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Distribution of Black-breasted Button-quail *Turnix melanogaster* in the Great Sandy Region, Queensland and associations with vegetation communities

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ABSTRACT

The Black-breasted Button-quail is a threatened forest inhabiting button-quail endemic to the east coast of Australia. Their distribution in the largest undeveloped portion of littoral forest within their range has, until this study, remained unsurveyed. In addition, their use of littoral vegetation is poorly described. Here we present findings from targeted camera trapping surveys in the Great Sandy Region collectively; K'gari (Fraser Island), Cooloola and Inskip Peninsula, Queensland. We also review all published and unpublished reports of this species in this region, and assess their veracity. The associations of high veracity records with vegetation communities are presented. The species was most readily associated with littoral forest along the eastern coast of K'gari and Cooloola. Our findings reaffirm the distribution of Black-breasted Button-quail along the coast of K'gari, further they are distributed along the Cooloola coast and in a few isolated inland sites. This study addresses one of the persistent knowledge gaps documented in the 2010 and 2020 Action Plan for Australian Birds, pertaining to the species use and distribution in littoral vegetation of the Great Sandy Region. We anticipate the proposed distribution presented here will prove valuable in future surveys and research on this species in the Great Sandy region.

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Black-breasted Button-quail; Australian birds; threatened species; K'gari; Great Sandy National Park; turnix

Introduction

While Black-breasted Button-quail *Turnix melanogaster* are arguably the most intensively studied of all Australian button-quail species (Exposito 2020), basic aspects of the species' autecology remain unknown. Button-quail generally are a greatly understudied family of birds (Yarwood *et al.* 2019) and as a consequence the conservation of this group of birds is problematic. Only when essential knowledge gaps are filled can effective conservation be administered. Black-breasted Button-quail are endemic to the east coast of Australia with a distribution in both Queensland and New South Wales (Bennett 1985; Hamley *et al.* 1997). This species is considered threatened by habitat loss and degradation of remaining habitat fragments by weeds, grazing and fire incursion (Mathieson and Smith 2009; Garnett *et al.* 2011).

The species has been recorded utilising softwood scrubs, semi-evergreen vine thicket, araucarian microphyll forests, collectively known as dry rainforests, as well as littoral forests (Flower *et al.* 1995). Little is known of the species use of littoral forests other than brief notes (Liddington 2013; Morris 2016). This could

be considered a large oversight given the largest sub-population is thought to be reliant on littoral forest in the Great Sandy Region (Garnett *et al.* 2011).

This paper aims to determine the distribution of Black-breasted Button-quail in the Great Sandy Region and define the habitats occupied by this species in this region. Both aims align with the persistent research actions outlined in the Action Plan of Australian Birds (Garnett *et al.* 2011; Garnett and Baker 2021). The Action Plan of Australian Birds is an extensive review of the status of Australia's avifauna and a platform highlighting research and management actions required for the conservation of these species.

Materials and methods

Study area

The Great Sandy Region in south east Queensland collectively the Great Sandy National Park, which encompasses K'gari, Cooloola Recreation Area and Inskip Peninsula Recreation Area.

Cooloola recreation area

Cooloola Recreation Area is located 120 km north of Brisbane and consists of approximately 65 km of coastline from the Noosa River in the south to Rainbow Beach in the north. Cooloola Recreation Area has a mean annual rainfall of 1,364 mm and a mean annual temperature of 24.2°C; records were obtained at the Double Island Point Lighthouse (Bureau of Meteorology 2021).

Inskip Peninsula recreation area

Inskip Peninsula Recreation Area is located north of Rainbow Beach and encompasses the coastline and inland areas of Inskip Peninsula. Inskip Peninsula Recreation Area has a mean annual rainfall of 1,469 mm and a mean annual temperature of 25.5°C; records were obtained at Rainbow Beach (Bureau of Meteorology 2021).

K'gari (Fraser Island)

K'gari is within the Great Sandy National Park and is protected as the Great Sandy World Heritage Area (Wardell-Johnson *et al.* 2015). The Island is situated 185 km north of Brisbane at its southern most point. It is the world's largest sand Island covering 166,038 ha (Department of Environment and Science 2021c). The area has a mean annual rainfall of 1,267 mm and a mean annual temperature of 25.9°C; records were obtained at the Sandy Cape Lighthouse (Bureau of Meteorology 2021).

Review of records

Records of Black-breasted Button-quail prior to 31 December 2020 from the Great Sandy Region were sourced from online databases (Atlas of Living Australia 2020; eBird 2020; BirdLife Australia 2021; Department of Environment and Science 2021a) and published literature (Barry and Vernon 1976; Barry and Vernon 1977; Bennett 1985; Sutton 1990; Flower *et al.* 1995; Hamley *et al.* 1997; Mathieson and Smith 2009; Liddington 2013; Morris 2016). The veracity of each record was assigned using three categories based on the accuracy of the record and spatial data. The categories were: 1, confirmed record with accurate location (high veracity), 2, confirmed record with generalised location and 3, unconfirmed record or location. An unconfirmed record doesn't necessarily suggest the report was not Black-breasted Button-quail; rather it lacked sufficient evidence to be accurately determined.

Targeted camera trapping surveys

Surveys for Black-breasted Button-quail occurred on three occasions from October 2016 to June 2018. Camera traps (HyperFire HC550 and HyperFireHC600,

Reconyx, Holmen, USA) were utilised for each survey at 117 sites amounting to 4,424 trap nights. Camera traps were spaced approximately 2.5 km apart along the eastern coastline of K'gari and Cooloola except in habitat deemed unsuitable for the target species; i.e. on bare sand dunes or sand blows. Camera traps were placed at higher densities inland in areas of suitable habitat (i.e. Poona Lake, Thanne Scrub and Inskip Peninsula).

Data analyses

High veracity records of Black-breasted Button-quail sourced from camera trapping surveys, online databases and published literature were overlaid onto Regional Ecosystem (RE) data version 11.1 (Queensland Herbarium 2021) in ArcMap (ArcGIS Desktop 2021). REs describe communities based on three attributes: bioregions, land zones and vegetation. Associations between high veracity records and REs were created using the 'spatial join' tool in ArcMap. REs having associations with BBBQ records and deemed spatially accurate were extrapolated to create a distribution map of suitable habitat (Figure 1).

Results

Black-breasted Button-quail were recorded within the Great Sandy Region on 387 observations, up to the 31 December 2020 from both targeted surveys and the review of records (Table 1). Locations where Black-breasted Button-quail have been reported as discussed below are presented in Figure 1. The review of literature suggests they were first reported on K'gari in 1962 near Ungowa (Barry and Vernon 1976) on the Islands west coast; however, the description given was inadequate to separate it from Painted Button-quail *Turnix varius*, and their description suggests identification was uncertain. Similarly in 1972 portions of egg shells attributed to this species were located near Lake Coomboo but no birds were recorded at this site (Barry and Vernon 1976); again identification was not confirmed. Black-breasted Button-quail were recorded on three occasions from 1980 to 1981 at Sandy Cape (Sutton 1990). Further records on K'gari have been made at Dundubara in 1995, Eurong in 1990, Waddy Point in 1994, Dilli Village in 1996 and Hook Point in 2008 (eBird 2020; Department of Environment and Science 2021b). The species was detected on the small Woody Island west of K'gari in 2018 by Queensland Parks and Wildlife Service. On the mainland in the Cooloola region the species appears not to have been recorded until 1972 (Department of Environment and Science 2021b). No mention was made of this species in Ingram and

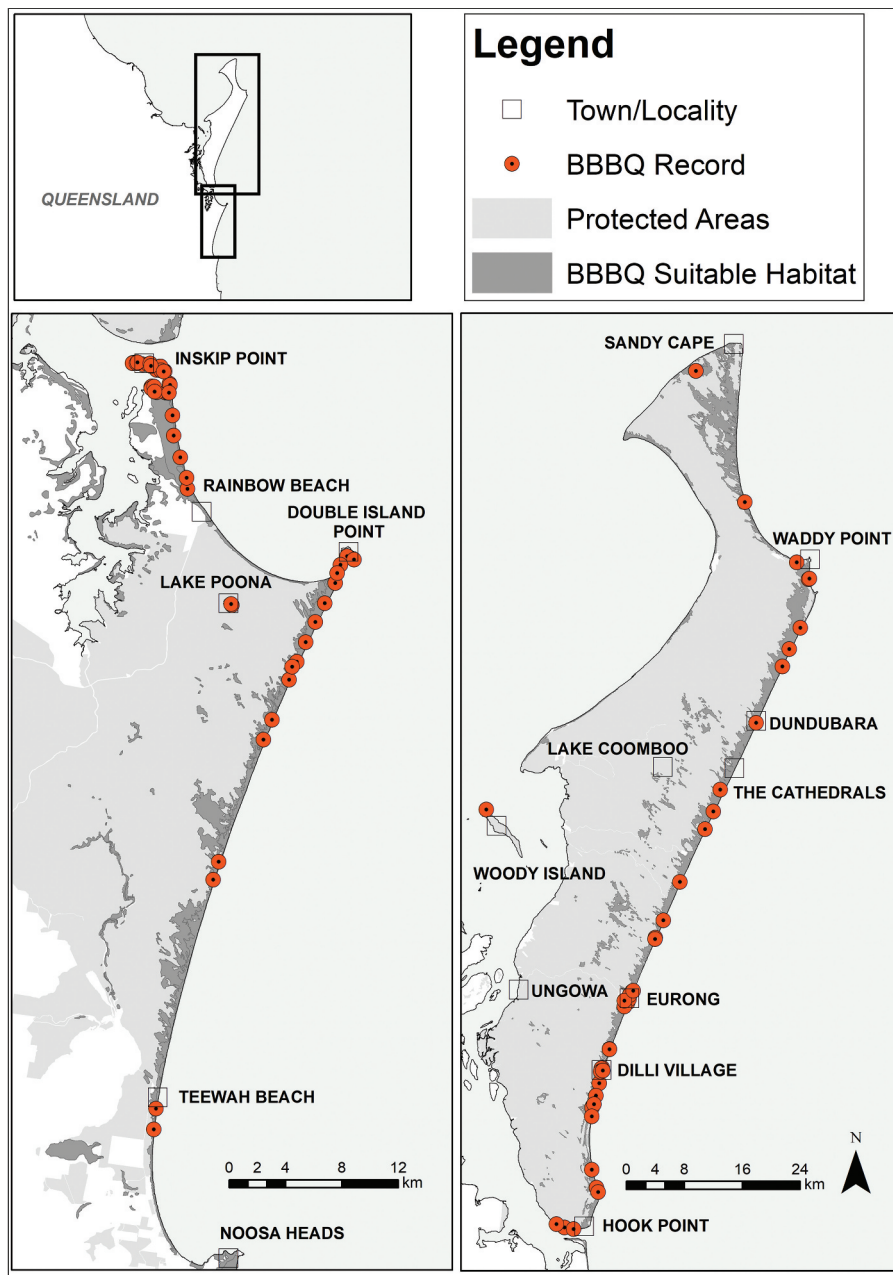


Figure 1. Map of K'gari (bottom right), Cooloola region and Inskip point (bottom left), south east Queensland showing confirmed records of Black-breasted Button-quail (BBBQ) from published literature and camera trapping surveys from this study (2016–2018) with associated suitable habitat (regional ecosystems).

Table 1. Records of Black-breasted Button-quail within the great sandy region from both camera trapping surveys (2016–2018) and reports from online databases and published literature.

	K'gari	Inskip Point	Cooloola	Woody Island	Unconfirmed location	
Confirmed record with accurate location (review of records)	15	27	3	1		
Confirmed record with accurate location (camera trap surveys)	32	12	18			
Confirmed record with generalised location	8	243	15			
Unconfirmed record or location	3	0	4		6	
Total	58	282	40	1	6	387

Roberts' (1976) review of the avifauna of the Cooloola region, and it was likely overlooked (G. Roberts pers. comm. 21 July 2021.). The species was recorded in 1988 from Bullock Jetty Road, and again in 1992 (Flower *et al.* 1995). Evidence of Black-breasted Button-quail indicated by platelets was detected at Double Island Point in 1992 and Thannaes Scrub in 1993 (Flower *et al.* 1995). The species' presence at Inskip Point became well known to the birding community in the early 2000's and reports have been numerous since (eBird 2020).

Black-breasted Button-quail were detected at 62 sites in the Great Sandy Region during surveys from 2016 to 2018. Camera traps detected the species at 42 sites, and traces in the form of platelets were detected at a further 20 sites. No other Button-quail species were detected by the camera traps during these surveys. A total of 325 independent reports of Black-breasted Button-quail were sourced from online databases and published literature. For the purpose of spatial analysis 108 records were accompanied by accurate spatial data and a further 266 could only be assigned to a generalised location (e.g. Inskip Point Recreation Area) due to the nature of reporting platforms such as eBird, which often use generalised locations. There were an additional 13 records which were inconclusive.

The high veracity records were associated with eight REs and non-remnant vegetation. RE 12.12.19 (rocky headlands), 12.2.6 (*Eucalyptus racemosa* open forest), 12.2.9 (*Banksia aemula* open woodland) and 12.2.16 (sand blows) were not used for analyses as they were spatially inaccurate with on-ground conditions; i.e. the RE description did not match the vegetation community in the field. The most frequently associated RE was 12.2.14 ($n=60$) (foredune complex), which accounted for 55% of records. Other REs with associations were RE 12.2.11 ($n=16$) (*Corymbia tessellaris* woodland with vine forest species), RE 12.2.3 ($n=2$) (*Araucarian* vine forest), and RE 12.2.5 ($n=7$) (*Corymbia intermedia* woodland with vine forest species). Extrapolation of RE associations with high veracity records highlights the distribution of suitable habitat in the Great Sandy Region (Figure 1). On K'gari suitable habitat extends along the entire east coast from Hook Point in the south to Sandy Cape in the north, excluding sand blows. The same vegetation community extends along Platypus Bay on the west coast from Moon Point and further north, though it is not as extensive as the east coast. Inland suitable habitat in the form of RE 12.2.3 is widely scattered from Lake Bowarraday and further south. Suitable habitat on the mainland extends along the eastern coast from Inskip Point in the north to the Noosa River in the south. Small fragments of suitable habitat also occur inland, mostly south of Lake Poona.

Discussion

Prior to this study Black-breasted Button-quail were known to occur along a thin strip of the east coast of K'gari and at a few isolated points along the Cooloola coast. Our study reaffirms the distribution on K'gari proposed by Hobson (Garnett *et al.* 2011) and suggests a similar distribution along the Cooloola coast. We have presented confirmed records of Black-breasted Button-quail from the Great Sandy Region and shown associations with REs, to propose a potential distribution of the species within the region. These findings greatly increase our understanding of this species in the Great Sandy region and fill a fundamental knowledge gap highlighted in The Action Plan for Australian Birds (Garnett and Baker 2021). It is important to note the sampling effort of these surveys was not stratified by RE, therefore the associations with the present vegetation communities may not represent all potential habitat utilised by this species. Also spatial accuracy of the REs is a limitation of this proposed distribution.

Black-breasted Button-quail in the Great Sandy region appear to utilise two distinct habitat types: *Araucarian* vine forest and littoral forest; the latter is more extensive in this region. The littoral forest occupied by the species falls into two categories: low sclerophyll thickets on sand deposits, and littoral forest within or behind the coastal sand dune system (Flower *et al.* 1995). Sclerophyll thickets on sand deposits are classified under RE 12.2.14. It should be noted that this RE covers a spectrum of vegetation communities along the dunes, not all utilised by the species. Suitable habitat in this complex is usually comprised of low shrubs of *Acacia* spp., Midgen Berry *Austromyrtus dulcis* and Prickly Broom Heath *Monotoca scoparia*. The second type of littoral forest in this region, i.e. littoral forest within or behind the coastal sand dune system, is classified as RE 12.2.5 and 12.2.11. These vegetation communities support a low canopy comprised mostly of *Eucalyptus* spp., *Corymbia* spp. and *Acacia* spp. with a variety of vine forest species notably Coastal Canthium *Cyclophyllum coprosmoides*, Fraser Island Apple *Cronychia imperforate*, Tuckerroo *Cupaniopsis anacardioides* and Celerywood *Polyscias elegans*. These littoral forest vegetation communities are floristically dissimilar to dry rainforest communities utilised by the species elsewhere; however, they are structurally comparable. Similar to dry rainforest, littoral forest is structurally a low, dense vegetation community typically devoid of groundcovers. The canopy is comprised of plant species that produce profuse amounts of leaf litter, notably *Acacia* spp., creating a deep foraging substrate for Black-breasted Button-quails (Flower *et al.* 1995; Hamley *et al.* 1997).

Littoral forest, the primary habitat utilised by this species in this region, extends along the entire east coast from Sandy Cape at the northern tip of K'gari, and south to the mouth of the Noosa River on the mainland. This represents 220 km of suitable habitat of which 183 km was determined to be occupied during the 2018 surveys. The extent to which the species extends landward is uncertain. Hobson, cited in Garnett *et al.* (2011), suggested the habitat only extended 1 km inland. Similar vegetation communities exist on the west coast of K'gari, but due to the difficulty of access they remain unsurveyed. In addition to the habitats already mentioned, the species also occupies Araucarian vine forest on the mainland (RE 12.2.3). This habitat is widely scattered inland throughout K'gari and Cooloola but to date very few of these areas have been surveyed.

The vegetation communities of the Great Sandy Region are fire prone (Spencer and Baxter 2006; Srivastava *et al.* 2013) and the littoral forest communities are regularly impacted by fire (NAFI 2021). Significant areas of littoral forest were burnt in the years 2009, 2012, 2013, 2016 and 2020 (NAFI 2021), indicating that Black-breasted Button-quail and their habitat in this region are influenced by fire. These vegetation communities may return to a state suitable for the occupancy of this species, although many biotic and abiotic factors will impact this succession, as it does for other species (Lindenmayer *et al.* 2008). Many of the plant species in these littoral communities are pioneer species such as *Acacia* spp. which readily and rapidly regenerate after fire. The exact impact that fire has on Black-breasted Button-quail populations is unknown and requires further research, particularly as fire patterns in this area are expected to alter with climate change (Wardell-Johnson *et al.* 2015).

Our findings suggest Black-breasted Button-quail are widely distributed in the Great Sandy Region. Our understanding of the current conservation status of Black-breasted Button-quail in this landscape is not comprehensive and requires further research into the impacts of fire, resource use and the species' ability to disperse. We intend that our proposed habitat distribution map and defined suitable habitat will act as a reference for future surveys and research on this species. We therefore encourage citizens to report any observations of this species to an online database with accurate location details and supporting evidence (e.g. photographs).

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