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Essential research to secure the Buff-breasted Button-quail *Turnix olivii*

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Front cover image: Fitting a GPS/VHF tag to a Chestnut-backed Button-quail *Turnix castanotus* at AWC's Wongalara Sanctuary, Northern Territory. Image: Patrick Webster

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Executive summary

Buff-breasted Button-quail is one of Australia's rarest and most threatened birds. Contemporary research on this species has suggested a wide geographical distribution and seemingly stable, but low population size. Extensive survey effort conducted from 2018 to 2021 during this project has failed to locate a single population. Further, an investigation into the veracity of all contemporary research and reports has indicated the last confirmed record dates from the early 1920s. It is therefore reasonable to suggest there has been a decline in the population of this species. Similar changes in the population and distribution of other bird and mammal species of the Cape York savanna are currently being experienced with the likely drivers being introduction of cattle, changed fire regimes and feral predators. This report highlights the likely dire conservation status of the Buff-breasted Button-quail and recommends where further research and survey effort is required.

Introduction

In context of all Australian bird species, Buff-breasted Button-quail remains the most mysterious and potentially most threatened. This species appears rarely in the historical ornithological literature, but is seemingly more common in contemporary literature, though the value and authenticity of these contemporary reports are now increasingly questioned. The Buff-breasted Button-quail was first collected at an unknown location near Cooktown in 1899 by E. Olive. It resembled the previously described Painted Button-quail *Turnix varius* and Chestnut-backed Button-quail *Turnix castanotus*, but had a larger bill and plainer plumage (Figure 1). It was described the following year by H. C. Robinson and given the name Buff-breasted Button-quail *Turnix olivii* (Robinson 1900). Some 20 years later the natural historian H. L. White employed W. R. McLennan to travel to Cape York Peninsula to collect, amongst other species, this newly described button-quail (White 1922). Throughout the course of his time at Coen, McLennan had numerous encounters with this species, and collected six specimens and four clutches of eggs. One of McLennan's most important contributions to ornithological science was his meticulously kept daily diary. The diary provides descriptions of each of his encounters with this button-quail, and to this day provides the only first-hand insights into the autecology of the species (McLennan 1922, White 1922, White 1922). The observations by McLennan and his acquaintances appear to be the last confirmed records for some 60 years until the species was apparently rediscovered in the early 1980's much further south, in the Wet Tropics and Einasleigh Uplands Bioregion (Squire 1990).

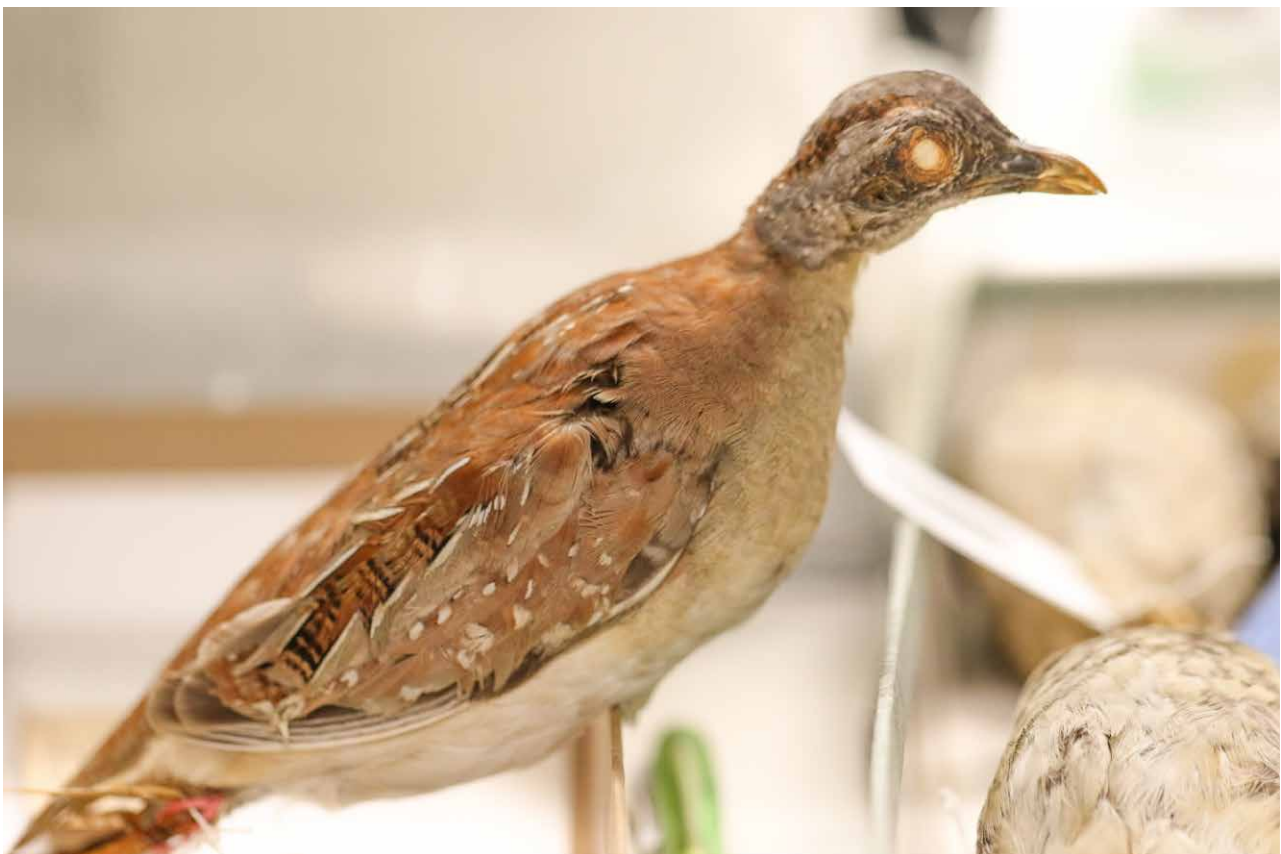


Figure 1. Study skin of Buff-breasted Button-quail collected by W.R. McLennan at Coen in 1922, held in the H.L. White Collection at the Melbourne Museum, Image: Patrick Webster.

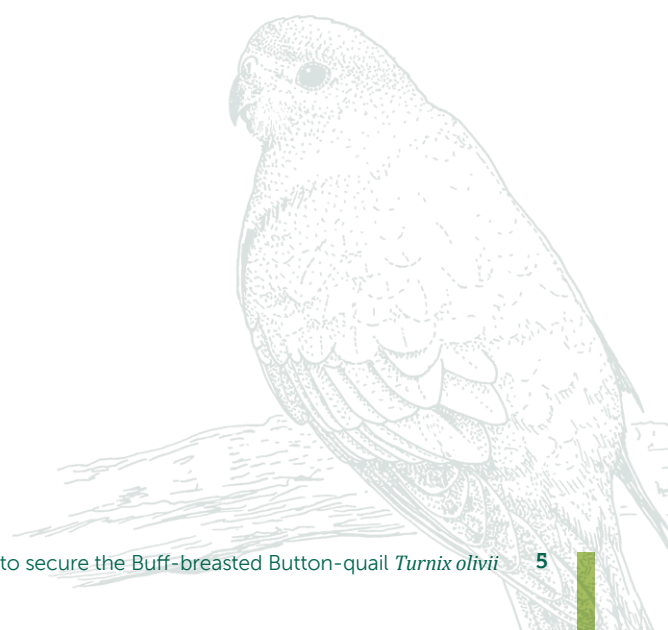
Following Squire's (1990) reports, Buff-breasted Button-quail were increasingly reported by local and travelling birdwatchers (Rogers 1995, Nielsen 2000, Wildlife Conservancy of Tropical Queensland 2009, Chaplin 2011), with published reports continuing to 2016 (Mathieson and Smith 2017, Smith and Mathieson 2019). However, no contemporary reports are accompanied by verifiable evidence, such as a skin or photograph, despite the dramatic increase in photography by the birding community. The Wet Tropics and Einasleigh Uplands Bioregion 'population' of Buff-breasted Button-quail have formed the basis for all contemporary research conducted on this species. These observations have influenced our perception of the species' autecology and threats, and are the basis of the species' conservation status and recovery plans (Mathieson and Smith 2009).

The avifauna of the Cape York savanna system appears to be under significant threat, which seems to be driven by over grazing and the alteration of fire regimes (Crowley and Garnett 1998). Species such as the Brown Treecreeper *Climacteris picumnus* (Garnett and Crowley 1995), Golden Shouldered Parrot *Psephotus chrysopterygius* (Garnett et al. 2011) and Black-faced Woodswallow *Artamus cinereus* (Garnett and Crowley 2000) which constitute a typical Cape York savanna bird community all appear to have suffered significant declines. It is hypothesised the Buff-breasted Button-quail is following a similar trajectory, but due to the species' cryptic habits this has gone largely undetected. The Buff-breasted Button-quail is listed as endangered nationally under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 and in Queensland under the Nature Conservation (NC) Act 1992 (Department of Agriculture Water and the Environment 2021) and critically endangered by the International Union for Conservation of Nature (IUCN).

The major threats impacting this species are thought to be reduction in habitat quality as a result of over-grazing, and woody thickening brought about by the introduction of cattle and the alteration of fire regimes (Crowley and Garnett 1998, Garnett et al. 2011). Other threats such as predation by feral pigs and cats, as well as the threat of introduced weeds may also be impacting this species (Garnett et al. 2011).

After scrutinising all records of Buff-breasted Button-quail, we conclude that the most recent records of Buff-breasted Button-quail that are accompanied by verifiable evidence are those made by W. R. McLennan in the 1920's (McLennan 1922, White 1922). Consequently, we argue that McLennan's observations of the species autecology should be treated as the most accurate understanding of this species. The Buff-breasted Button-quail occurs in open savanna dominated by Darwin Stringybark *Eucalyptus tertradonta* and Cullens's Ironbark *Eucalyptus cullenii* with a high diversity of annual and perennial grasses in an open understory. It uses this habitat for breeding, with nests made at the base of perennial grass tussocks. Breeding commences with the onset of the wet season, typically November to December, and continues through to March or April. A clutch constitutes four eggs which are incubated and raised by the male alone. Stomach contents of shot birds contained fragments of insects, sand and seed suggesting the Buff-breasted Button-quail is omnivorous.

Despite the many contemporary reports there is no known population of this species and it is reasonable to say our understanding of the species' status and threatening processes is largely conjecture. Given the declining trajectory of the comparatively well known Cape York savanna avifauna, we argue there is sufficient evidence to be highly concerned for the conservation outlook of the Buff-breasted Button-quail. To determine the status of this species and inform conservation management a thorough understanding of the species' population and autecology is required.



Context

This project (NESP 2.6 *Essential Research to secure the Buff-breasted Button-quail*) forms part of the PhD research of student Patrick Webster. The main focus of the NESP 2.6 component was locating a population of the study species for targeted autecological research. Unfortunately a population was not detected therefore two other species of button-quail; Painted Button-quail and Chestnut-backed Button-quail were used as surrogates. These two species are thought to constitute a group of closely related species that occupy Australia's three distinct savanna systems: East Coast, Cape York and Top End - Kimberley (Macdonald 1971). In addition to the NESP focused research, concurrent research into the potential misidentification of Buff-breasted Button-quail with Painted Button-quail in the Wet Tropics and Einasleigh Uplands Bioregion is underway. Our research has found that many of the features and methods researchers and birdwatchers have used to separate Buff-breasted Button-quail from Painted Button-quail are incorrect. This may suggest that a significant proportion of southern records of Buff-breasted Button-quail could involve misidentified Painted Button-quail. In addition, none of the Wet Tropics and Einasleigh Uplands Bioregion records are supported by substantiating evidence. Given that our current understanding in the peer-reviewed literature of Buff-breasted Button-quail's status and autecology is largely based on these southern records, a thorough investigation into the veracity of all Buff-breasted Button-quail records is warranted and as such is underway. The research findings presented here include the survey effort to date and the targeted research on habitat use of Painted and Chestnut-backed Button-quail.

Methodology

Surveying for Buff-breasted Button-quail

Surveys for the Buff-breasted Button-quail were conducted over three consecutive wet seasons (December to April) from 2018 to 2021. Areas surveyed were determined based on contemporary records and the historical records of McLennan. Initial surveys used the following methods: camera trapping, call playback, searches for platelets (foraging scrapes), flush surveys and automated recording units (ARUs). Camera trapping was performed opportunistically in areas of suitable habitat when a button-quail was flushed but could not be identified, or a platelet was found and the species responsible was unknown. Call playback was performed using the female vocalisation of the Painted Button-quail and the Chestnut-backed Button-quail. Searches for platelets and flush surveys were conducted concurrently in areas of suitable habitat. ARUs were used as the primary detection method for the Buff-breasted Button-quail across all survey seasons. Wildlife Acoustics Songmeters (SM2, SM4 and SM Mini, Maynard, United States of America) were used. ARUs were deployed throughout Cape York Peninsula (Figure 2) for part of the wet season (December to April, 2019 to 2021). Settings for the ARUs can be found in table 1. Audio files were analysed using Wildlife Acoustics' Kaleidoscope automated signal detection software, using reference calls of Painted, Chestnut-backed and Red-backed Button-quail. Potential button-quail vocalisations were extracted and further analysed using audio-editing software Audacity.

To determine the optimum period of detection for button-quail vocalisation, a series of recorders were set to record continuously for a 10 day period at The Australian Wildlife Conservancy's (AWC) Wongalara Sanctuary, (Southern Arnhem Land, NT). The number of calls detected per hour was calculated.

Table 1: Settings of Wildlife Acoustics Song Meter 4 utilised for button-quail detection.

Settings for SM 2 SM 4 and SM Mini	
Sample Rate	8000 Hz
Gain	18 dB
Channel	Mono
Recording length	60 mins
Recording Period	Sunrise to Sunrise + 3 hours
	Sunset - 3 hours to Sunset

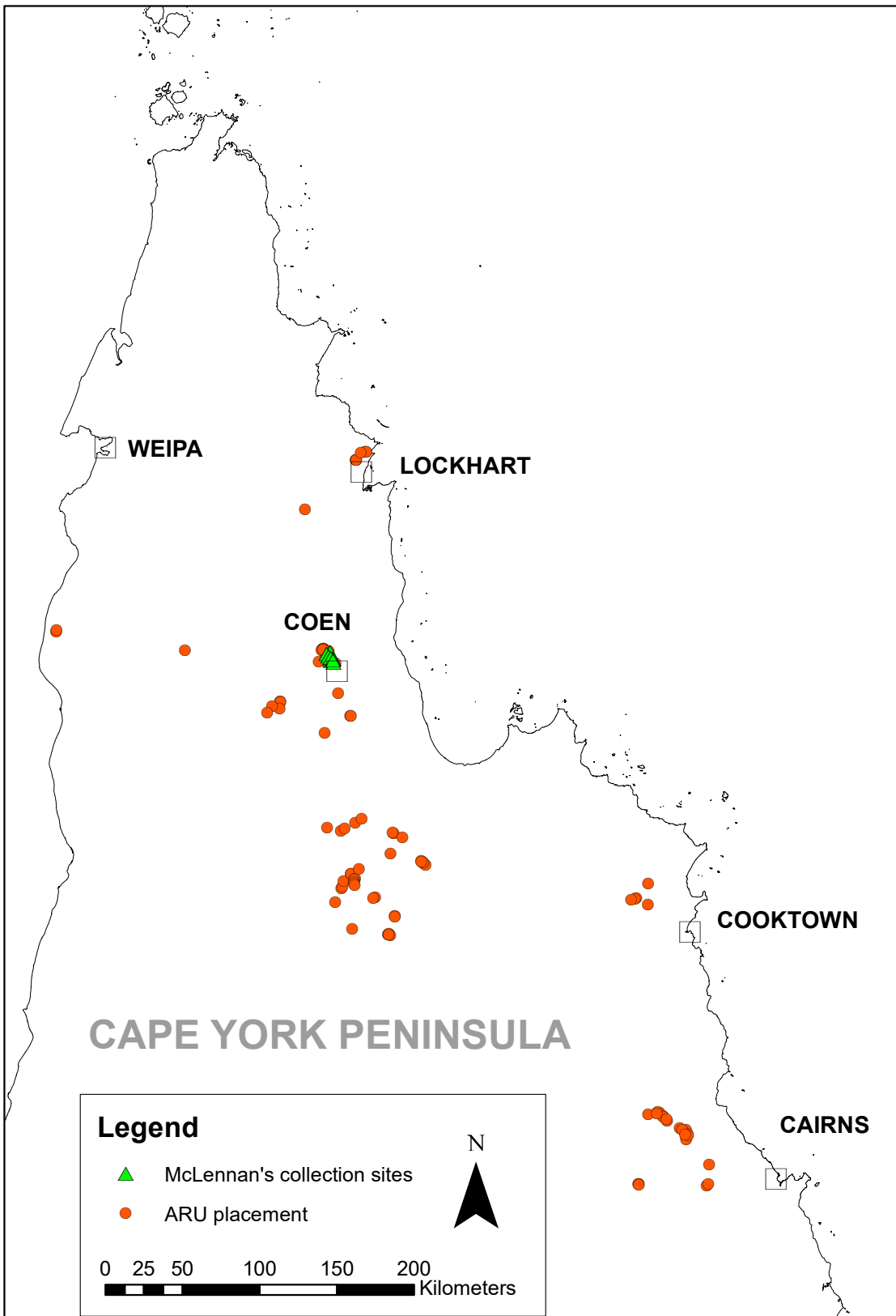


Figure 2. Placement of ARUs throughout the study site from 2018 to 2021 and McLennan's collection sites.

GPS tracking and habitat use of tropical savanna button-quail

A sample of Painted Button-quail ($n=11$) and Chestnut-backed Button-quail ($n=3$) were caught and fitted with GPS/VHF tags to determine habitat use. Button-quail were caught in mist nets, then fitted with a combined GPS/VHF tag (Pinpoint 10, 50 and Picopip Ag376, Lotek, New Zealand). The GPS tags took 16 to 30 fixes per day, for a period of three to ten days. From the GPS data, a sample of habitat assessment points were selected. The following features were analysed at each habitat assessment point: canopy cover, understory cover, ground cover, grass height, number and species of perennial grasses, groundcover species, and proportion of bare ground. This research was performed at two study sites for each species. Painted Button-quail were studied at Forever Wild's Mareeba Wetlands (Mareeba, QLD) and AWC's Brooklyn Wildlife Sanctuary (Mount Carbine, QLD) and Chestnut-backed Button-quail were studied at Bonrook Station (Pine Creek, NT), and at AWC's Wongalara Wildlife Sanctuary (Central Arnhem Land, NT) (Figure 3). This data was used to define broad trends in habitat use for each species.

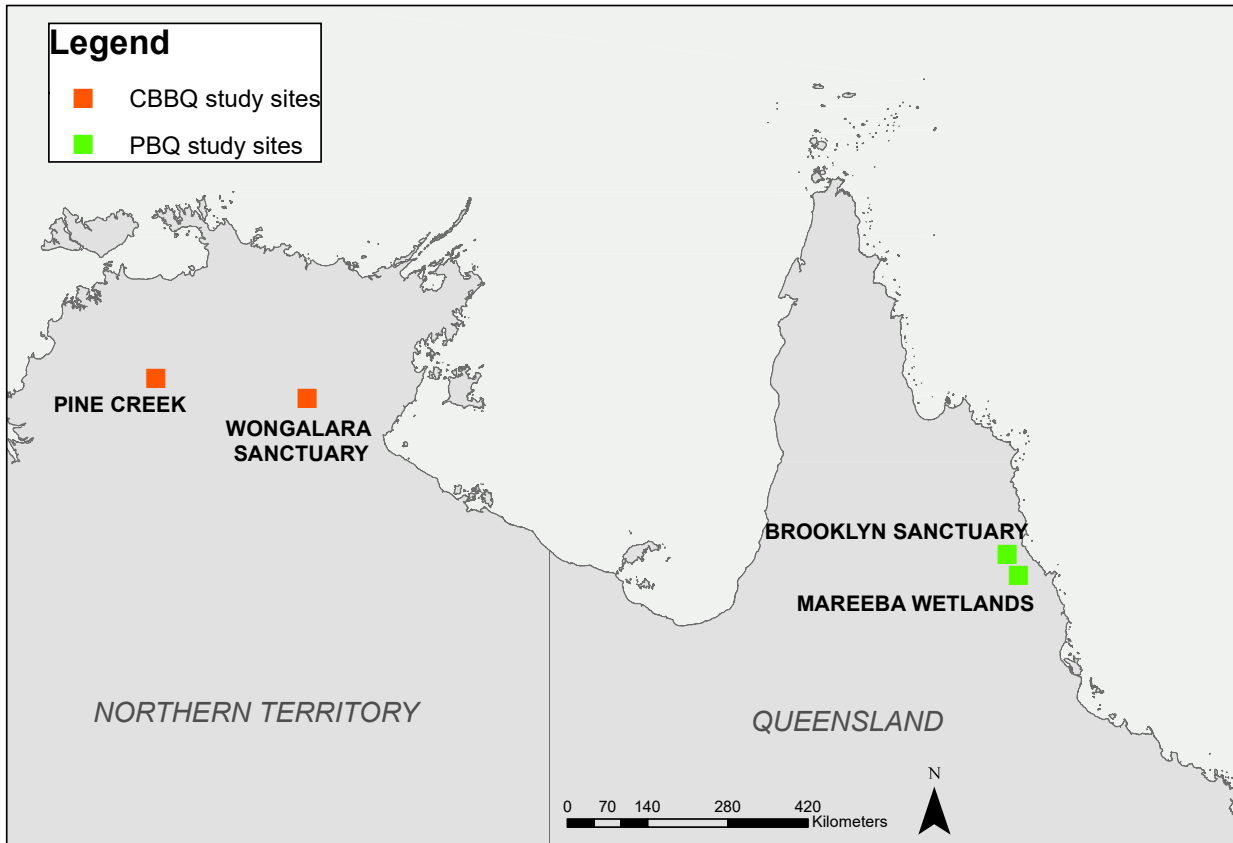


Figure 3. Location of study sites for GPS tracking and habitat use of tropical savanna Button-quail component of research. Chestnut-backed Button-quail (CBBQ) and Painted Button-quail (PBQ)



Results

Despite extensive surveys across all historical and contemporary sites from 2018 to 2021, no evidence of Buff-breasted Button-quail was detected. Painted Button-quail were found to be common in the southern study area, being detected at 112 sites. In the northern part of the study area, including at McLennan's collection locations, no evidence of Buff-breasted or Painted Button-quail was detected; however, the three smaller species of button-quail – Little *Turnix velox*, Red-chested *Turnix pyrrhothorax* and Red-backed *Turnix maculosus*– were detected, but in very low numbers.

ARUs proved to be an efficient and effective method of button-quail detection. This method provided an unbiased record of the species in comparison to other methods such as flush and platelet surveys, where the identification to species level is difficult, and rarely certain. Analysis of continuously recorded audio data suggested there is a peak in button-quail vocalisations at dawn and just before dusk (Figure 4.).

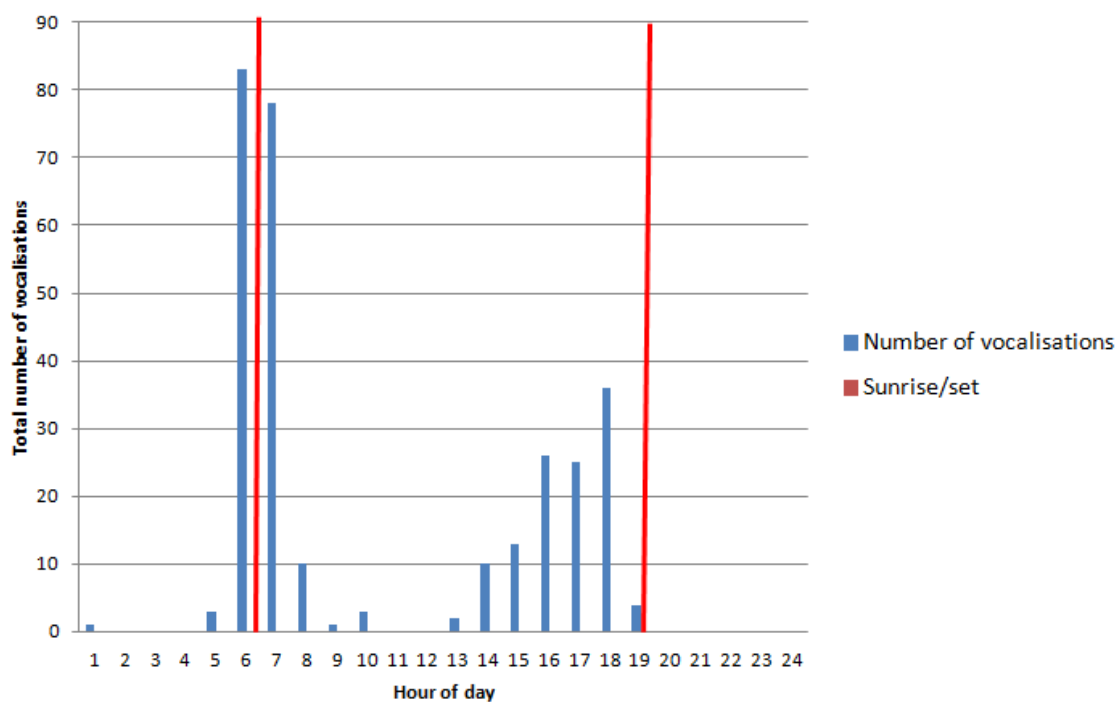


Figure 4: Cumulative number of Chestnut-backed Button-quail vocalisations per hour, recorded over a ten day period at Wongalara Sanctuary (Central Arnhem Land, NT).

The tracking and habitat assessment study demonstrated that both Painted and Chestnut-backed Button-quail use a habitat structure similar to that described for Buff-breasted Button-quail (McLennan 1922). A total of 11 Painted Button-quail and three Chestnut-backed Button-quail were successfully GPS tracked. Habitat assessments demonstrated that both species occupy an open savanna system with an open ground cover of perennial tussock grasses (Table 2 and Figures 5 & 6). The type and density of groundcovers appears to be an important habitat requirement for these species. Both species preferred relatively open sites, dominated by perennial grasses with areas of exposed ground.



Figure 5: Typical habitat of Chestnut-backed Button-quail. Note the density of perennial tussocks and the presence of bare ground. Image taken at AWC's Wongalara Sanctuary (Central Arnhem Land, NT). Photo by Patrick Webster



Figure 6: Typical habitat of Painted Button-quail. Note the density of perennial tussocks and the presence of bare ground. Image taken at AWC's Brooklyn Sanctuary (Mount Carbine, QLD). Photo by Patrick Webster

Table 2. Perennial grasses recorded at habitat assessments sites of tracked button-quail.

Painted Button-quail	Chestnut-backed Button-quail
<i>Themeda triandra</i>	<i>Eriachnae mucronata</i>
<i>Aristida</i> spp.	<i>Aristida</i> spp.
<i>Heteropogon contortus</i>	<i>Chrysopogon</i> spp.
<i>Heteropogon triticeus</i>	<i>Sarga plumosum</i>
<i>Arundinella setosa</i>	<i>Triodia bitextura</i>
<i>Mnesithea rottboellioides</i>	<i>Themeda triandra</i>
<i>Cymbopogon bombycinus</i>	<i>Sehima nervosum</i>
<i>Paspalidium</i> spp.	<i>Heteropogon triticeus</i>

Discussion

Extensive search effort over the past three consecutive wet seasons has found no evidence of Buff-breasted Button-quail. This is despite numerous peer-reviewed and anecdotal reports of the species from the Wet Tropics and Einasleigh Uplands Bioregion since the 1980s (Squire 1990, Nielsen 2000, Mathieson and Smith 2017, Smith and Mathieson 2019). The last confirmed records of Buff-breasted Button-quail dates back to 1924 when an acquaintance of W. R. McLennan, D. Anderson, collected two clutches of eggs from the Coen region (Atlas of Living Australia 2020). No confirmed records in 97 years in addition to the failed search effort reported here raises serious concerns for the conservation outlook of the Buff-breasted Button-quail.

With such little data on this species' population and apparent decline, it is difficult to pinpoint key threatening processes. Despite this, examination of the threatening processes known to be affecting Cape York Peninsula's avifauna, and comparing these with the ecology of the closely related Painted and Chestnut-backed Button-quail, inferences can be made. The two main threatening processes impacting the Cape York avifauna are habitat degradation or change, and increased predation pressure, by native and introduced predators (Garnett and Crowley 1995, Crowley and Garnett 1998, Garnett and Crowley 2002, Garnett et al. 2011). Habitat degradation and change has been brought about by the introduction of cattle, changed fire regimes, and the introduction of exotic pasture species and other weeds. The combined threat of cattle and changed fire regimes has resulted in vegetation thickening (Crowley and Garnett 1998) that is being experienced across Cape York Peninsula. The sum outcome of these threats is a reduced abundance of perennial grasses (Crowley 2008), and a greatly thickened canopy and understory leading to elevated predation pressure. Our findings suggest Painted and Chestnut-backed Button-quail are reliant on an open canopy and understory combined with a groundcover of diverse perennial grasses; this habitat also appears critical for Buff-breasted Button-quail (McLennan 1922). The impact of introduced predators, notably feral cats and pigs, is unassessed for any button-quail globally, though given the impact these two predators play on other ground-dwelling species in Australia (Legge et al. 2018), this threat should be considered.

Despite the extensive search effort conducted during this project, some quite large areas of potentially suitable habitat still remain unsurveyed in Cape York Peninsula. Currently little to no search effort other than from amateur birdwatchers has occurred north of the Pascoe River, in the vicinity of Staaten River National Park, and in the area between Cooktown and Cape Melville. Additional effort should be focused in these areas, particularly areas that support an open savanna vegetation structure and an understory of perennial grasses. These areas are typically characterised by lower grazing pressure whether that be through grazing management, or by particular landscape features that prevent high grazing densities.

We found that traditional methods for surveying button-quail such as platelet and flush surveys often do not provide the most reliable assessment of a species' presence. In addition these methods are open to bias and the results difficult to repeat. Our findings suggest that button-quail are particularly vocal at certain periods of the year, and these vocalisations make them ideal for monitoring with ARUs. As button-quail are most vocal during the wet season, at dawn and in the late afternoon, ARUs set to record at these times are likely to provide the most effective method of detection (Figure 7).



Figure 7. ARU, Song Meter 4 deployed at AWC's Brooklyn Wildlife Sanctuary, QLD. This ARU detected the presence of Painted Button-quail. Photo by Patrick Webster

Application of research

A nomination application to up-list the species from endangered to critically endangered under the NC Act 1992 has been submitted to the Queensland Government for consideration. Following consideration of this nomination, the same will be done federally under the EPBC Act 1999. Separate from government threatened species listings, the same suggestion has been made to and approved by the IUCN. Prior to our research virtually all resources, both governmental and non-governmental, have been focused in the Wet Tropics and Einasleigh Uplands Bioregion where the status of the Buff-breasted Button-quail is unclear. Due to our research there is now evidence to suggest many, and perhaps most reports from this region may have been misidentified Painted Button-quail. Through the publication of our findings, which is anticipated in the next 12 months, and consultation and engagement with relevant stakeholders, we anticipate making our findings fully public so that research and recovery can be better targeted.

Due to the potential for misidentification of Buff-breasted Button-quail with Painted Button-quail that has been brought to light, the Birdlife Australia Rarities Committee (BARC) now requires all observations to be submitted for verification. To date two records have been submitted to the committee for validation and it is anticipated more will be submitted in the future.

Our research has highlighted the inferred decline of the Buff-breasted Button-quail and provided another significant example of a decline in the Cape York savanna bird community. It is anticipated this and subsequent research inspired by this work will act to address current land management practices on Cape York Peninsula. These land management practices pertain to the management of grazing livestock and fire regimes.

Impact of the research

Our research has highlighted that there needs to be a shift in the geographical area where research and conservation action is focussed. We anticipate government departments such as the Department of Environment and Science, along with non-government organisations such as the Australian Wildlife Conservancy and Bush Heritage Australia and indigenous groups such as land councils and Olkola Corporation, will adopt our findings and seek to work on the species in areas of Cape York Peninsula where it has historically been confirmed to have occurred. We also anticipate these organisations and other researchers adopting our proposed survey methods not just for Buff-breasted Button-quail but also for other button-quail generally.

Broader implications

Our findings suggest a decline in the population and distribution of Buff-breasted Button-quail. A similar decline is being mirrored by many species in the Cape York savanna avifauna (Garnett and Crowley 1995, Garnett and Crowley 2002, Garnett et al. 2011). Habitat degradation and habitat change are theorised as the key threats of population decline for this avian assemblage. The drivers of these threats are the introduction of cattle and the alteration of fire regimes. Both of these threats can be managed by alteration to current land management practices. Any improvements in our understanding of this system and any alterations that act to address these threats not only impacts Buff-breasted Button-quail but may also improve the situation for much of the Cape York Peninsula avifauna.

Future research priorities

Further research into the declining/changing avifauna of Cape York and the drivers of decline is warranted. Strong links between current land management practices and the drastic change and or degradation of the savanna system have been presented and are currently being investigated. It is crucial this research associating land management practices with drivers of avian decline are supported and the ecological and land management communities kept informed of the results. Additionally, the impact feral predators have on button-quail is largely unknown and warrants further investigation. Research into this field would assist not only Buff-breasted Button-quail, but button-quail globally, as there is currently no data on these impacts.

Data sets

A sample of Painted and Chestnut-backed Button-quail vocalisations recorded during this project will be uploaded to the public avian vocalisation data site Xeno-canto (available at: <https://www.xeno-canto.org/>). Members of the public are able to access and download all recordings submitted to this site. Most importantly, researchers working on button-quail will be able to use these calls to identify recordings captured on ARUs.

All confirmed records of button-quail (Painted, Chestnut-backed, Little, Red backed and Red-chested) recorded during this project will be uploaded to the Queensland Governments database, Wildnet for public access, available at: (<https://www.qld.gov.au/environment/plants-animals/species-information/wildnet>).



Recommendations

On completion of this project it is clear further survey effort is urgently needed to locate and secure a population of Buff-breasted Button-quail. This research has identified several areas that support potentially suitable habitat for this species as well as having developed an ARU based survey method. Given the decline of the Cape York avifauna and the inferred decline of Buff-breasted Button-quail it is critical these areas are surveyed in the immediate future. Funding is urgently needed to undertake these surveys. A desktop analysis should be performed to pinpoint locations for survey based on predictive GIS modelling. On-the-ground surveys would rely heavily on traditional owner involvement and collaboration. Funding would be required to cover training of traditional owners, ARU units and field survey expenses. Areas that have thus far received little to no survey effort include north of the Pascoe River, in the vicinity of Staaten River National Park and in the area between Cooktown and Cape Melville. Any individuals or organisations considering surveying for this species are encouraged to contact the authors of this report for further support and guidance.

Our research has indicated that ARUs provide an efficient unbiased means of surveying and identifying button-quail. We recommend that future surveys for Buff-breasted Button-quail use ARUs as the primary means of detection. ARUs such as Wildlife Acoustics Songmeters and Frontier Labs Bioacoustic Recorders are perfectly suited to this task. Recorders should be set to record as per Table 1. We recommend the use of Wildlife Acoustics' Kaleidoscope programme for the analysis of the recording data.

Conclusion

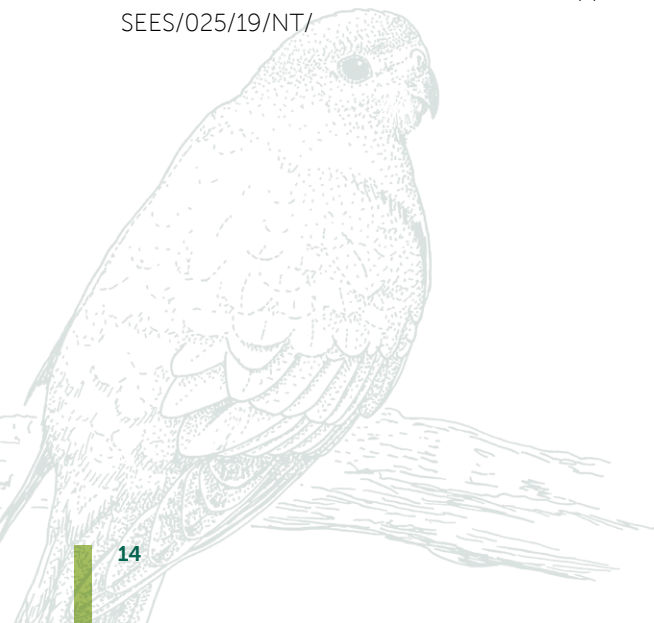
This project has failed to locate a single population of Buff-breasted Button-quail. We have confirmed that the last record accompanied by verifiable evidence was from the Coen region in the early 1920s. Furthermore, this project has determined that a significant proportion of reports from the 1980s to the present day in the Wet Tropics and Einasleigh Uplands Bioregion could have been misidentifications. Still, extensive areas of the species' distribution in Cape York Peninsula remain unsurveyed. The use of ARUs has been found to be an effective technique for the detection of Painted and Chestnut-backed Button-quail and likewise should be efficient for Buff-breasted Button-quail. The knowledge gained through this project on detection techniques and habitat use should prove invaluable in future surveys and conservation action for Buff-breasted Button-quail.

Acknowledgements

As our research has been carried out in many regions throughout the country we would like to acknowledge the traditional owners on which this project took place: Kuku-yanlaji, Agwami, Guugu-Yimidhirr, Olkola, Thaypan, Lama Lama, Kanntju, Wagiman, Jawoyn, Bardi, Wilinggin, Miriwoong & Ngaliwurru people. We would like to thank the support and advice given by Lloyd Nielsen, Geoff Smith, Mike Mathieson and Stephen Garnett. This project could not have been conducted without the generous access to properties granted for this research. In particular we would like to thank the owners of Lockinvar, Wetherby, Blue Lagoon, Yarraden, Holroyd River, Artemis and Mt Mulligan Stations and the Australian Wildlife Conservancy.

Ethics statement

This research was conducted under the approval of The University of Queensland's Animal ethics approval SEES/025/19/NT/



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Further information:

<http://www.nespthreatenedspecies.edu.au>

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