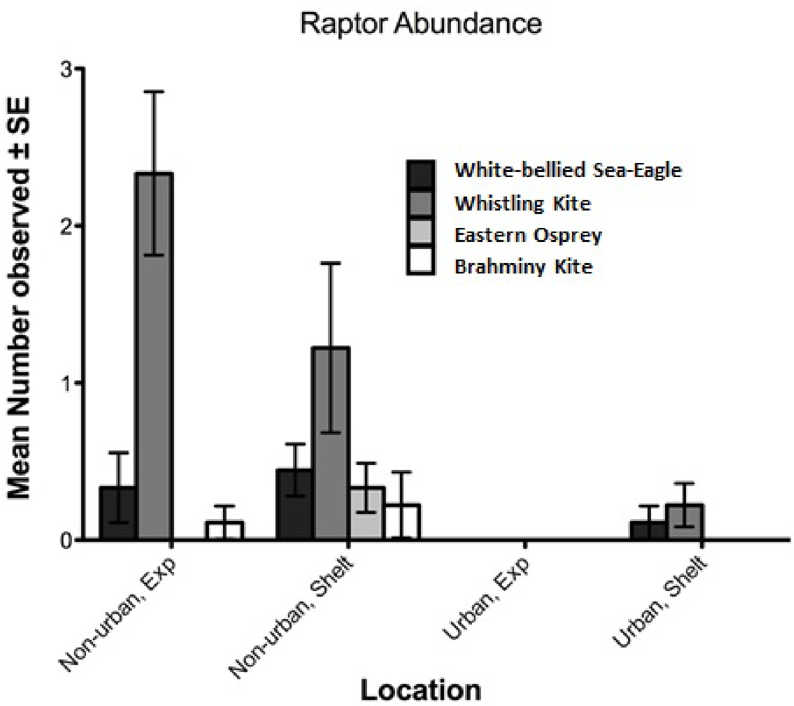

Figure 2: Raptor relative abundance over the entire study for the four locations.

Table 1: Summary of two-way (Exposure vs Urbanisation) PERMANOVA results for abundance of each raptor species. P-values in bold are considered significant (≤0.05). N=12 in every case.

Species	Exposure	Urbanisation	Exposure x Ubanisation
White-bellied Sea-Eagle	0.190	**0.041**	0.646
Whistling Kite	0.455	**<0.001**	0.109
Eastern Osprey	0.068	0.065	0.066
Brahminy Kite	0.911	0.483	0.912

For the raptor assemblage as a whole, there were no significant differences between the levels of exposure or urbanisation, or between exposed and sheltered locations, but a strong difference between urbanised and non-urbanised locations (Table 2). This is apparent in the nMDS (Figure 3), where almost all the urban locations are coincident, because no raptors were recorded talking bait at urban locations, whereas non-urban locations are distinctly separated, but there is no consistent separation between exposed and sheltered non-urban locations. The vectors on the nMDS indicate that White-bellied Sea-Eagles, Whistling Kites and Eastern Ospreys all influenced the result, and Brahminy Kites less so (Figure 3).

Table 2: Two-way (Urbanisation x Exposure) PERMANOVA table for differences in raptor assemblage. P-values by Monte Carlo randomisation.

Factor	df	Pseudo-F	p
Urbanisation	1	20	**<0.001**
Exposure	1	2.750	0.062
Urbanisation x Exposure	1	1.403	0.252

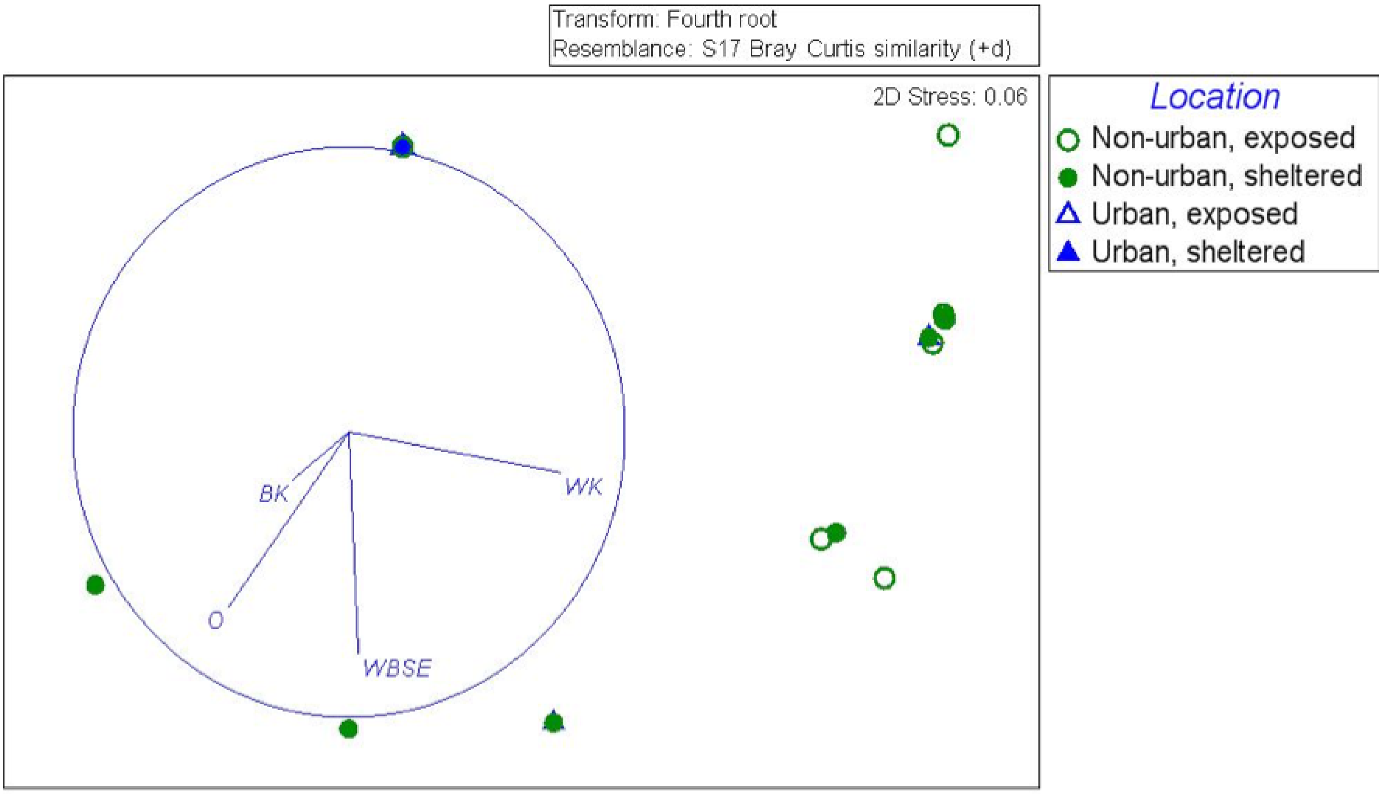

Figure 3: nMDS of raptor assemblage structure, with vectors showing the relative influence of each species. WK = Whistling Kite, WBSE = White-bellied Sea-Eagle, O = Eastern Osprey, BK = Brahminy Kite.

Carrion Preference

Preference scores for different types of carrion showed a clear trend between raptor species, with White-bellied Sea-Eagles preferring mullet bait and Whistling Kites preferring quail bait (Figure 4). However, the Mann-Whitney tests showed that there was no significant difference in carrion preference between raptor species (U=3.0, P=0.167), and no significant difference between the four locations (U=12.0, P=1.00).

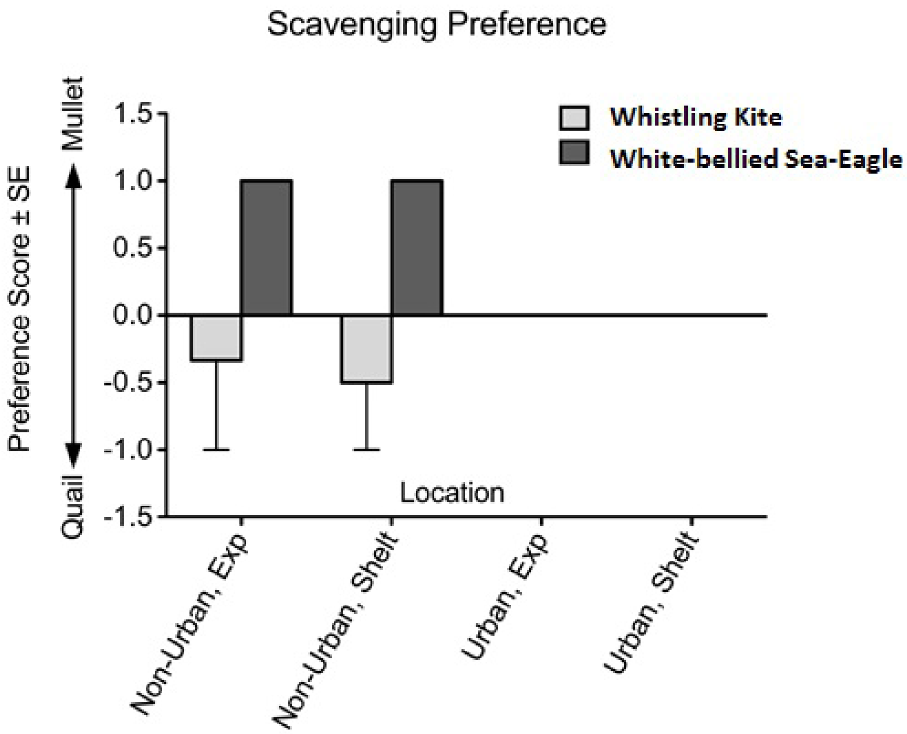

Figure 4: Carrion preference of Whistling Kite and White-bellied Sea-Eagle in each of the four locations.

Observations

Out of 48 trials, bait was taken from 10 baited cameras. Three White-bellied Sea-Eagles were recorded taking bait on separate occasions, including two immature individuals. Mullet was taken on each of these occasions (Figure 5).

Figure 5: White-bellied Sea-Eagle taking mullet bait a) immature White-bellied Sea-Eagle taking mullet over quail; b) adult White-bellied Sea-Eagle taking mullet over quail. Quail bait is circled in red. Photographs: Victoria Thomson and Tim Stevens.

Whistling Kites chose quail over mullet on five occasions (quail was taken on another occasion after a White-bellied Sea-Eagle had taken the mullet, leaving only one carrion type, and therefore not included in the statistical analysis) (Figure 6). Mullet was chosen on two occasions by Whistling Kites.

Figure 6: Whistling Kite taking different baits. a) taking quail bait when there was no other option; b) taking quail over mullet; c) taking quail over mullet; d) taking mullet over quail. All non-chosen bait is circled in red where available. Photographs: Victoria Thomson and Tim Stevens.

Kleptoparasitic behaviour (in which one takes food from another) was observed between individual Whistling Kites on two occasions. First, during an interaction by two Whistling Kites over a mullet bait (the quail had already been taken previously by another Whistling Kite), and second (recorded on camera), where the quail had been taken on the wing by a Whistling Kite, after another Whistling Kite had landed in front of the quail. The Whistling Kite that landed then took the mullet bait shortly after, apparently as a second preference. Interestingly, kleptoparasitism between Whistling Kites and Torresian Crows *Corvus orru* was a common occurrence throughout the sampling period, with both species competing over prey.

Discussion

Scavenging raptors in south-east Queensland are clearly being affected by urbanisation (Mooney 1998; Huijbers *et al.* 2013, 2015). These species actively avoid populated areas (Huijbers *et al.* 2013, 2015); and have had breeding success affected by urbanisation and other human disturbance (Debus *et al.* 2014; Rourke & Debus 2016), including being driven out of home ranges by the demolition of nesting sites (O'Donnell & Debus 2012). This impact is reflected in the results of this study. Raptor assemblages and the abundance of the two main species (White-bellied Sea-Eagle and Whistling Kite) differed significantly between urban and non-urban locations. All four coastal raptor species were sighted in the non-urbanised locations, but only White-bellied Sea-Eagles and Whistling Kites were detected in the urbanised locations (sheltered location only). Both urbanised locations had multiple disturbance factors present, including dogs and vehicles (rubbish tractor, surf life-saving patrols, and helicopters).

A trend was observed for carrion bait preference in both White-bellied Sea-Eagles and Whistling Kites, although no statistically significant difference was found. This trend suggests that White-bellied Sea-Eagles prefer mullet (or marine) carrion, whereas Whistling Kites prefer quail (or terrestrial) carrion in their respective scavenging habits. As the mullet baits were roughly 1.5 times the weight of the quail, this could be related to the different size of these species. White-bellied Sea-Eagles are much larger at 75–85 cm in body length, and a wingspan of 180–218 cm; compared to a body length of 51–59 cm and a wingspan of 123–146 cm in Whistling Kites (Debus 2012); and a weight difference between species of approximately 2.9kg in females, and 2.5kg in males (Olsen *et al.* 2013). However, on the video recordings we never observed a Whistling Kite (or any other species) attempt to seize a bait but fail to do so, or to apparently struggle with the weight of the bait, so this is not considered to have been a limiting factor.

Raptors of south-east Queensland are established as dominant scavengers on rural beaches (Huijbers *et al.* 2013, 2015) and are regarded as important biological vectors transporting nutrients from marine to terrestrial systems (Schlacher *et al.* 2013). It is therefore not only important to preserve their habitat for their own conservation, but for the health of the coastal ecosystems for which they play a major part. With ever-increasing coastal development, and coastal ecosystems threatened as a result

(Lotze *et al.* 2006; Huijbers *et al.* 2013; Sanger *et al.* 2015), it is important to understand the complexity of anthropogenic impacts on these aerial apex predators, including foraging habits and their abilities to adapt to an ever-changing environment.

The findings of this study cannot state with clear certainty that urbanisation affects the carrion preference of Australia's coastal raptors. However, the clear difference in the raptor community between the non-urban and urban locations, and absence of raptors taking bait in urban locations indicates that these birds utilise the non-urban locations for feeding purposes and rarely visit the urban locations. This is despite urban locations being very similar in ecological structure and being located within a few hundred metres of the non-urbanised locations.

It was also noted during this study that Gold Coast City Council rubbish tractors regularly traversed the exposed urbanised locations during the morning. These tractors operated along strips of the beach collecting rubbish and carrion, including a Short-tailed Shearwater *Puffinus tenuirostris* carcass, a potentially important food source for coastal raptors and other scavengers. Although the evidence is currently non-conclusive, it is postulated that the frequent clearing of potential foraging resources from beaches is dramatically reducing the capacity of these beaches to support resident raptors, as well as posing increasing levels of danger and disturbance. Simple well-meaning actions such as mechanised litter collection could have serious implications for the feeding ecology of coastal scavengers.

The limited presence of raptors in the urban locations, and the significant difference in raptor assemblage between differing urbanisation levels, suggests that urbanisation and coastal expansion could indeed severely affect the foraging ecology of coastal raptors. It would be beneficial for further studies to explore whether or not an increase in urbanisation results in a decrease of foraging areas for coastal scavengers, including raptors; and whether foraging territories and home ranges would be subsequently increased, and breeding densities decreased, to compensate for lost resources.

References

Ahmed, N. and Glaser, M. 2016. Coastal aquaculture, mangrove deforestation and blue carbon emissions: Is REDD+ a solution? *Marine Policy* 66: 58–66.

Anderson, M. and Gorley, R. 2007. *PERMANOVA+ for PRIMER: Guide to Software and Statistical Methods*. PRIMER-E: Plymouth.

Berry, M. E., Bock, C. E. and Haire, S. L. 1998. Abundance of Diurnal Raptors on Open Space Grasslands in an Urbanized Landscape. *The Condor* 100(4): 601–608.

Birch, G. F., Olmos, M. A. and Lu, X. T. 2012. Assessment of future anthropogenic change and associated benthic risk in coastal environments using sedimentary metal indicators. *Journal of Environmental Management* 107(0): 64–75.

Debus, S. J. S. 2008. Biology and Diet of the White-bellied Sea-Eagle *Haliaeetus leucogaster* Breeding in Northern Inland New South Wales. *Australian Field Ornithology* 25(4): 165–193.

Debus, S. J. S. 2012. *Birds of Prey of Australia*. CSIRO Publishing: Collingwood.

Debus, S.J.S., Baker, G., Owner, D. and Nottidge, B. 2014. Response of White-bellied Sea-Eagles *Haliaeetus leucogaster* to encroaching human activities at nest sites. *Corella* 38: 53–62.

Eduardo, C., Carvalho, A. and Marini, M. Â. 2007. Distribution patterns of diurnal raptors in open and forested habitats in south-eastern Brazil and the effects of urbanization. *Bird Conservation International* 17(4): 367–380.

Huijbers, C. M., Schlacher, T. A., Schoeman, D. S., Weston, M. A. and Connolly, R. M. 2013. Urbanisation alters processing of marine carrion on sandy beaches. *Landscape and Urban Planning* 119: 1–8.

Huijbers, C. M., Schlacher, T. A., Schoeman, D. S., Olds, A. D., Weston, M. A. and Connolly, R. M. 2015. Limited functional redundancy in vertebrate scavenger guilds fails to compensate for the loss of raptors from urbanized sandy beaches. *Diversity and Distributions* 21(1): 55–63.

IUCN 2016. 2016 *The IUCN Red List of Threatened Species.* <http://www.iucnredlist.org/>. Accessed 27 August 2016.

Lotze, H. K., Lenihan, H. S., Bourque, B. J., Bradbury, R. H., Cooke, R. G., Kay, M. C., Kidwell, S. M., Kirby, M. X., Peterson, C. H. and Jackson, J. B. C. 2006. Depletion, Degradation, and Recovery Potential of Estuaries and Coastal Seas. *Science* 312(5781): 1806–1809.

Lutter, H., Mcgrath, M. B., Mcgrath, M. A. and Debus, S. J. S. 2006. Observations on Nesting Brahminy Kites *Haliastur indus* in Northern New South Wales. *Australian Field Ornithology* 23(4): 177–183.

Marczak, L. B., Thompson, R. M. and Richardson, J. S. 2007. Meta-Analysis: Trophic Level, Habitat, and Productivity Shape the Food Web Effects of Resource Subsidies. *Ecology* 88(1): 140–148.

Mooney, N. 1998. Status and conservation of raptors in Australia's tropics. *Journal of Raptor Research* 32: 64–73.

O'Donnell, W. B. and Debus, S. J. S. 2012. Nest-sites and foraging of the White-bellied Sea-Eagle *Haliaeetus leucogaster* on the subtropical eastern coast of Australia. *Australian Field Ornithology* 29(3): 149–159.

Olsen, J., Debus, S.J.S., Rose, A.B. and Judge, D. 2013. Diets of White-bellied Sea-Eagles *Haliaeetus leucogaster* and Whistling Kites *Haliastur sphenurus* breeding near Canberra, 2003–2008. *Corella* 37: 13–18.

Olsen, J., Fuentes, E. and Rose, A. B. 2006. Trophic relationships between neighbouring White-bellied Sea-Eagles (*Haliaeetus leucogaster*) and Wedge-tailed Eagles (*Aquila audax*) breeding on rivers and dams near Canberra. *Emu* 106(3): 193–201.

Polis, G. A., Anderson, W. B. and Holt, R. D. 1997. Toward an Integration of Landscape and Food Web Ecology: The Dynamics of Spatially Subsidized Food Webs. *Annual Review of Ecology and Systematics* 28: 289–316.

Rodewald, A. D., Kearns, L. J. and Shustack, D. P. 2011. Anthropogenic resource subsidies decouple predator-prey relationships. *Ecological applications* 21(3): 936–943.

Rourke, J. and Debus, S.J.S. 2016. The breeding cycle of a pair of Brahminy Kites *Haliastur indus* in New South Wales. *Australian Field Ornithology* 33: 151–155.

Sanger, D., Blair, A., Didonato, G., Washburn, T., Jones, S., Riekerk, G., Wirth, E., Stewart, J., White, D., Vandiver, L. and Holland, A. F. 2015. Impacts of Coastal Development on the Ecology of Tidal Creek Ecosystems of the US Southeast Including Consequences to Humans. *Estuaries and Coasts* 38(1): 49–66.

Schlacher, T. A., Strydom, S., Connolly, R. M. and Schoeman, D. 2013. Donor-Control of Scavenging Food Webs at the Land-Ocean Interface. *PloS one* 8(6): e68221.

Stirling, H. 2009. *South East Queensland regional plan 2009-2031*. Queensland Department of Infrastructure and and Planning. Brisbane.

Vitousek, P.M., Mooney, H.A., Lubchenco, J. and Melillo, J.M. 1997. Human domination of Earth's ecosystems. *Science* 277(5325): 494-499.

Book Review

Birds of the Wet Tropics of Queensland and Great Barrier Reef and Where to Find Them

By Lloyd Nielsen

Published by Lloyd Nielsen, 2015
Paperback, 404 pages
AU$45.00
http://www.birdingaustralia.com.au/shop.html

Reviewed by Nick Leseberg

It is 20 years since the first edition of this book was published, a book that remains one of the best local guides available in Australia. As a young birder preparing for my first trip to the Wet Tropics I remember poring over a copy lent to me by a friend, looking at the species accounts and then planning which sites I would visit. Several years later I purchased my own copy, which shows much evidence (some fossilised and now falling onto my keyboard from between the pages!) of many trips to the rainforests, wetlands and savannah of the region. Always the first recommendation, and often loan, to any birding friends visiting the Wet Tropics, this first edition was starting to show its age. There have been a number of taxonomic developments, new species recorded, and of course changes to the birding sites in the region over that time. This second edition is a timely and welcome revision.

The format of the first edition was simple, and contained: an illustrated identification section, including a sub-section on difficult to identify species; a section detailing the status, range, and habits of each species, including good sites to search for them; and, a regional site guide, with details and maps on the best sites to find birds in the Wet Tropics. This format has been retained in the second edition, although there has been a significant expansion of the section on species that are “Difficult to Identify”. There has also been the addition of a small but fascinating section on a handful of species whose occurrence and/or status in the Wet Tropics is mysterious, including the possibly undescribed species, the “Herberton Honeyeater”, and a recently discovered subspecies (or perhaps full species) of Spotted Quail-thrush.

The identification section contains illustrations of every species that occurs in the Wet Tropics, including most plumage variations. The strength of this section is how the species are grouped; not by family or taxonomic order, but by distinguishing field marks. So, there are sections for species with “Red bills”, “Black or very dark plumage”, and even “Forages on tree trunks and limbs”, etc. This arrangement may confuse readers familiar with the layout of modern field guides, but recognises that most casual birders identify species by latching onto clear field marks as a starting point. All illustrations are the work of the author, and while satisfactory for identification of clear field marks, they are simple, and often fail to capture the "jizz" of the species being illustrated. This may not concern casual or beginner birders, for whom "jizz" may be a new concept, while more experienced birders are likely to have an additional field guide with better illustrations on hand for identification purposes.

The "Difficult to Identify" section will be that most valued by the experienced birder. It contains some excellent summaries of how to distinguish species within some of Australia's most difficult species groups, such as waders, bronze-cuckoos, Papuan and Tawny Frogmouths, Bassian and Russet-tailed Thrushes and the Leaden/Satin/Broad-billed Flycatcher complex. This section is clearly built on countless hours of research and time in the field observing the birds, and will be valuable to birders anywhere in Australia, not just those in the Wet Tropics.

The "Status and Range" section is comprehensive, including an exhaustive and impressive analysis of historical records in the region. It dovetails nicely with the final section on "Best Birding Areas". Between these two sections any birder visiting the Wet Tropics can plan a trip that gives them the best opportunity to find their target species. The site information is relatively broad, with the Wet Tropics broken into seven smaller regions, and about 15 sites described for each of these regions including key species, other likely species, facilities and access information. The information is not as specific as that found in some locality guides, such as McCrie and Watson's "Finding Birds in Darwin, Kakadu and the Top End", but still gives the birder a good starting point for trip planning.

After a thorough perusal, it is difficult not to be impressed, and even awed, by the monolithic amount of field work and research that has gone into this book. In some instances Nielsen has relied on his extensive knowledge to take some liberties with the content, including elevation of the Wet Tropic's race, lurida, of Southern Boobook to full species status, and recognition of his records of Pacific Swallow, although they have not been accepted by the BirdLife Australia Rarities Committee. Nielsen has also adopted species status for "Gould's" Bronze-Cuckoo, another taxonomic riddle yet to be solved. In each case Nielsen explains the reasons for his decisions, and given the volume of research that has clearly gone into this book, his decisions are difficult to fault.

"Birds of the Wet Tropics" has been the go-to guide for Australia's most diverse birding region for the past 20 years, and this second edition ensures it will remain so for probably the next 20 years. Whether you are a beginner or expert, are planning a trip to the Wet Tropics, or want to simply absorb a work that can only be the result of countless hours of field observation and methodical research, this book is recommended.

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.

Papers are invited from members and non-members on all aspects of ornithology, e.g. life history, distribution, behaviour, ecology and taxonomy. Papers may take the form of major articles, short notes and book reviews. Intending authors should consult recent issues of The Sunbird to see acceptable forms of contributions. Recent issues are available as full text in the Humanities & Social Sciences Collection of the Informit website (http://search.informit.com.au/search;res=IELHSS).

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

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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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