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Front Cover: Laughing Kookaburra (left - Vince Bugeja) and Blue-winged Kookaburra (right - Mark McCaffrey)

Interspecific territoriality between Blue-winged Kookaburras *Dacelo leachii* and Laughing Kookaburras *D. novaeguineae* in eastern Queensland, with observations from Magnetic Island

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Abstract

The Blue-winged Kookaburra *Dacelo leachii* is sympatric in eastern Queensland with the closely-related, and ecologically similar, Laughing Kookaburra *D. novaeguineae*. In both species breeding pairs, some with related helpers, defend perennial, all-purpose territories. The habitat preferences of the two species in the sympatric zone are not well understood, while interspecific territorial defence has not been documented. We observed a breeding pair of Blue-winged Kookaburras on Magnetic Island, north Queensland, over three years, which defended a territory of ~5.5 ha from 2–3 neighbouring groups of Laughing Kookaburras, with behaviours typical of interactions with conspecifics. We also sought records of territorial interactions between the two species from the published literature, eBird and birdwatchers, and found evidence of such behaviour in all regions of eastern Queensland. However, the extent to which their spatial segregation in sympatry relates to differential habitat preferences or interspecific territoriality remains unknown, and requires further study.

Introduction

The Blue-winged Kookaburra *Dacelo leachii* (BWK) is sympatric in eastern Queensland with the closely-related Laughing Kookaburra *D. novaeguineae* (LAK) (Plate 1). The LAK is slightly larger (Higgins 1999), but their ecology – including diet, breeding, social structure, and defence of perennial all-purpose territories – is very similar (Higgins 1999; Legge 1999; Curl 2005). Thus, to persist as separate species in sympatry implies a division of the area by differential habitat selection, interspecific territorial defence, or both (Orians & Willson 1964; Cowan et al. 2020). There have been no systematic studies of their habitat preferences in the sympatric zone, and published observations are inconsistent. For example, Parry (in Frith 1976) stated that BWKs prefer wetter areas, and coexist with LAKs where wet and dry woodlands intersect. Conversely, Woodall (2020) asserted that BWKs prefer *drier* areas, except where they defend territories against LAKs on Magnetic Island.

In both species territorial defence includes regular raucous choruses, made by the breeding pair throughout the year, with helpers (if any) joining in, especially on boundaries at dawn and dusk. Both species also engage in 'hole-showing' (calls and flights to actual or symbolic nest hollows) and a range of postures, calls and flight patterns in the presence of other groups (Higgins 1999; Legge 1999; Curl 2005). Their vocalisations also have many shared components (Curl 2005). Depending on conditions and group size, BWK calls can be heard for up to 1 km (Curl 2005) and LAK calls for about the same distance (ECS, pers. obs). Physical conflict is rare and is typically directed against intruders or subordinate group members seeking a breeding opportunity (Legge 1999; Curl 2005). Higgins (1999) stated that the two species exclude each other by territorial defence where they both occur, but provided no details. As implied by Woodall (2020), interspecific territoriality has been reported only from Magnetic Island, off Townsville, north Queensland. Parry (in Frith

1976) visited Magnetic Island and noticed that BWKs and LAKs defended territories from each other 'almost as if they were conspecifics', although not with their full range of displays. Curl (2005) used playback to identify territories and interactions of both species over eight days near Rockhampton, central Queensland, but the results of that study were not published.

Plate 1. Laughing (top) and Blue-winged (bottom) Kookaburras (Vince Bugeja and Mark McCaffrey)

Both species are common breeding residents in Townsville and on Magnetic Island, although the BWK is less common in suburbs (Hopkins 1948; Wieneke 1988). We resided on Magnetic Island from August 1985 to October 1988 and made opportunistic observations of kookaburras, especially a pair of BWKs that nested on our house block in 1987–1988 (Scambler & Daly 2023). In this paper we report observations of territorial interactions between the BWK pair and neighbouring LAKs over three years, with a map of the estimated BWK territory, and review other records of the species' interactions.

Study area and methods

The study site was a house block in the village of Arcadia (19°9'S, 146°51'E; see Scambler & Daly 2023 for map). The residential subdivision was in mixed *Corymbia* woodland on a lowland plain, with ephemeral creeks and mature trees with hollows. Houses had been built on about 20 of the 60 blocks in the subdivision. Most vacant land, and the house block, retained some original vegetation. A creek gully 50 m to the south of the study site contained fragments of vine thicket, while Petersen Creek, 110 m to the east, was lined with large Weeping Paperbarks *Melaleuca leucadendra*, native figs and palms. The climate is monsoon-tropical, with most rain falling in the summer wet season (December–April; BoM 2023). Further details of the study area and site can be found in Scambler & Daly (2023).

Opportunistic observations of BWKs and LAKs were made from August 1985 to October 1988. We recorded three categories of territorial behaviour by the resident BWKs: hole-showing while other pairs or groups were absent; choruses with display flights between trees and branches, sometimes including hole-showing, in the presence of another group; and physical conflict. Boundaries of the BWK territory were estimated from the sites of interactions with other groups and sites of regular chorusing. We also noted instances of LAKs entering the territory while the BWKs

were not visible. We assumed that the same BWK pair occupied the territory for the whole study period, but the birds were not marked and replacements, e.g. due to the death of an adult, may have occurred. The term 'group' is used for a kookaburra pair, or a pair accompanied by young and/or adult helpers. The breeding season (defined as the months in which clutches were commenced) of both species extends from October to January (Lavery et al. 1968; Higgins 1999).

Reports of interactions between BWKs and LAKs and their habitat use in the sympatric zone were sought in the published literature and eBird (2024), and in interviews with local birdwatchers. We also asked volunteers from Arcadia Coast Care and other island residents to report sites occupied by kookaburras, including species, nest locations and period of occupancy. Territory sizes for BWK and LAK were obtained from previous studies (Parry 1973; Legge 1999; Curl 2005). Common and scientific names for birds follow IOC (Gill et al. 2023) and other species' names follow AFD (2023). Details of Regional Ecosystems were obtained from the Queensland Government (2023) and cadastral data were obtained from QSpatial (2023).

Results

Territorial behaviour and interspecific interactions

The BWK pair chorused from roost and other trees and regularly engaged in hole-showing at a number of hollows, including the 1987–1988 nest site. No other BWKs were heard initiating calls or responding to the resident pairs' calls. The BWKs confronted groups of LAKs at the territory boundary, and up to 100 m inside the BWK territory, with full choruses and flights between branches and trees, as if they were conspecifics (Table 1). These displays lasted for up to five minutes, and four (16%) included hole-showing by the BWKs. Of a total of 26 confrontations, 24 (92%) involved LAKS from the north or west of the territory, while two (8%) involved LAKs from the south or east (Fig. 1). On one occasion, the BWK pair repelled two LAKs from within the north-east corner of the BWK territory, after which the male BWK briefly perched in the LAK territory and gave a short call. This was the only observed incursion by the BWKs into a LAK territory.

We observed one physical conflict only (Table 1). On 23 August 1985, a male BWK and a LAK were seen fighting in the creek gully 60 m south of the house, with bill-wrestling and wing-flapping. They flew to a tree branch next to the house and continued bill-wrestling, until the LAK flew back towards the gully and did not return. The BWK remained on the branch resting for over an hour, with the nictitating membranes closed. Nevertheless, LAKs were observed in the BWK territory when the BWKs were apparently absent on 17 occasions, mostly in non-breeding seasons. During these incursions the LAKs usually foraged, but at times 2–4 LAKs gave full choruses and flew between trees inside the BWK territory without attracting the BWKs.

Table 1. Records of territorial behaviour by resident Blue-winged Kookaburras in Arcadia in the breeding and non-breeding seasons, August 1985–October 1988. LAK = Laughing Kookaburra.

Behaviour	Number of records by season		Total
	Breeding	Non-breeding	
Hole showing (intraspecific)	10	24	**34**
Chorus & display when LAKs present	13	12	**25**
Physical conflict (with single LAK)	0	1	**1**
Total	**23**	**37**	**60**

Table 2. Records indicating territorial interactions between Blue-winged (BWK) and Laughing (LAK) Kookaburras in eastern Queensland. Locations are listed from north to south.

Location	Observation	Source
Cape York Peninsula		
Archer River roadhouse, 2009	BWK started dawn chorus, followed by LAK	eBird (2024)
Artemis Station, 2014	Dusk chorus, BWK immediately after LAK	eBird (2024)
Near Laura, 1981	Simultaneous dusk choruses of one BWK group and one LAK group, ~100 m apart	Forshaw & Cooper (1983)
Far north Queensland		
Julatten, 2018	Territorial dispute between 2 BWKs and 2 LAKs, 06:37 hrs, but 2 species occupy separate areas, with loud calling and 'chases' at boundaries	eBird (2024); K. & L. Fisher (pers. comm.)
Weatherby Rd, near Mt Molloy, 2021	LAK out-competing the BWK calls	eBird (2024)
Tinaroo Falls village, Atherton Tablelands, 1994	~09:00 hrs, a group of each species chorusing simultaneously on adjacent trees in woodland	ECS (unpubl. data)
Ravenshoe district, Atherton Tablelands	Young BWK tried to join LAK pair, they flew at it, calling, over 2 days: it left	E.C. Edwards (pers. comm.)
Rockingham Bay, near Tully, 1916-17	Frequently heard 'yelping' [BWK] and 'laughing' [LAK] together in forest	Campbell & Barnard (1917)
North Queensland		
Magnetic Island, 1984	LAK found on road wounded, 'guarded' by two BWKs, died soon after	Label on specimen B47313 (SA Museum, Adelaide)
Bushland Beach, 2013	One LAK physically attacked a BWK	eBird (2024)
Ross River Dam borrow pits, Townsville, 2020	1 BWK called in response to 3 nearby LAKs calling, 11:50 hrs	eBird (2024)
Mt Jukes, 28 km NW of Mackay, 2020	LAK calling at the same time as BWK were calling, 08:30 hrs	eBird (2024)
Habana, 18 km NW of Mackay, 2014	BWK and LAK 'singing each other off in the same tree', 07:00 hrs	eBird (2024)
Central Queensland		
Gladstone, 2017	1 BWK called once, chased off by 8 LAKs, 07:30 hrs	eBird (2024)
Rosedale, 53 km NW of Bundaberg, 2023	4 BWKs having a 'turf war' with 3 LAKs, 16:30 hrs	eBird (2024)
Dawson R, near Moura, 2020	LAK heard calling at the same time as BWK	eBird (2024)
South-east Queensland		
Lake Clarendon, near Gatton, 2015	3 BWKs calling from woodland with 3 LAKs, 06:55 hrs	eBird (2024)
Warrill View, 26 km SW of Ipswich, 2011	BWK rescued from barb wire fence after being chased by LAKs	eBird (2024)

We found reports indicative of territorial interactions between BWKs and LAKs, such as simultaneous chorusing and harassment of intruders, from all regions of eastern Queensland (Table 2). One record, of two BWKs 'standing guard' over an injured LAK, was equivocal (see Discussion). However, BWKs and LAKs have been seen foraging from the same powerline, over cropland on the north Queensland coast and over fields at Dimbulah on the Atherton Tablelands (V. Parry, in Frith 1976; J.D.A. Grant, pers. comm.).

Kookaburra territories and habitats

The territory of the BWK pair was entirely within the residential area of Arcadia and covered ~5.5 ha, with a boundary of ~930 m (Fig. 1). There were at least two, and probably three, LAK groups in the surrounding area but this could not be confirmed. LAKs occupied mixed eucalypt woodlands on rocky hillsides in the National Park to the north and west of the BWK territory, while to the east and south, LAKs occupied lowland residential areas similar to the BWK territory, including some parts of Petersen Creek. The majority of provisioning visits to BWK nestlings in 1987–1988 originated from the south and east of the territory (unpublished data).

BWKs were occasionally sighted on the Geoffrey Bay foreshore ~200 m from the south-east corner of the territory, but these birds were considered to be a separate group because the intervening area was occupied by LAKs, and food items fed to BWK nestlings in 1987–1988 did not include marine invertebrates, such as crustaceans, which abounded on the foreshore (Scambler & Daly 2023). There were insufficient data to map current territories, but residents reported that sites in Arcadia and along the island's west coast had been occupied by only one kookaburra species for long periods, in some cases for over 20 years.

The reviewed literature did not support a consistent preference for 'wetter' or 'drier' habitats by either species in eastern Queensland, although both species prefer

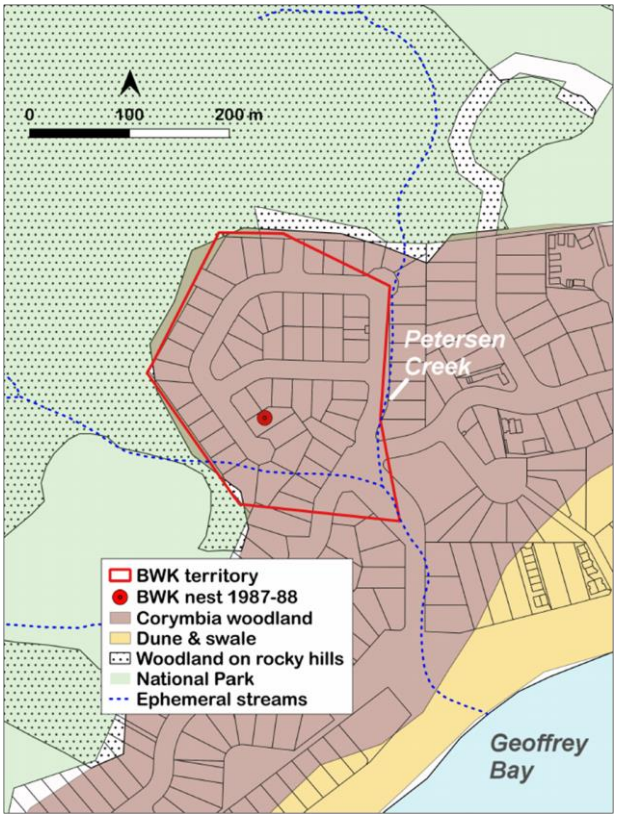

Figure 1. Habitats in Arcadia, Magnetic Island, north Queensland, and estimated territory of Blue-winged Kookaburra pair, 1985–1988.

riparian forest in dry areas (Table 3; Forshaw & Cooper 1983; Storr 1984; Higgins 1999). However, BWKs are absent from Wet Tropical rainforest, which is marginal habitat for LAKs (Williams 2006).

Discussion

Although our observations were opportunistic over the three years of this study, we nevertheless observed long-term territorial defence by BWKs against LAKs as if they were conspecifics, including a rare record of physical combat, and provide the first description of these interactions. The occurrence of hole-showing in only 16% of these encounters may explain the disparity between Parry's and Curl's accounts of the range of behaviours that BWKs employ in defence against LAKs; perhaps Parry only saw shorter, less complex displays in the limited time she spent on Magnetic Island. Higgins (1999) cited Campbell & Barnard (1917) as

Table 3. Examples of habitat selection by coexisting Blue-winged (BWK) and Laughing (LAK) Kookaburras. Locations are listed from north to south: CYP = Cape York Peninsula, FNQ = far north Queensland, NQ = north Queensland, CQ = central Queensland.

Location and source	Habitat preference	
	BWK	LAK
Pennefather River, Weipa, CYP (Gould 2005)	Many habitats including closed forest & mangroves	Fewer habitats, not in closed forest
Cooktown-Laura, CYP (Storr 1953)	Open forest, sometimes away from water; savanna woodland	Riparian & swamp areas with large eucalypts
45 km S of Cooktown, FNQ (Johnson & Mighell 1989)	Wet and dry sclerophyll	Riparian, and wet & dry sclerophyll
Atherton Shire, FNQ (Bravery 1970)	'All' habitats but mostly farms, woodlands, and streams	All habitats including rainforest
Clemant State Forest NQ, 40 km NW of Townsville (Kemp & Kutt 2004)	As for LAK plus closed forest, paperbark swamp and estuarine	Open forest and tea tree woodland
Military area 60 km SW of Townsville, NQ (Woinarski & Ash 2002)	Ungrazed sites (undisturbed & military uses); riparian	Grazed and military sites (more open at ground level than for BWK); riparian
Eungella region, CQ (Leach *et al*. 2020)	Dry country around Eungella Dam and further west	Open habitats and rainforest

evidence that the species sometimes co-occur, but without noting the significance of the continual simultaneous choruses of BWKs and LAKs they reported in the same forest. Similar evidence may have been overlooked by observers not fully aware of the territorial significance of chorusing and related behaviours. Further, where kookaburras defend large territories there may be few opportunities to observe territorial interactions, especially as BWKs in remote areas are very wary of humans (Curl 2005). Even so, the available records indicate that interspecific territorial competition is more widespread than previously reported and is likely to occur wherever their ranges overlap.

Mutual use of foraging perches over cropland or fields (Parry, in Frith 1976; J.D.A. Grant pers. comm.) suggests that the perennial territories occupied by the respective kookaburra groups had undefended borders where they adjoin habitat unsuitable for breeding, as found by Parry (1973) for some LAK groups. Such foraging sites are therefore neutral territory, especially in the non-breeding season. There is insufficient information to interpret the observation of two BWKs 'standing guard' over a wounded LAK on a road; it could have been struck by a car while intruding into the BWK territory, or perhaps injured in a skirmish with the BWKs.

To our knowledge, this study has provided the first estimate of territory size for BWKs in the zone of sympatry. In kookaburras, territory size is related to both group size and territory quality (Parry 1973; Legge 1999; Curl 2005), and several factors suggest that the Arcadia BWK pair occupied a high quality territory. It was one-third the area of the smallest territory occupied by pairs without helpers in savanna woodland in the NT and equivalent to the average territory size for LAK pairs (with and without helpers) in partly urbanised woodland in the Dandenong Ranges, Victoria (Table 4). In 1987–1988 the pair successfully reared three chicks to fledging (Scambler & Daly 2023). Further, pressure from LAKs was concentrated in the north and west, where the BWK territory bordered drier, sparser habitat on rocky hillsides. LAKs that occupied areas to the south and east in similar habitat to the BWKs initiated fewer confrontations, even

Table 4. Territory sizes of Blue-winged (BWK) and Laughing (LAK) Kookaburras

Species (source)	Location (no. of territories)	Territory size (ha)	
		Pair (no helpers)	Mean (range)
BWK (Curl 2005)	Kakadu National Park, NT (18)	16.0–25.0	24.9 (16.0–47.3)
LAK (Parry 1973)	Dandenong Ranges, Vic (19)	2.0– 3.4	5.5† (2.0–7.4)
LAK (Legge 1999)	Canberra Nature Park, ACT (30)	~16.0–52.0*	69.0 (16.0–224.0)

† Calculated from Parry (1973, Table 3, p. 88); area of the largest territory reduced from 9.9 ha to 7.4 ha, to allow for a patch of thick forest not used by the birds.
* 1997 year only, estimated from Legge (1999; Fig. 1, pp. 33–34).

though (based on the direction of BWK nest-provisioning flights) that part of their territory was productive in food resources. The territory also held several potential nest hollows, an essential breeding resource.

Given that BWKs are less common than LAKs in suburbs in the study area (Hopkins 1948; Wieneke 1988), they may adapt less successfully to increasing urbanisation. LAKs are tolerant of some urbanisation, continuing to occupy, and breed in, well-vegetated suburbs of major Australian cities (e.g. Sewell & Catterall 1998; Loyn & Menkhorst 2011). However, despite revegetation efforts, the LAK population in Belconnen, Canberra, is threatened by a scarcity of suitable nest sites as remnant trees senesce and die, and competition increases from the hollow-nesting introduced Common Myna *Acridotheres tristis* (King *et al*. 2021). On Magnetic Island both kookaburra species compete for hollows with e.g. Australian Boobook *Ninox boobook* and Common Brushtail Possum *Trichosurus vulpecula*; the focal BWK pair displaced a possum from the hollow before nesting in it (Scambler & Daly 2023). Common Mynas are abundant and increasing in Townsville (Jones & Wieneke 2000) and occasionally reach the island, where their detection and removal is a high priority biosecurity action for local government (Townsville City Council 2020). However, the number of mature trees in the settled lowlands of Magnetic Island is declining due to senescence and deliberate removal (Arcadia Coast Care, pers. comm.), which can be expected to reduce the availability of hollows for all hollow-dependent species over time.

In Kakadu National Park, resident Forest Kingfishers *Todiramphus macleayii* chose similar nest sites as migratory Sacred Kingfishers *T. sanctus*, and defended core areas of permanent territories against them, using the same behaviours as against conspecifics (Curl 2005, pp. 295-296). Robinson (1989, 1990) studied sympatric breeding of resident Scarlet Robins *Petroica boodang* and migratory Flame Robins *P. phoenicea*, and found they displayed more intense aggressive behaviours against conspecifics intruding into breeding territories than against each other (Robinson 1989). Drury *et al*. (2020) reviewed studies of 81 species-pairs of North American passerines that engage in interspecific territoriality, and found most pairs were of similar body size, and exhibited a high degree of overlap in breeding habitat, nest site selection (particularly tree hollows) and diet. All the factors identified by Drury *et al*. (2020) apply to sympatric BWKs and LAKs, but the evidence of habitat segregation is equivocal. Broad descriptions, or lists, of habitats occupied by sympatric BWKs and LAKs have done little to explain their habitat choices, the predominance of one species or the other in particular localities, or at a more fundamental level, their coexistence as separate species in sympatry. A more detailed investigation of breeding habitats and territories is desirable, but could be assisted by birdwatchers reporting locations and details of interactions between BWKs and LAKs.

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